

CHAPTER 3

Affected Environment



Downingia spp. Photograph by Bob Griffith.

3.1 PHYSICAL ENVIRONMENT

3.1.1 CLIMATE

The climate at Turnbull Refuge is semi-arid with an average annual precipitation of 16.5 inches. The majority of precipitation falls as snow from November to February with a yearly average of 50 inches. Above average snow-years occur three out of every ten years. Drought periods are common. Summers are warm and dry with average daily highs above 80 degrees Fahrenheit. Winter months are cool with mean daily temperatures between 25 and 30 degrees Fahrenheit.

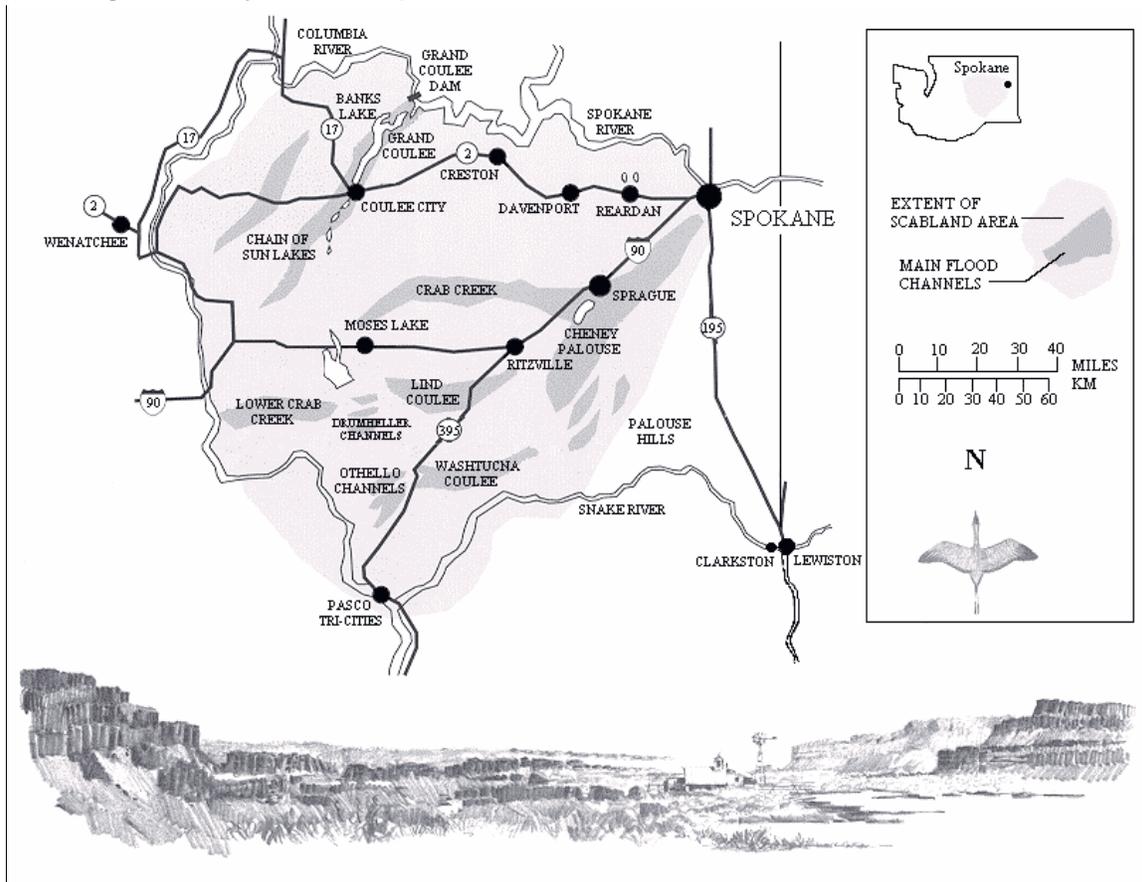
3.1.2 GEOLOGY AND SOILS

The Refuge is part of a much larger landform, called the Columbia Plateau. The Columbia

Plateau is the result of numerous lava flows that spread over the area and hardened between 16 and 6 million years ago. These flows, originating as far east as Idaho, flowed down the broad valleys of the Columbia River Basin all the way to the coast. Over 200 flows piled up layer upon layer of lava to a total thickness measured in thousands of feet and covering an area of around 80,000 square miles (Baker 1978). The immense weight of the covering of basalt resulted in settling and tilting of the plateau from the northeast to the southwest.

During the two million years of the last ice age, periodic extensions and retreats of the continental ice sheet left exposed glacial outwash sediments on the plateau that were picked up by strong winds blowing off the expansive ice sheets. These dust-like particles were redeposited on the eastern side of the Columbia Plateau, covering the basalts to depths

Figure 2. Location of Channeled Scablands formations in Eastern Washington State (figure used with permission of Maurice Vial)



of up to 150 feet thick. This thick covering of loess became the rolling grass covered hills referred to as the Palouse Formation.

The Channeled Scablands formation extends over approximately 2,000 square miles on the Columbia Plateau (See Figure 2). The Scablands were formed in a series of dramatic events approximately 15,000 years ago at the end of the last great ice age. At that time, a lobe of the continental ice sheet dammed the Columbia River and drainage of the Clark Fork River creating three glacial lakes, two on the Columbia River and the other comprising ancient Lake Missoula on the Clark Fork which covered 2,900-square-miles of northwestern Montana (Allen et al. 1986). As the rising water of the lake lifted the ice dam terminus of Lake Missoula, the lake emptied resulting in catastrophic floods that scoured away the wind deposited soils of the Palouse Formation in large tracts exposing the underlying basalt. Numerous channels and depressions were eroded in the basalt. Subsequent deposition of glacial outwash sediments and ash from the eruption of the volcanoes of the Cascade Range resulted in the formation of a diverse complex of lakes, sloughs and ponds in the flood tracts. In contrast to the deep and more uniform soils of the Palouse Formation, the uplands of the flood tracts of the Channeled Scablands are a mosaic of exposed, fractured basalt, small mounds of deeper soils and swales comprised of shallow lithosols. This unique patterned ground is often referred to as biscuit and swale topography (Daubenmire 1970).

The soils of the Scabland uplands are primarily of the Hesseltine complex with the major portion mapped as Hesseltine very rocky complex, with 0 percent to 30 percent slopes (Donaldson and Giese 1968). This soil mapping unit includes from 25 percent to 50 percent basalt rock outcrops and unnamed very stony, very shallow soils in the swales. The mounds or biscuits are primarily Hesseltine silt loam with topsoil 16 inches deep underlain by coarse gravel and stones to a depth of 60 inches over basalt bedrock. Hesseltine soils are either

covered by steppe grassland vegetation or forested.

Soils in the meadows and around potholes are of the Cocolallala silty clay loam series. These soils range up to 60 inches deep and are formed in volcanic ash deposits mixed with silty alluvium. Highly organic Semiahmoo muck soils are found in the deepest portions of the potholes. These peat soils average 4 feet deep but can be as deep as 12 feet.

3.1.3 HYDROLOGY (WATER QUANTITY, DISTRIBUTION, USE, RIGHTS, AND QUALITY)

Surface Watersheds/Drainage

The Refuge encompasses the upper portions of three watersheds: Hangman Creek, Rock Creek, and Cow Creek. The Hangman Creek watershed drains toward the northeast and the Spokane River. Both the Cow Creek and Rock Creek watersheds drain to the south and southeast into the Palouse River. Few natural drainages occur on the Refuge as a result of low relief and the complex topography created by the Ice Age floods. Pine Creek, which originates on the eastside of the Refuge and flows into Rock Creek, is the only natural perennial stream course on the Refuge.

The diverse complex of lakes, sloughs and ponds, so prominent in the Channeled Scablands, were not uniformly valued by early settlers. The lakes and marshes were drained in an attempt to create or find land suitable for agricultural development, after the dry, rocky uplands proved too difficult to farm. Early settlers formed a drainage district, constructing numerous ditches which connected the previously separate lakes and wetlands. Between 1910 and 1912, all of the lakes in the area now encompassed by the Refuge (except Stubblefield Lake) were drained. Most of the large lakes and wetlands located within the Study Area were also drained at the time. These drains and ditches form four separate drainage networks which traverse the Refuge

vicinity. The four main networks, or subwatersheds, are Company, Philleo, Kaegle, and Phillips. Company contributes to the Cow Creek watershed; Philleo terminates at Philleo Lake and at Stubblefield Lake on the Refuge. Both Kaegle and Phillips drain into the Rock Creek watershed. Map 7 shows the location of ditches and the outlines of the four main drainage “sub-watersheds” or networks that extend from the surrounding private lands into the Refuge. Surface water recharge for 1,952 acres of Refuge wetlands now comes from local run-off within these subwatersheds (Table 3-1).

Wetlands

Alteration and Restoration: Pre-settlement, most surface waters in the Channeled Scablands were isolated in individual wetland basins. Some wetlands were briefly connected in spring during years of above average rainfall. Wetland depths were dictated by the depth of the basin or the topographic low separating wetland basins from each other or one of the natural drainages of the region.

As previously discussed, many of the wetland basins in the Channeled Scablands area were connected to a manmade drainage system to provide additional acreage for farming. As a consequence, wetlands throughout the Channeled Scablands formation were drained.

In 1937, the Turnbull Refuge was established and restoration of the natural wetland habitats began. This was accomplished by plugging the

drainage ditches in smaller wetlands and building dikes and water control structures at the outlets of larger sloughs and lakes. There are now 17 low dikes varying from 40 feet to 800 feet in width across the Refuge. There are also 22 water control structures used to manage water distribution and depth amongst the now connected wetlands and lakes.

There are few known water control structures within the Study Area. Sixty percent of the wetlands within the Study Area continue to be drained annually through the ditch network providing pasture for cattle. Historically, these wetlands represented the larger, more permanent wetland basins such as those on the Refuge. Map 8 shows the distribution of drained and undrained wetlands within the vicinity of the Refuge.

Wetland Recharge: Because of the regional nature of the drainage system, surface water from several drained wetland basins on private land flow through a chain of Refuge wetlands to the south through the Rock Creek and Cow Creek drainages to the Palouse River. As a result, some Refuge wetlands receive supplemental water from these off-Refuge sources, and control structures allow limited management of water levels. Other wetlands that were drained occur at the “head” of a drainage system and do not receive supplemental water from other wetlands. The wetlands of the Refuge and the surrounding area

Table 3-1. Regional Subwatersheds Affecting Refuge Wetlands

Drainage	Sub-Watershed Size Off-Refuge (acres)	Land Uses	Refuge Wetland Acres Affected
Company	4,397	Dairy, farming, livestock grazing, domestic	1,282
Kaegle	1,708	Livestock grazing, domestic, forestry	501
Phillips	6,973	Livestock grazing, domestic, forestry	120
Philleo	9,403	Dryland farming, livestock grazing	49

Map 7. Surface Watersheds and Drainage Features with Influence on Refuge

Map 8. Historic and Current wetlands within Refuge Vicinity

receive water primarily from spring rains and snowmelt. Surface runoff is intermittent, localized, and generally ceases by late April. Wetlands not recharged by perennial surface water or groundwater sources begin to drawdown as a result of groundwater seepage and evapotranspiration beginning in May.

Within the Study Area, wetlands range in size from vernal pools less than 0.1 acres to large permanent wetlands over 400 acres in size. The average wetland density is 10 per square mile with nearly 16 percent of the landscape consisting of wetlands.

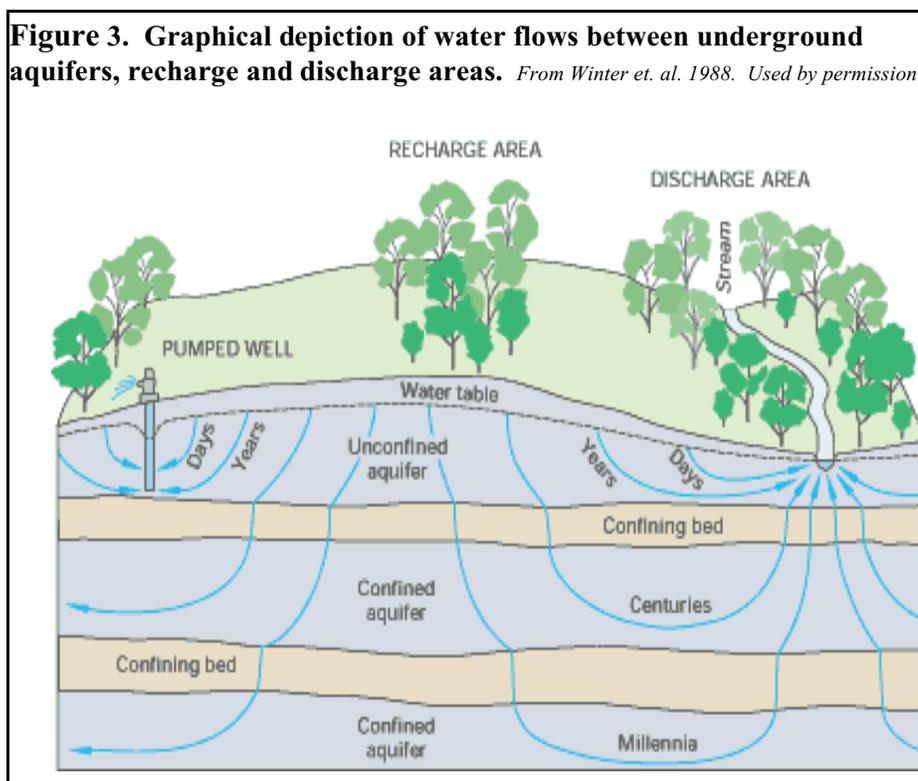
Groundwater

The groundwater system underlying scabland wetlands consists of three major formations in Miocene Basalts: a deep, confined aquifer (Grande Ronde Basalts), a shallow, unconfined aquifer (Wanapum Basalts), and a confining bed (Wanapum-Grande Ronde Interbed) comprised of fine sediments and clays that impede water movement between the shallow and deep aquifer (Vaccaro 1999). Both the Wanapum and Grande Round Basalts consist of numerous lava flows. The major water conductance and storage portions of these aquifers are at the contact zone of individual flows, which consists of rubbly basalt, cinders, and ash (Luzier and Burt 1974). The centers of individual flows are very dense and relatively impervious to water movement except along vertical fracture lines. The result is numerous water bearing layers of rock that are increasingly confined with depth. Since the Wanapum Basalts occur

near the surface and the upper layers are relatively unconfined, water levels in this aquifer in general constitute the local water table. The major areas of recharge for these aquifers are along the northern and eastern edge of the Plateau including the Refuge area where outcrops of Wanapum basalts occur. Vertical recharge to the system is on the order of one to two inches per year (Vaccaro 1999).

In the Refuge area, the basalt formations are relatively thin and highly variable as they pinch out near the edge of the plateau and amid ridges and humps of pre-Miocene granite. The Wanapum Basalts in this area range from less than one foot to 400 feet in thickness and the Grande Ronde Basalts range between 10 feet and 400 feet in thickness. The granite humps create a groundwater divide approximately two miles northeast of the Refuge (Luzier and Burt 1974). Southwest of the divide, groundwater flows slowly toward the Refuge and further southwest. Northeast of the divide, groundwater flows toward Hangman Creek and the Spokane River. The result of these conditions is a much lower

Figure 3. Graphical depiction of water flows between underground aquifers, recharge and discharge areas. From Winter et. al. 1988. Used by permission.



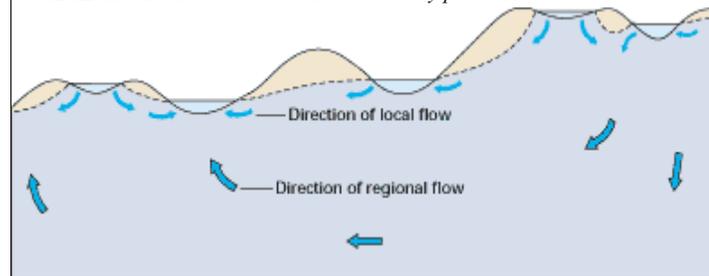
groundwater storage capacity and a smaller area of potential recharge which makes this area vulnerable to groundwater depletion from overuse.

Most wetlands in the Channeled Scablands are directly influenced by groundwater as they are a surface expression of water levels in the underlying shallow, unconfined aquifer. The relationship of wetlands to groundwater depends on their topographic position. When wetlands occur near topographic highs, such as on ridges or the tops of buttes or plateaus, they tend to lose water to the shallow, unconfined aquifer and are often referred to as recharge wetlands. Wetlands or streams situated in regional lows generally receive inputs from groundwater and are called discharge wetlands. When wetlands are located at intermediate elevations, they can be both recharge and discharge wetlands (Winter et al. 1998).

When water levels decrease in the unconfined, shallow aquifer as a result of drought or pumping, the water table declines (Heath 1998). Groundwater recharge from wetlands will then increase and discharges to wetlands will decrease (Winter et al. 1998). The result is shallower, temporary wetlands more prone to drought. Marsh edge species, including introduced species such as reed canary grass, then encroach into the basin. This negatively affects the production of waterfowl and other waterbirds by decreasing the number of acres of open water and brood rearing habitat in summer.

Recent monitoring of the groundwater and wetland water levels on the Refuge has clearly demonstrated that wetland water levels are supported through the summer months by inflow from the shallow water table (Roland 2000). Based on the general direction of groundwater flow, the area that influences the Refuge's groundwater supply extends off the Refuge approximately one mile north and east, and one half mile south and west (Map 9).

Figure 4. Relationship of groundwater flows to wetlands. From Winter et. al 1988. Used by permission.



This means that groundwater pumping within this zone has the potential to directly affect wetland levels on the Refuge.

Water Use and Water Rights

Groundwater: There are at least 200 wells located within one mile of the Refuge boundary (Map 9). Most of these are located northeast of the Refuge and are small domestic systems that do not trigger a permitting and review process for drilling or annual use. Most of these wells are removing water from the shallow Wanapum Basalts aquifer.

In addition to these numerous small domestic wells, the city of Cheney has recently added additional deep municipal wells that penetrate into the lower aquifer (Grande Ronde Basalts). Although this aquifer is confined primarily by the Wanapum -Grande Ronde Interbed, “vertical conductivity” (or passage of water between aquifer layers) does occur in the shallower Wanapum Basalts. To clarify, when drill holes penetrate the shallow aquifer to reach the deeper aquifer, water cascades from the shallow aquifer down to the lower aquifer. Major declines in the shallow Wanapum aquifer could have long-term impacts on the local water table. “Casing” the well can prevent water from cascading down the drill hole.

Groundwater pumping within one mile of the Refuge boundary has the potential to directly affect Refuge wetlands.

Map 9. Groundwater Zone and Features with Influence on Refuge Wetlands

Most of the current and future domestic and industrial development in the area is reliant on groundwater withdrawals from the local shallow aquifer. The number of new wells and the lack of regulations to curb groundwater “mining” pose a threat to the shallow aquifers in the area. Using the aquifer’s water faster than its recharge rate will result in lowering the water table.

Surface water: The Service has claims on all major drainages flowing onto the Refuge but only five water rights have been adjudicated. Hence, the majority of the Refuge’s water rights are still unadjudicated claims. The State of Washington has no immediate plans to complete the adjudication of claims in this area. It will likely be many decades before the Refuge has a final determination of its water rights. Although the Refuge’s claims are valid water rights, which allow for the diversion and use of water in the Refuge wetlands, the State’s water rights process does not provide protection for unadjudicated water rights. Therefore, the existing surface water supply is neither protected nor reliable. This, coupled with an increasing population and the fact that most scientists agree that the global warming trend will continue and could cause a drying effect in this area, causes concern about maintaining and protecting the local surface water supply.

Landowners to the east of the Refuge have stated that they are unwilling to continue to maintain levees on Rock Creek. Disintegration of the levee system will cause Rock Creek to flood out of its banks and greatly reduce the water flow to Stubblefield Lake (a unique playa lake) on the Refuge. In addition, the Philleo Duck Club has a water right claim on Rock Creek. If adjudicated, this right could result in a water diversion to Philleo Lake and less water for Stubblefield Lake. The loss of an adequate water supply to Stubblefield Lake would lead to a significant loss of waterfowl and waterbird maintenance and production habitat.

Water Quality

Until recently, little water quality information was available specific to the Refuge’s watersheds. Over the past 30 years, bodies of water in the Pine Creek Drainage of the Refuge have consistently supported extensive mats of algae. Refuge records note several accounts of fish kills frequently attributed to oxygen depletion from large standing crops of respiring and decaying algae. The most recent die off occurred in 1987, caused by low dissolved oxygen concentrations coupled with high ammonia nitrogen, a toxic combination.

Negative effects from excessive algal production and associated changes in water quality are not limited to lethal effects on fish. Dense algal mats compete with submerged aquatic plant species for light and space resulting in decreased biomass and seed production. The roots, seeds and foliage of submerged aquatic plant species are important food resources for many waterfowl species and other wetland dependent wildlife. These plants are also an important substrate for aquatic invertebrate species that are the most important source of protein and fat for pre fledging waterfowl. These dense mats of algae also prevent young waterfowl from physically accessing important foraging areas.

In response to this problem, a study was initiated in 1991, under contract with Eastern Washington University. The major goal of this study was to determine if nutrient loading from off-Refuge sources was significantly impacting Refuge waters, and if the enrichment was substantial enough to support excessive algal growth. The study looked specifically at two major drainages that enter the Refuge through private lands, the Kaegle System and the Phillips System, both of which contribute to the Pine Creek System. The study found that nutrient concentrations were higher in the Pine Creek drainage on the Refuge than off the Refuge, and that nutrient loads tended to increase as the flow proceeded through the Pine Creek wetlands. Nutrients were possibly

contributed by other surface inflow, groundwater inflow, and/or sediment release from past nutrient inputs to wetlands. Conclusions on source were limited by the sampling scheme and the low run-off conditions that year. In the Kaegle Ditch System, nutrient levels were found to be higher just inside the Refuge boundary than in the upper part of the drainage. Livestock grazing practices and cattle feedlots off-Refuge appear to be responsible for these elevated levels.

In 2002, a more extensive nutrient study was undertaken to determine if nutrient loads have changed significantly since 1991, evaluate the effectiveness of remediation actions taken in the Pine Creek System, and monitor other surface water inflows not studied in 1991. Preliminary results indicate that water entering the Refuge from both Company Ditch to the northwest and Philleo Ditch to the southeast are carrying total phosphorus and nitrogen concentrations several orders of magnitude higher than the mean concentrations in either the Phillips and Kaegle System or in Refuge wetlands with no inputs from private land. Company Ditch originates below a dairy and the Philleo Ditch redirects Rock Creek whose watershed is dominated by dryland agriculture. Water entering the Refuge from the other two drainage systems flow through a series of drained wetlands that are used for hay and pasture.

The proximity and growth of Spokane, Cheney, and other communities in the Spokane metropolitan area has the potential to affect the quality of both groundwater and surface run-off waters. Septic systems continue to be the primary method of domestic waste disposal in the area. Increased septic system loading increases the potential for non-point source pollution of groundwater that ultimately feeds Refuge wetlands.

3.1.4 AIR QUALITY

Air quality is a particularly sensitive issue within the region surrounding the Refuge. Portions of Spokane County have been

designated as non-attainment areas for PM₁₀ (particulate matter 10 microns or less in size) under the provisions of the Clean Air Act (Public Law 95-95). The Clean Air Act established "National Ambient Air Quality Standards" and allows the states primary jurisdiction in air quality management. Under the act, states are required to identify areas which have air pollutant levels not meeting national standards (non-attainment areas) and develop regulations and a state implementation plan to bring these areas into compliance. Significant sources of particulate matter in the region are silvicultural and agricultural field burning, dust from gravel and dirt roads, automobile emissions, windblown dust from tilled agricultural fields, smoke from wood burning stoves and fireplaces, and burning of yard waste.

3.1.5 CONTAMINANTS

There are no known sources of contaminants within the current Approved Refuge Boundary. Four sites have been identified in proximity to the Refuge that are potential sources of contamination. These include an auto-wrecking yard, a dairy, a heavy equipment training school, and an old crop-duster airstrip. Specifics are not known at this time. Contaminants associated with agricultural lands, old homesteads, and confined animal operations are likely present on some properties.

3.2 REFUGE AND STUDY AREA HABITATS

The Study Area straddles the Northeast and Columbia Basin Ecoregions of Washington state, as defined by the Washington State Gap Analysis (Cassidy et al. 1997a). The Northeastern Corner Ecoregion is characterized by extensive areas of coniferous forests. The Columbia Basin Ecoregion consists primarily of steppe communities, large portions of which have been converted into agricultural fields.

3.2.1 HABITAT TYPES

Wetlands

As discussed in more detail above in the Hydrology section, approximately 7,110 acres of wetland habitat are located in the Study Area. They range from tiny vernal pools to large permanent wetlands over 400 acres in size. There is a great diversity of plant species found in these wetlands, dictated by water depth and the length of time a portion of a wetland basin is flooded.

The Study Area includes numerous historically permanent and semi-permanent wetlands that were drained in the 1920s and have subsequently been used for ranching. Since peat soils and a cold growing season create unfavorable conditions for farming, most of these former wetlands were farmed for only a few years and then converted to pasture. The larger basins have low spots where remnant wetland plant communities persist. Restoration could be easily and inexpensively accomplished by plugging the drainage ditches and allowing the natural basins to flood.

The potential of the Channeled Scablands vicinity to support wetland habitats and species is potentially very high. Figure 5 compares a 7.5 minute quadrangle (area = 32,345 acres) within the local vicinity of the Channeled Scablands with a 7.5 minute quadrangle (same area) within the Prairie Pothole region in the north-central United States and Canada, an area renowned for its waterfowl. The analysis shows that the Channeled Scablands rival or exceed the Prairie Pothole Region for wetland depth, size, and abundance in almost every category. Additionally, the Channeled Scablands had a greater proportion of the land in wetland area. In areas such as the Refuge where the Refuge complex is still intact, duck breeding pair densities of several species is actually greater than in the Prairie Pothole region, which is globally known for its waterfowl production.

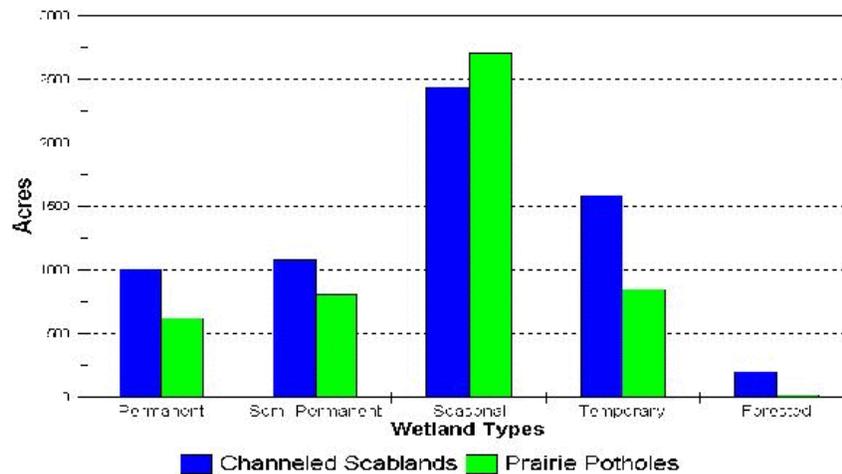
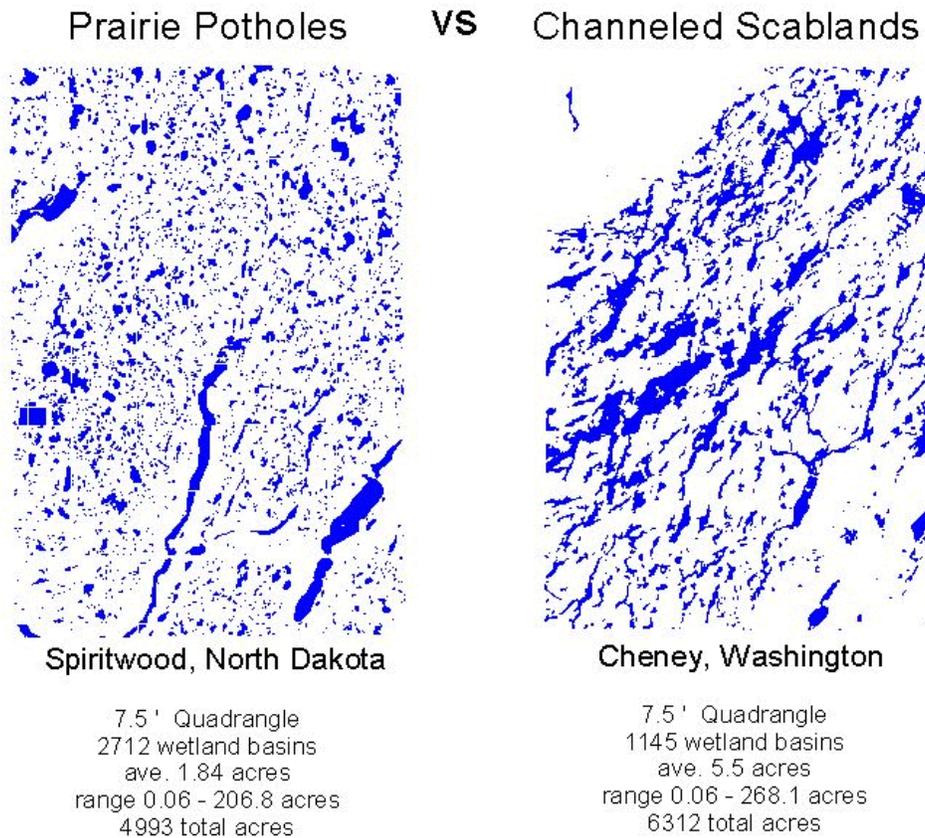
Vernal pools are a unique ephemeral wetland type located in the Palouse steppe portions of the Study Area that warrant special consideration. Vernal pools occur in shallow depressions with a perched water table. Standing water is usually present for less than two months in most years. Because of the relatively short lived nature of these wetlands they are host to a unique plant (Bjork 1997) and animal community (Rabe 1997).

The small, semi- permanent wetlands of the Channeled Scablands also support the threatened plant species, water howellia (*Howellia aquatilis*). The Refuge and vicinity support one of the largest known metapopulations of this species within its range (Shelly and Gamon 1996). Although very little of its potential habitat has been surveyed in the Refuge vicinity, there are numerous wetlands that have the same attributes of the known occurrences within the Study Area. Expanding the number of protected sub-populations would further conserve this meta-population.

The Refuge also falls within the suspected range of Ute ladies'-tresses (*Spiranthes diluvialis*), an orchid species federally listed as threatened. This species was discovered in Washington State for the first time in 1997. It is found in wetland and riparian areas generally below the lower margin of montane forest in transition , open shrub and grasslands zones. The species is found in early and mid-seral communities, usually in relatively open vegetation with sparse canopy in full sun to partial shade.

Ute ladies'-tresses has not been documented on the Refuge. Several plant surveys have been conducted on the Refuge since 1984 without documenting its presence. Hooded ladies'-tresses (*Spiranthes romanzoffiana*), a similar species, has been found on the Refuge. Suitable habitat may occur here, but is generally dominated by reed canarygrass. This invasive grass species forms a dense thatch layer that can prevent the germination and growth of herbaceous plant species such as Ute ladies'-tresses which appears to require early

Figure 5. Comparison of Channeled Scablands Wetlands Density, Size, and Type with Prairie Potholes Region.



successional habitats. It is unlikely that it occurs on the Refuge.

Aspen/Deciduous shrub Riparian Forests

Approximately 380 acres of aspen forests occur within the Study Area. Map 10 shows the distribution of aspen habitat within the Refuge vicinity.

Aspen communities, including waterbirch, alder, and hawthorn, occur mostly as narrow bands along the edge of meadows and large sloughs, and around the margins of pothole wetlands. Aspen dominated stands are a critical resource for wildlife species requiring both cavities and deciduous foliage in tree and shrub canopies for breeding and foraging.

This habitat has been significantly reduced in the Refuge vicinity by competition from encroaching ponderosa pine and the suppression of aspen and shrub regeneration by grazing livestock. In recent years, a growing Rocky Mountain elk population may have been contributing to this problem (see further discussion in Section 3.4). Many of the existing stands are dominated by overmature trees with little regeneration. In the past, periodic fire removed encroaching pines and encouraged regeneration of aspen and understory shrubs.

Grasslands (Steppe)

Approximately 11,955 acres of open grasslands (or areas that can be restored to open grasslands) occur within the Study Area. Map 11 shows the location of current steppe habitat and former (historic) steppe habitat in the Refuge vicinity.

The open grassland habitats of the Study Area fall into a broad category of plant associations referred to as Palouse steppe (also known as “meadow steppe”). Meadow steppe plant associations form a chain around the periphery of the Columbia Basin Ecoregion between areas of extensive forests to the north and east and the drier shrub-steppe areas of the lower Columbia Basin. These plant associations occur on two

distinct landforms, the rolling Palouse Prairie hills, and the unique “biscuit and swale” patterned ground of the Channeled Scablands. The Idaho fescue/common snowberry (*Festuca idahoensis* and *Symphiocarpus albus* respectively) association is common to both landforms, and together with other plant associations found in the grasslands, can support a diverse community of native plant species including some that are endemic to the northern Columbia Basin. One of these species, Spalding’s silene, is a federally listed threatened species. Several populations have been located on the Refuge and the surrounding area on remnants of high quality steppe.

Nearly 90 percent of the original Palouse Prairie steppe habitat has been converted to dryland farming (Cassidy et.al. 1997a). The extent of this loss places this ecosystem on the list of critically endangered ecosystems in the United States (Noss et.al. 1995). Most of the remnant Palouse Steppe is found in small fragments on north slopes too steep for plowing or within the “biscuit and swale” land form of the Channeled Scablands. The Study Area includes approximately 1,000 acres of land with the potential to restore from farmed agricultural use back to functioning steppe habitat.

Although 54 percent of the remaining steppe habitat within the Study Area is in good ecological condition, many acres have been impacted through partial conversion to agriculture, rural development, introduction of exotic species and heavy grazing. Reductions in livestock grazing, control of exotic species, restoration of farmed areas and minimizing further subdivision would greatly improve habitats for these species as well as protect rare vernal wetland habitat and the habitat of Spalding’s silene.

Washington State completed its first GAP analysis in 1997. GAP analysis seeks to identify habitat types and species not adequately represented in the network of areas managed for biodiversity. Vegetation is used as the primary filter in GAP analysis, because vegetation

patterns are determinants of overall biodiversity patterns (Levin, 1981; Noss 1990, Franklin 1993). Gap analysis assumes that most plant and animal species will be adequately represented if all vegetation types are adequately represented in biodiversity management areas.

According to the Washington Gap Analysis (Cassidy et al. 1997), “the most glaring gap in the protection of biodiversity in Washington is in the steppe zone.” The Gap Analysis delineated each vegetation type in the state, determined the percentage of each vegetation zone under different land protection management and compiled the information into an overall Conservation Priority Index (CPI) to sift out the vegetation zones most lacking in protection. The Palouse Steppe rated highest of all vegetation types in Washington on the CPI index. The Gap Analysis authors stated:

With this CPI, the Palouse is ranked, by far, as the zone with the highest conservation priority because of the small percentage of its area on protected land, its near total conversion to agriculture, and its moderately large size. (Volume 5, p. 78)

Because of the high CPI of the Palouse, lands in the Palouse zone should also be an acquisition priority. Since there are virtually no Palouse grasslands left to acquire, acquisition would have to be accomplished by restoration. The restoration of Palouse lands, if attempted, would be an excellent joint project between the Refuge and researchers interested in restoration.

Ponderosa Pine Forests

Approximately 20,090 acres of ponderosa pine forests occur within the Study Area (Map 12). The shallow rocky soils of the flood channels provide an avenue for a narrow extension of the Ponderosa Pine Zone of the Northeast Corner Ecoregion into the steppe habitats of the Columbia Basin.

The two pine associations found in the Study Area are ponderosa pine (*Pinus ponderosa*) /Idaho fescue and ponderosa pine/snowberry (Daubenmire 1952 and Franklin and Dyrness 1973). The distribution of these associations is influenced primarily by soil moisture regime. The ponderosa pine/fescue occurs on drier sites with shallow rocky soils. These stands are often found on flat to gently sloping terrain and the low ridges between wetland drainages. The understory is comprised of an abundance of other perennial grasses and perennial forbs including bluebunch wheatgrass, Sandberg's bluegrass, prairie junegrass (*Koeleria cristata*), arrowleaf balsamroot, grass widow (*Sisyrinchium inflatum*), deer vetch (*Lotus nevadensis*), and fringe cup. Canopy cover is typically less than 50 percent. The ponderosa pine/snowberry association is found mostly in shallow depressions, at the bottom of slopes near wetlands, and on the north aspects of basalt bluffs. Soils are deeper, less well drained and consist primarily of silt loams of the Hesseltine complex. The understory of this association can consist of a dense growth of common snowberry, Wood's rose, bearberry (*Arctostaphylos uva-ursi*), and Oregon grape (*Berberis repens*) with a suppressed herbaceous layer consisting of bluebunch wheatgrass, several *Poa* species, pinegrass (*Calamagrostis rubescens*) and starry Solomon-plume (*Smilacina stellata*). In wetter sites, pinegrass can assume dominance of the herbaceous layer. Associated herbaceous species may include rhizomatous bluebunch wheatgrass, starry Solomon-plume, cinquefoil (*Potentilla gracilis*), and strawberry (*Fragaria vesca*). At the edge of wetlands and in deeper depressions, a tall deciduous shrub layer may occur, comprised of such species as *Spiraea* sp., serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), golden currant (*Ribes cereum*), and Wood's rose. Quaking aspen, mountain alder (*Alnus incana*), and water birch (*Betula occidentalis*) may also be represented in the understory. Trees on these sites grow quickly and tend to be more densely stocked due to the uniform nature of the soil and higher moisture

Map 10 - Aspen / Riparian Habitat Quality within Refuge Vicinity

Map 11 - Current and Historic Steppe Habitat within Refuge Vicinity

Map 12 - Ponderosa Pine Forest Habitat within Refuge Vicinity

conditions that reduces fire frequency. Canopy cover on these sites often exceeds 50 percent. Within the Study Area these associations are intermixed on uplands with both steppe and edaphic climax plant associations.

Although ponderosa pine is a widespread ecosystem, most large-diameter, late-seral ponderosa pine trees are now gone from their former range throughout the Western states, lost to timber harvest and the changes in fire regimes. Timber harvest has severely affected these habitat types because of the high value of the trees and the fact that, located at lower elevations, these habitats have been more accessible than higher elevation types. Fire exclusion has also played a role in the loss of this habitat, as fire exclusion has resulted in a gradual shift in stand composition from shade-intolerant tree species such as ponderosa pine to shade-tolerant species such as Douglas-fir and grand fir.

Less than 4 percent of the ponderosa pine habitat within Washington State is included in lands where conservation of biodiversity is the primary objective (Cassidy et al. 1997). Species such as white-headed woodpecker, white-breasted nuthatch, pygmy nuthatch, and Lewis' woodpecker are strongly associated with large diameter ponderosa pine trees. Within the entire Interior Columbia River basin (an area covering most of the states of Oregon, Washington, and Idaho as well as a good quarter of Montana and portions of Nevada and Utah), "source habitats" (habitats in good enough condition to provide for successful breeding) for these species have declined about 50 percent for the first three species and 85 percent for the Lewis' woodpecker (Wisdom et al. 2000). Within the basin, late-seral, large-diameter ponderosa pine habitats have declined 81 percent decline from historic levels (Hann et al, 1997; Wisdom et al, 2000). The magnitude of decline in historical vegetation structure and composition has been greater for this forest habitat type than for any other forest habitat types in the Interior Columbia Basin. As a consequence, the suite of species dependent on this cover and structural

type is among those considered at highest risk within the Basin (Wisdom et al, 2000).

For more site-specific analysis, the authors of the Interior Columbia Basin Assessment divided the 145-million acre basins into smaller areas known as Ecological Reporting Units (ERUs). The Turnbull NWR and its Study Area straddle two ERUs, each of which show declines even greater than that seen basin-wide for the late-seral ponderosa pine cover type. In the Northern Glaciated Mountains ERU (17.6 million acres), which includes part of the northeast section of the Study Area, late-seral, single layer ponderosa pine has declined from historic levels by 99.3 percent. In the Columbia Plateau ERU (24.3 million acres), where the rest of the Study Area is located, late-seral, single layer ponderosa pine has declined from historic levels by 93.9 percent. (Data from Hann, et al. 1997).

Within the Study Area, only 40 percent of the ponderosa pine forest stands are considered high quality wildlife habitat. These high quality stands have a mature tree component, and they are contiguous with existing Refuge stands and relatively unfragmented. The remaining pine forests in the Study Area have been degraded through logging and the suppression of fire. The results are overstocked stands of suppressed second growth that is at risk for loss by wildfire, insects and disease and that provides only marginal habitat for wildlife. Many of these lower quality stands have been fragmented by rural development, clearing for agriculture and road and fence construction.

3.2.2 MAJOR WILDLIFE VALUES

Based on the distribution of habitats within the Study Area, Refuge information, and modeling performed by Washington State Gap Analysis (Grue et al. 1995), 7 amphibian species, 10 reptile, 45 mammal and 203 bird species are predicted to occur within the Study Area. Among these species are several with special conservation status including federally listed, proposed and candidate species, as well as many

State listed species and others of management concern (Table 3-2).

Wetland Wildlife

Located within the Pacific Flyway, the large, historically permanent wetland basins within the study area are shallow flooded in the spring providing migration habitat for peak waterfowl populations of over 100,000 birds, principally mallards, northern pintail and American widgeon. In addition, as many as 2,000 tundra swans utilize the same wetlands in the spring. These concentrations of birds also attract bald eagles in moderate numbers. Numerous undrained wetlands currently provide breeding habitat for 17 waterfowl species, numerous marshbirds including sora, Virginia rails, American bittern, and black terns, yellow-headed black birds and Columbia spotted frogs.

As these same wetlands naturally drawdown in late summer they also provide important shallow foraging habitat along their shorelines for up to 25 species of migrating shorebirds such as the western, least and Baird's sandpiper, greater and lesser yellow-legs, and long-billed dowitchers.

The few existing undrained large permanent wetlands found in the Study Area provide important fall migration and wintering habitat for waterfowl and bald eagles until freeze up in late November. At the current time, fall waterfowl habitat within the Study Area is very limited as a result of extensive drainage of the large, historically permanent wetland sloughs in the early 1900s. Over 70 percent of the wetlands in this area have been drained. The remaining fall habitat occurs on the Refuge and on several deepwater lakes in the vicinity of the Refuge. As a result of the extensive drainage of fall migration habitat in the Refuge vicinity and extensive development of irrigation wasteways and agriculture in the central Columbia Basin, much of the fall waterfowl migration has shifted west of the Refuge. Increases in waterfowl use of the Refuge in the fall during above average precipitation years, however, indicate that

restoration of fall migration habitat would likely increase waterfowl populations in this area.

Restoration of the large, drained wetland basins in the Study Area would increase breeding habitat for all of the above-mentioned species especially redheads, lesser scaup, and black terns. These restored wetlands would significantly increase the amount of fall migratory waterfowl and shorebird and wintering bald eagle habitat that is currently limited in the area surrounding the Refuge.

Steppe Wildlife

The Palouse steppe habitat in the Study Area has the potential to support substantial populations of several ground nesting passerines including the grasshopper, savannah and vesper sparrows. Many of these species are experiencing declining population trends regionally and have been identified as species of concern (Table 3.2).

These habitats also support large small mammal populations including the Columbia ground squirrel, Great Basin pocket mouse, vagrant shrew and northern pocket mouse. This abundant prey base supports a diverse community of predators consisting of several raptor species, coyotes, and badgers.

Aspen/Riparian Wildlife

Aspen and riparian habitats support the highest diversity of wildlife species of all habitats within the Study Area. Sixty-five of the 124 breeding birds in this area frequent the aspen and deciduous shrub riparian plant communities for either reproduction or foraging. The aspen community type is the primary foraging and breeding habitat for ten of these species, including the willow flycatcher, yellow warbler and red-naped sapsucker (all neotropical migrants).

Table 3-2. Special Status Species that Likely Occur within the Study Area (Including Plants)

SPECIES	STUDY AREA USE
Federally Threatened ---- Total of 4 species	
<ul style="list-style-type: none"> • Bald eagle • Water howellia (<i>Howellia aquatilis</i>) • Ute's lady's tresses (<i>Spiranthes diluvialis</i>) • Spaulding's silene (<i>Silene spauldingii</i>) 	<ul style="list-style-type: none"> transitory winter visitor small vernal wetlands wet meadow Palouse steppe endemic
Washington State Endangered ---- Total of 3 species	
<ul style="list-style-type: none"> • Sandhill crane • American white pelican • Upland sandpiper 	<ul style="list-style-type: none"> Rare spring migrant Summer visitor on area lakes with fish Previously nested Stubblefield Lake area
Washington State Threatened ---- Total of 1 species	
<ul style="list-style-type: none"> • Ferruginous hawk 	<ul style="list-style-type: none"> Rare summer visitor
Washington State Candidate ---- Total of 6 species	
<ul style="list-style-type: none"> • Columbia sharp-tailed grouse • Townsend's big-eared bat • Northern goshawk • Lewis Woodpecker • Loggerhead shrike • Golden eagle 	<ul style="list-style-type: none"> Extirpated Rare resident requiring caves or crevices Migrant and rare breeder Migrant and past breeder Rare fall visitor Summer visitor
North American Waterfowl Conservation Act Priority Waterfowl ---- Total of 7 spp.	
<ul style="list-style-type: none"> • Mallard • Pintail • Lesser scaup • Redhead • Wood duck • Canvasback • Ring-necked duck 	<ul style="list-style-type: none"> Common breeder - marshes Common breeder - marshes Uncommon breeder - marshes Common breeder - marshes Breeder - marshes Breeder - marshes Breeder - marshes
Partners in Flight Priority Species * ---- Total of 30 species	
<p>(Only five described here for brevity's sake)</p> <ul style="list-style-type: none"> • Yellow-headed black bird (12) • Grasshopper sparrow (11) • Yellow warbler (11) • Eastern kingbird (9) • Chipping sparrow (9) 	<ul style="list-style-type: none"> Common breeder- marshes Uncommon breeder -steppe Uncommon breeder - riparian Common breeder- upland shrub Common breeder- open young forest
Region 1 Species of Management Concern ** ---- Total of 10 species	
<ul style="list-style-type: none"> • American bittern • Black tern • Bewick's wren • Lark sparrow • Grasshopper sparrow • Lewis woodpecker • Short-eared owl • Loggerhead shrike • Olive-sided flycatcher • Ferruginous hawk 	<ul style="list-style-type: none"> Common breeder Common breeder Uncommon breeder -riparian Uncommon breeder -steppe Uncommon breeder -steppe Migrant and past breeder Winter visitor Rare fall visitor Uncommon spring migrant/potential breeder Rare summer visitor

* PIF Priority Index from Andleman and Stock (1994); only species with ratings of 9 or higher shown here.

** R-1 list established in 1995.

The substantial insect populations associated with the high structural diversity and vegetation density in these habitats also makes them a focal point for many insectivorous species such as bats and neotropical migratory landbirds. Several species of bats, including the big brown bat, hoary bat, and silver-haired bat, utilize either aspen foliage or cavities in aspen trees and snags for roost.

The dense cover of aspen / riparian habitats also provides critical fawn rearing habitat for white-tailed deer and important winter browse for Rocky mountain elk and white-tailed deer.

Ponderosa Pine-dependent Wildlife

There are twenty eight species of wildlife that utilize the ponderosa pine forest in the Refuge vicinity as breeding and foraging habitat. Although most of the Study Area's ponderosa pine forest stands have been heavily logged and now consist of dense unhealthy stands of small diameter trees, habitat exists for several tree canopy nesting birds such as the chipping sparrow and cavity using wildlife species, including several bat species of concern. The potential exists to restore these forest to more natural stand conditions supporting large diameter trees and snags that will provide improved habitat for such species as the western bluebird and the Lewis' woodpecker, a state candidate species.

3.3 LAND STEWARDSHIP OVERVIEW

The Refuge (15,656 acres or 24.5 square miles) comprises one of the only protected areas within the Channeled Scablands. The vicinity map (Map 1) in Chapter 1 shows the locations of publicly owned lands within Spokane County. Turnbull NWR, managed by the U.S. Fish and Wildlife Service, is the only major land management agency in the area geared towards wildlife habitat protection.

3.3.1 CURRENT LAND USE WITHIN STUDY AREA

Most parcels within the Study Area are in private ownership, and as shown in Table 3-1 earlier in this chapter, are used for livestock grazing, dairy, farming, domestic, or forestry.

The Refuge comprises one of the few protected areas within the Channeled Scablands.

The majority of tax lots within the Study Area measure over 80 acres in size, although some subdivided parcels are as small as six acres. There are about forty landowners owning 250 or more acres within the Study Area; six landowners have holdings of one thousand or more acres. Many of the property owners are aging or retired and there could be significant ownership turnover and subdividing in the near future.

Although the current land uses are predominantly rural, over the last ten years a number of tracts have been subdivided into parcels intended for residential use. To date, only some of these have actually been sold and houses constructed.

There are nine State land parcels within the Study Area, totaling about 875 acres (management by Washington Department of Natural Resources - DNR)-. Other than these scattered parcels, there are few public lands in the area. Public lands including Palouse Prairie steppe habitat are especially rare. Bureau of Land Management is the only other federal land manager within forty miles of the Refuge. Their six tracts to the southwest average about 3,500 acres each. The Idaho Panhandle National Forest is located nearly fifty miles east from the Refuge at its nearest point. Little Pend Oreille NWR is located 90 miles to the north.

Riverside and Mount Spokane State Parks are located twenty-five and fifty miles away, respectively. These parks, though sizeable, are geared primarily towards providing recreational

opportunities to the local population, not at providing wildlife and habitat protection.

3.3.2 COUNTY ZONING WITHIN STUDY AREA

Spokane County recently completed its Comprehensive Plan (Spokane County, 2002). The plan maps important County resources, updates County zoning, establishes goals and policies for future County growth, and establishes patterns of acceptable land uses.

Turnbull National Wildlife Refuge and most of the surrounding Study Area are located within the newly designated Rural Conservation zone, a zone that was developed from Spokane County's Critical Areas program and from the University of Washington study *Wildlife Corridors and Landscape Linkages: An Approach to Biodiversity Planning for Spokane County* (University of Washington, 1998). This category encourages low-impact uses, and has a maximum density of 1 dwelling unit per 20 acres. Bonus densities are allowable when clustering is employed. Clustering is a new technique aimed at minimizing population density and retaining rural character. Rural clustering encourages the grouping of home sites on areas of the site best suited for development, while retaining the remainder of the site for open space. Clustering is thought to result in a number of environmental benefits, including (for the same amount of housing constructed) fewer road miles, ability to use a community well, and greater security against wildfire.

Spokane County is predominantly rural, but the average population density of 237 persons per square mile far exceeds the state average of 88 persons per square mile.

The Spokane County Division of Long Range Planning projects an increase of 68,114 people in the unincorporated areas of the County, for a total of 265,158 people by the year 2020 (Spokane County, 2002 [Ch. 9]). This represents a projected increase of 35 percent over current population.

County Designated Open Space

Most of the Study Area is mapped as part of the County system of Open Space Corridors. The County establishes several goals around open space in its recent update of the Comprehensive Plan. One applicable here is:

PO.5a Preserve and protect existing and designated open space areas and corridors throughout Spokane County.

County Designated Critical Natural Resources

The Study Area encompasses most of the wetlands-rich areas in the County. The Study Area is also largely mapped as moderately susceptible to contamination of aquifers. Most of the Study Area is mapped as a Fish and Wildlife Conservation Area. More specifically, these conservation areas include those areas mapped by WDFW as Priority Habitats / Species areas and also includes all naturally occurring ponds under 20 acres. The County established several goals related to wetlands protection, groundwater protection, and fish and wildlife critical areas. One is reiterated here:

NE.24: Protect, maintain, and improve critical fish and wildlife habitat conservation areas and habitats of local importance through a variety of methods including public ownership of the most critical areas and incentives for privately owned lands.

3.3.3 LAND PROTECTION ACTIVITIES WITHIN REFUGE VICINITY

Ecosystem Management Initiatives and Goals

A number of entities have expressed support for additional protection of biodiversity within Eastern Washington and specifically within the habitats specified in this CCP. A portion of Chapter 1 (section 1.8 - Relationship to Regional Conservation Goals) outlines some of the more pertinent plans, initiatives, and policies important to consider for this area.

Governmental Programs for Land Protection

The federal and State governments maintain numerous programs managed through a variety of different agencies to promote land and water conservation, habitat protection, and improvement of environmental quality. Some programs are directed at private landowners, while others are directed at municipalities, tribes, agencies, conservation districts, non-governmental organizations, or others. The various programs usually utilize some kind of grant or payment; technical assistance program; or cooperative agreement to accomplish program goals. Program objectives may be directed at management, restoration, acquisition, planning, or other aspect of natural resource management. These programs are too numerous to list and describe here, but as a start, information may be obtained from agencies like U.S. National Resource Conservation Service (<http://www.nrcs.usda.gov/programs/>) and the U.S. Fish and Wildlife Private Stewardship Grants program (http://endangered.fws.gov/grants/private_stewardship).

In addition to the federal and state programs, Spokane County has developed a Conservation Futures program. This program provides a means for counties to acquire lands and habitats important to the preservation of wildlife or lands having significant recreational, social, scenic, or aesthetic values. The Legislature granted counties the local option of a tax up to 6.25 cents per \$1,000 of assessed valuation to acquire open space.

3.3.4 PRIVATE AND PARTNERSHIP LAND PROTECTION INITIATIVES

A number of private organizations, many working in partnership with federal, state, and local agencies, are active within the local area to protect and restore habitats and open space for the future (in particular, see North American Wetland Conservation Act section below).

A variety of land protections tools are utilized in partnership efforts and also independently by land trusts. Some common mechanisms for protecting land include: outright acquisition, conservation easements, outright land donation, bargain sale of land, donation of undivided partial interests, donations of land by will, donation of remainder interest in land with reserved life estate, and restrictive covenant. Most of the tools result in income and estate tax reductions to the landowner. A number of these mechanisms allow a landowner to continue to occupy and use the land, and to gain the benefit of income tax reductions while still occupying the land.

A conservation easement is a legal agreement between a private landowner and an organization. It allows landowners to pledge their land for conservation values, scenery, or open space while retaining title. The conservation easement specifies which activities can take place upon the land, as well as which activities are restricted. Allowed activities typically include farming, forestry, recreation, and limited construction. Restricted activities usually include development, subdivision, surface mining, dredging, and other actions that would damage the conservation values of the property.

Each conservation easement is tailored to meet the specific needs and conservation purposes of the signatory parties. The easement stays with the property no matter who owns it, much like a road or utility easement. Future owners of the property are bound by the easement's terms. Landowners may receive cash for the value of the foregone development rights and/or tax credits.

North American Wetland Conservation Act (NAWCA)

Two NAWCA grants were awarded recently in the amount of nearly two million dollars for protection and restoration of wetland and riparian habitats in Spokane, Lincoln, and Adams Counties. These first two grants fund

Phases 1 and 2 of a five phase project plan for the Intermountain West Joint Venture Channeled Scablands Focus Area (CSFA).

Fourteen public and private organizations provided matching and in-kind funds in the amount of \$3.2 million (Phase II) and \$6.2 million (Phase I). The organizations include: Ducks Unlimited, Spokane County Parks and Recreation Department, Spokane County Conservation District, U.S. Bureau of Land Management, U.S. Natural Resources Conservation Service, U.S. Fish and Wildlife Service, The Nature Conservancy, Avista Corporation, U.S. Farm Services Agency, Washington Department of Fish and Wildlife, Inland Northwest Wildlife Council, Inland Northwest Land Trust, Friends of Turnbull NWR, and Spokane Audubon Society. Numerous private landowners are also partners in the project. The goals of Phase I and Phase II of the project are to acquire, restore and enhance over 15,000 acres of wetland, riparian, and adjacent upland habitat within the area covered by the CSFA Implementation Plan.

The Refuge is a partner to an ongoing effort by 14 organizations to protect and restore wetlands and riparian areas within the Channeled Scablands. Two million dollars in federal grants were recently awarded to this project, and partners have put up a total of nearly ten million dollars in matching and in-kind funds.

Inland Northwest Land Trust (INLT)

INLT is a local, non-profit, non-political organization with 300 members. According to this organization, 10,000 acres of open space are being lost each year in Spokane County. Primarily through donated conservation easements, the INLT has preserved over 4,000 acres of wetlands, shorelines, farmlands, and forests in eastern Washington and northern

Idaho since 1994. The INLT ensures compliance with the terms of conservation easements by committing to regular monitoring and annual visits to the property.

The Nature Conservancy

The Nature Conservancy's mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Through a strategic, science-based planning process called Conservation by Design, TNC identifies the highest-priority places that, if conserved, promise to ensure biodiversity over the long term. TNC identified approximately 139 sites of conservation interest within their Columbia Plateau Ecoregional Assessment, including Turnbull NWR and the surrounding area (Soper 1999).

TNC works with all of the land protection tools mentioned above. Its acquisition program often works with the goal to transfer properties over to other land management agencies, rather than keeping all acquired properties under TNC ownership in perpetuity. Within the local area, TNC recently acquired two properties on the eastern boundary of the Refuge, that the Service later purchased.

Trust for Public Land

Trust for Public Land is another national land conservancy but with a slightly broader mission than TNC. TPL is the only national nonprofit working exclusively to protect land for human enjoyment and well-being. TPL helps conserve land for recreation and spiritual nourishment and to improve the health and quality of life of American communities. Though most of its Washington activities have centered in the Western portions of the state, TPL has recently expressed interest in broadening its programs within the Spokane Area.

In the Northwest, TPL works with individual landowners through the Northwest Working Landscapes Program. Working landscapes

include agriculture lands such as farms, ranches and orchards; forestlands and woodlots that are the sources of wood products; and estuaries, tidelands, lakes and rivers that support commercial fishing. These lands are valuable not only because of their economic impact and commodity production, but also for their benefits as undeveloped land for wildlife habitat, scenic open space, protecting water quality and acting as buffers to existing preserved land. By offering a variety of conservation solutions for critical farmland, forests and fish-bearing watersheds, TPL can give private landowners alternatives to development while protecting natural resources.

3.4 ELK MANAGEMENT

3.4.1 HISTORY OF ROCKY MOUNTAIN ELK IN REFUGE VICINITY

Although archaeological evidence suggest that elk may have once been fairly widespread in eastern Washington and were hunted by native Americans residing in the area, the earliest written records of Rocky Mountain elk in eastern Washington exist from the late 1800's for only the Okanogan, Blue Mountains, and Yakima areas. Elk, if historically present in the Refuge area and the forested portions of northeastern Washington, appear to have been eliminated by the time of settlement.

Reintroductions in the early 1900's, however, resulted in expanding herds throughout much of the forested portions of eastern Washington. From these reintroductions and subsequent transplants, elk populations increased dramatically in the 40's, 50's and 60's. Rocky Mountain elk were first observed on the Refuge in the late 1950's. Although increasing numbers were observed on the Refuge and in most of southern Spokane County since their first appearance, dramatic increases did not occur until the early 1980's.

By the late 1980's, the elk population in the Refuge vicinity was estimated at between 60 to

80 animals, based primarily on incidental observations. As the elk population grew in size so did interest in its management. In 1993, the elk of southern Spokane County were designated the Hangman Creek sub-herd by the Washington Department of Fish and Wildlife and managed as part of the Selkirk Herd of northeastern Washington.

3.4.2 RECENT POPULATION ESTIMATES

The first aerial survey of this population was completed during the spring of 1993. The estimated population size was between 271-384 (95 percent confidence interval) with 60 elk observed on the Refuge. Additional aerial surveys were conducted in 1994 and 1995. These surveys indicated a growing population with high productivity. During an aerial survey conducted by the State in 1997, 93 elk were observed on the Refuge and the estimated population for the sub-herd was between 115 and 219 animals (95 percent confidence interval). This population decrease for the entire sub-herd is likely the result of the any-bull strategy and offering either-sex and antlerless hunts with extended seasons for muzzle loaders and Advanced Hunter Education graduates. The most current survey data from 2004 found 254 elk on the Refuge, with an additional 100 elk in the vicinity, for a total estimated herd size of 354.

3.4.3 ELK ISSUES

Since this population has become well established, three primary issues concerning this population of elk have developed, including impacts to aspen-dominated habitats, damage to private lands and recreational hunting opportunities.

Although aspen habitats occur in small amounts relative to other habitats on the Refuge, they are particularly important to a large portion of the wildlife on the Refuge, as previously discussed. Elk use and preference for aspen and other deciduous browse is well documented. Under high populations and limited habitat, elk

browsing can have a significant negative impact on the regeneration of aspen. In areas of suburban development or intense hunting pressure, elk use of such places like Turnbull NWR - that provide both security cover and forage - increases. Increasing use of this security cover is evidenced by the increase in elk numbers observed on the Refuge from 1993 to 1997 (62 to 94) when the sub-herd population decreased.

Currently research is being conducted by the State and Eastern Washington University to determine the extent that the Refuge acts as security cover for this sub-herd. Preliminary results indicate that radio-collared elk are utilizing the Refuge disproportionately to other areas. Over 90 percent of the relocations made during the day have been recorded on the Refuge. During the hunting season radio-collared elk seldom leave the Refuge during daylight hours.

This high elk use has resulted in heavy browsing of young aspen and other deciduous shrubs and trees on the Refuge, especially in recently burned areas. Whether this use is sustainable has yet to be determined. Research has been initiated to quantify the impact of elk on this habitat. The possibility exists that current elk use of Refuge aspen is having a significant negative impact on the structure and sustainability of this important habitat.

Although the Refuge is receiving the greatest proportion of elk use in this area, the Washington Department of Fish and Wildlife has received numerous complaints of elk damage to hay, other crops, fences, and ornamental shrubs within the Hangman Creek sub-herd's range since the early 1990's. Since 1992, two claims have been paid by the State for elk damage to agricultural crops. Claims have declined since 1999 as a result of several landowners in the area leasing their lands for hunting.

Hunting and trapping were once popular activities in the area with settlers before the

Refuge was established. In the 1930s when the Refuge was established the prevailing public view was that there should be no hunting at the Refuge. The original advocates for Refuge establishment included the Spokane Sportsman's Association, who wanted a sanctuary where hunting would not be permitted. They hoped to create a place where wildlife could flourish and act as a source for adjacent hunted lands. Hunting was not then and has never since been permitted at the Refuge.

Some hunting advocates have expressed the desire to see the Refuge opened to elk hunting, primarily as a way to mitigate for some of the depredation that occurs occasionally on adjacent lands.

The Washington Department of Fish and Wildlife has openly advocated an elk hunt on the Refuge over the past 10 years primarily to help alleviate problems with elk depredation on private lands around the Refuge. In the Washington State Selkirk Elk Herd Plan (Zender and Hickman 2001), one of the the objectives for the Hangman Creek PMU which includes the Refuge is to "stabilize elk numbers at levels tolerable with landowners and suburban expansion." One of the strategies proposed to achieve this objective besides extended seasons and liberal either-sex recreational hunts in the area is to "encourage the Turnbull National Wildlife Refuge to consider a limited entry season for antlerless elk to address the increasing number of elk using the Refuge during hunting seasons."

Staff from the State and the Refuge have met on several occasions during this time period to discuss the elk issue and options for population control. The Service position has been that a hunt on the Refuge could not be offered as an alternative without a better understanding of the ecology of this population and the impacts the herd is having on Refuge habitats. The State and the Refuge have cooperated on research to answer these questions. The State's desire for a Refuge hunt has not been as strong lately as a

result of decreasing damage claims. Several landowners in the area have responded to elk damage by leasing their land for hunting to reduce damage and provide income.

3.5 REFUGE INFRASTRUCTURE AND ADMINISTRATIVE FACILITIES

3.5.1 ENTRANCES AND ROADS

There is one public entrance to the Refuge at Smith Road, off Cheney Plaza Highway, which accesses the Public Use Area. Other roads access the Refuge but none are public entrances.

The Refuge includes a network of paved, gravel and dirt roads totaling approximately 69 miles. Only the paved roads and the gravel-covered Auto Tour Route are open to the public and these roads are open year round, while the native surface roads are often closed during winter.

The interior road network serves as the backbone of fire breaks, as well as providing quick and efficient access for fire suppression activities. At one time, the Refuge maintained a peripheral fire break surrounding the Refuge, but this has not been maintained in fifteen years. The road network within the Study Area also serves as the main fire break there.

Paved Roads

There are a total of 5.8 miles of paved roads within the Approved Refuge Boundary, however, all are maintained by the county. Cheney-Spangle Road runs northwest-southeast on the Refuge's eastern border; and Mullinix Road, runs north-south along the western border. Cheney-Plaza Road, running north-south, bisects the Refuge interior.

Primary Roads

The 5 ½ mile auto tour route as well as the

entrance road (Smith Road) are surfaced with gravel or a combination of gravel and native materials and are maintained by the Refuge. Two miles of entrance road and 5 1/2 miles of auto tour route were improved in October 2003. The gravel surface of both roads was brought up several inches, the auto tour route was widened and several pullouts installed along it for observation (and possible future interpretation sites). A small portion of the entrance road was paved. Culverts were replaced as well.

There are a total of 7 miles of gravel roads within the Public Use Area and these are also considered primary roads.

Dirt Roads

Single lane roads with mostly a native surface road bed comprise the remainder of the Refuge road inventory and are maintained by the Service. These roads access the more remote areas of the Refuge, and are closed except for administrative purposes. This category also includes fire roads and non-maintained roads that are impassable to vehicles. A total of 56 miles of dirt roads are located within the Approved Refuge Boundary.

3.5.2 ADMINISTRATIVE FACILITIES

On the Refuge, existing administrative facilities have been developed over a long period beginning in the early 1940s. The Refuge headquarters covers approximately 30 acres adjacent to Pine Creek. Buildings at headquarters include one residence, two offices, a shop-service building, two equipment and supply storage pole barns, two vehicle storage buildings, a hazardous storage building, and two well houses. The headquarters also includes a rest station and environmental education building that includes a classroom and Friends of Turnbull book store, both built and maintained for the public.

Other buildings on the Refuge include a residence on the former Helm tract (property purchased by the Refuge in 1987) and a house,

garage, barn and equipment shed located on the former Goodwin tract. The Helm's farmhouse (originally the Cosselman house) is currently being used as a bunk house for Refuge volunteers and seasonal employees. The house, shop, and garage on the Goodwin Tract is currently occupied or being used under a life-time use arrangement with the former owners. The other existing structures on the Goodwin Tract are vacant.

Drainage Network, Dikes, and Water Control Structures

Seventeen low dikes, varying from 40-800 feet in width, are located at lake and wetland outlets across the Refuge. There are also 22 water control structures used to manage water depth and distribution amongst the now connected wetlands and lakes.

Drains and ditches form 4 separate drainage networks that traverse the study area. Map 7 shows the location of ditches and the outlines of the four main drainage "watersheds" or networks that extend from the surrounding area into the Refuge.

Five lakes in the Pine Creek Drainage (Windmill Pond, Headquarters Pond, Winslow Lake, Pine Lake and Cheever Lake) are not natural but were created through construction of a series of dams and dikes.

Turnbull Laboratory for Ecological Studies

In 1973, a laboratory owned and maintained by Eastern Washington University was constructed on Refuge lands. The Refuge co-manages the lab, known as the Turnbull Laboratory for Ecological Studies (TLES). The TLES facility is located on the northwest shore of Findley Lake in the northern part of the Refuge, approximately two miles south of Cheney on the Cheney Plaza Road. The lab is operated by the biology department at Eastern Washington University (EWU), and provides opportunities to EWU students for study and research in ecology and natural history. The facility is

furnished with an analytical lab, dry lab, general to special purpose area, library conference room, and offices. The building also houses a display area for public education. The laboratory measures approximately 3,800 square feet.

3.6 PUBLIC USE FACILITIES, ACTIVITIES AND PROGRAMS

3.6.1 OVERVIEW

Currently, an estimated 30,000 visitors come to the Refuge to participate in the environmental education program, observe wildlife, hike or bike, enjoy nature, photograph wildlife in a natural setting, and cross-country ski.

Visitation was also estimated at approximately 30,000 visitors in the mid-1970s. Total visitation estimates rose to as high as 50,000 in the early to mid 1980s. Some of the increase may have been due to a variety of non wildlife-dependent uses that were encouraged during those years. The fee station that was constructed in 1987 established an entry fee of \$2.00 per vehicle (increased to \$3.00/vehicle in the late 1990s) and Refuge staff believe that visitation dropped slightly as a result of the new fee.

3.6.2 VISITOR USE PATTERNS

Visitor Origin

In 1999, the Friends of Turnbull National Wildlife Refuge (Friends) & Refuge staff conducted a visitor survey to identify visitor use patterns, preferences, and needs related to the Refuge. A total of 531 visitor surveys were administered at nine different locations in Spokane County. The results of the surveys were analyzed by EDAW, Inc., a private consulting firm.

According to the survey results, 95 percent of the non-school group visitors to the Refuge were

from Spokane County. This high percentage emphasizes the importance of the Refuge as a recreation and education resource for residents of the greater Spokane area and county.

As a validation, visitor use data was analyzed from eight months of entrance fee envelopes, March, 1995 through October, 2000 (n=13,383 fee envelopes). School groups do not fill out these envelopes, so this analysis helped to deduce visitor origin for the non-EE activities available at Turnbull. The data showed that an average of 46 percent of visitors using the Refuge came from the city of Spokane, while 16 percent came from the nearby city of Cheney.

Seventy percent of the visitors were from Spokane County, and an additional 10 percent of all visitors came from other parts of eastern Washington. Seven percent came from western Washington, and 13 percent came from outside the state of Washington. In summary, this data shows that the majority of non-school group visitors are local and a small but significant percentage comes from outside the local area to enjoy Turnbull's amenities.

3.6.3 PUBLIC FACILITIES

Amenities available to visitors include approximately nineteen scenic overlooks (viewpoints) supported by vehicle pulloffs or parking areas (some of these constructed during 2003), four environmental education sites and an environmental education classroom, several short hiking trails, a disabled-accessible boardwalk, and one long cross-state trail (Columbia Plateau Trail) that passes through the Refuge. Four interpretive sites and four benches are located on the Refuge portion of the Columbia

Viewpoint - any area that has been designed specifically for the wildlife viewer in mind and includes areas with pulloffs, panels, blinds or "short" access trails (less than 1/10 mile).

Plateau Trail.

Five interpretive panels are installed on the Blackhorse Boardwalk. A photo/observation blind is located on Pine Lake. A 5.5 mile long self-guided Auto Tour Route winds through pine forest, past lakes and basalt rock outcrops and is open year-round.

Except for the Columbia Plateau Trail, all visitor facilities are located within the Public Use Area, a 2,200-acre area in the southeastern portion of the Refuge. The public is not allowed access to the other areas of the Refuge except by special permit. The Public Use Area comprises approximately 14 percent of the total 15,656 Refuge owned acres. See Map 13 for details of facilities within the Public Use Area.

The Refuge Environmental Education Classroom is maintained for hosting onsite activities for schools and organized groups of all ages. The classroom contains numerous animal mounts and skins, live specimens, track casts, preserved aquatic invertebrates, pressed plants, a landscape mural, and other natural history specimens. Through the assistance of over 100 volunteers and a fiscal year 2000 challenge grant, the building's interior was completely renovated during the winter of 2000-2001. In this remodeling, a corner of the building was designated for the Refuge's Friends group who opened a small store specializing in nature books, T-shirts and sweatshirts, and other articles. Profits from this store, which is staffed entirely with volunteers, go directly toward the Refuge's Environmental Education Program.

An accessible public restroom (located a quarter mile west of the headquarters) and four vault toilets are located within the Public Use Area and maintained for the visiting public. Another vault toilet is located along the Columbia Plateau Trail, near Ballinger Lakes.

Funds are being sought for design and construction of an information kiosk that will be placed near the public restrooms at the start of the Auto Tour Route.

Insert Map 13. Existing Recreational Facilities within the Public Use Area

The Refuge maintains a fee station near the public entrance on Smith Road. Visitors pay \$3 per car per day.

Trails

Table 3-3 displays the current trails located on the Refuge, together with the kind of surface, use, and length, in miles, of each trail.

Native Surface Trails: The Refuge Public Use Area has an estimated 7.7 miles of trail, some of which originated as maintenance roads. Most are short trails that terminate at a wetland. The Pine Lake Trail follows segments of shoreline along Winslow Pool and Pine Lake, meandering through ponderosa pine forest before looping back to wetlands again. This old service road has been converted to an asphalt surfaced accessible trail. The Bluebird Trail follows an old road along the eastern boundary of the Public Use Area and intersects the auto tour route near Kepple Lake.

The Headquarters Trail begins at Refuge Headquarters and follows the chain of Pine Creek wetlands south to Cheever Lake, ending at a riparian area below the lake. The Bluebird Trail and the Headquarters Trail both double as service roads and need to be graded annually.

In addition, each of the EE sites on the auto tour route have a short loop trail ($\frac{1}{2}$ to $\frac{3}{4}$ mile) winding through wetland, grassland, forest and riparian habitat. Volunteer groups are recruited to replace the bark on the EE trails every two years on a rotational basis. This ensures that the trails remain in good condition.

Disabled persons access trail at Blackhorse Lake: The Blackhorse Lake boardwalk (0.2 miles) was built in 1989 and was designed to provide access to persons in wheelchairs. The structure is in need of major reworking to comply with new Americans with Disabilities Act (ADA) guidelines.

Columbia Plateau Trail: In May, 2000, a new trail was opened for public use in the western portion of the Refuge. The Columbia Plateau Trail (CPT) encompasses 130 miles of an abandoned railroad right-of-way extending from East Pasco to Fish Lake near Cheney, and passes through the Refuge. Currently, 23 miles of trail between Lincoln County and Cheney are developed and open to the public. A future connection to the city of Spokane is under development.

Table 3-3 Existing Trails

TRAIL NAME	Surface	Open to:	Length (miles)
Columbia Plateau Trail	gravel	pedestrians, bikers, equestrian	4.75
Kepple Overlook	native	pedestrian	0.23
Kepple Peninsula (interpretive)	gravel/native	pedestrian	0.45
30-Acre Cutoff Trail	native	pedestrian	0.75
East Blackhorse EE Trail	native	pedestrian	0.45
Blackhorse Lake Boardwalk (interpretive)	wooden boardwalk	pedestrian	0.20
West Blackhorse EE Trail	native	pedestrian	0.29
Pine Lake Loop (interpretive)	asphalt	pedestrian	0.90
Headquarters	native	pedestrian	1.55
Bluebird	native	pedestrian	1.96
Total Length			11.53

Trail lengths calculated from GIS coverage (trailsarc)

A Cooperative Agreement was signed on January 25, 1995 between the Washington State Parks and Recreation Commission (WSPRC) and the U. S. Fish and Wildlife Service. This agreement addresses the 4.75 mile section of the abandoned railroad bed that intersects the western portion of the Refuge. Under the agreement, the Service will co-manage the trail through the Refuge portion in the same manner as it manages its Public Use Area, complying with existing rules and regulations pertaining to access and use. A notable exception to the Refuge regulations is that horseback riding is allowed on the section of the Columbia Plateau Trail traversing the Refuge. In addition to authorizing the Service to co-manage the public use section of trail and provide fire management presuppression and suppression activities, the WSPRC will assist the Service with law enforcement, noxious weed control, and maintaining the boundary fence on either side of the trail. The Refuge monitors use on the trail segment that crosses the Refuge.

Visitors may enter the Refuge portion of the trail from Cheney Spangle Road to the north or from Amber Lake to the south; these access points are not on the Refuge. The trail is developed for hiking, riding bicycles, or horses. Visitors using the trail are not required to pay a fee when crossing the Refuge, however, they pay a \$5.00 parking fee at the State managed parking lot.

This new trail creates opportunities for new recreation and environmental education, as well as concerns about potential trail user impacts on adjoining wildlife and habitat. The Columbia Plateau Trail crosses a segment of the Refuge that was closed to public use for over 60 years. A portion of the trail parallels Long Lake, a noted waterfowl production area. Disturbance of nesting waterfowl and other species is a concern. There are four Service roads maintained for management access that cross the trail. Trespass has been noted at these sites.

It is expected that the new trail will eventually become a popular destination for as many as

500,000 visitors each year over its entire length (pers. comm., Fraser, 1999), and the WSPRC expects approximately 20,000 visitors/year to pass through the Refuge portion each year. The trail has been open for approximately five years now. In 2003, the Refuge installed a traffic counter to provide usage estimates. During a five month period (March 23-August 30), 3,575 passages past the traffic counter were recorded. At least some of these included return visits.

Expected increased publicity about the trail will expose many more visitors to the Refuge in the future. To take advantage of this recreation and education opportunity, and to better manage potential user impacts, the USFWS and WSPRC have installed interpretation and education signs along the trail segment through the Refuge. This interpretation will help increase public awareness of this sensitive area and its fragile resources. Trail linkages between the CPT and the auto tour route may also be a consideration to further enhance the visitor experience.

Americans with Disabilities Act (ADA) Compliance

The 2000 U.S. Census found that 19 percent of Americans have disabilities. Approximately half of this number have physical mobility issues (<http://www.census.gov/Press-Release/www/2002/cb02ff11.html>). This number is expected to increase in the future with the aging of the U.S. population.

The Access Board, a federal agency that provides specific accessibility guidelines for buildings, facilities, recreation sites, and transportation devices that comply with the Americans with Disabilities Act can be found at <http://www.access-board.gov/>.

Facilities currently compliant with the ADA are the upstairs portion of the Refuge office, the environmental education building, maintenance building, public rest rooms, four vault toilets, and the Boardwalk.

Two Small Visitor Facility Construction grants were received by the Refuge in 2004 for developing an accessible surface on the Kepple Lake Peninsula Trail and the Pine Lake Loop Trail. Work began on these two projects in 2004 and will be completed in 2005. Kepple Peninsula Trail will have a 1/4 mile packed gravel surface and an accessible observation/photography blind. Two benches will be placed along the trail. The 1.25 mile Pine Lake Loop Trail will have a combination of packed gravel surface and 4 foot wide asphalt surface. Four benches will be placed along the trail edge. The Friends of Turnbull NWR were successfully awarded a grant that purchased two SeaCoast binoculars for placement on an overlook over Winslow Pool adjacent the new accessible Pine Lake Loop Trail.

Facilities in need of upgrades are the Fire Management Office, Helm's bunkhouse, and the photo blind.

3.6.4 RECREATION PROGRAM AND ACTIVITIES AT THE REFUGE

Visitor Preferences

As mentioned previously, in 1999 the Friends of Turnbull National Wildlife Refuge (Friends) conducted a visitor survey to identify visitor use patterns, preferences, and needs related to the Refuge. A total of 531 visitor surveys were administered at nine different locations in Spokane County.

Results of the Friends survey showed that visitors to the Refuge participate in a number of recreational activities (see Table 3.4) with "enjoying nature" being the most popular activity among visitors.

The Refuge keeps its own data and estimates of visitation, including estimates of how many visitors participate in activities of interest. Estimates are entered yearly into a database called the Refuge Management Information System (RMIS). Table 3-5 provides recent data on visitor estimates reported in RMIS. Annual

discrepancies from year to year are a result of a) natural variability in visitation; b) staff member changes and consequent different methods of counting visits; and c) program variability (i.e. funding for EE program can vary substantially from year to year).

Table 3-4. *Most Common Visitor Activities at Turnbull NWR*

Activity	Percent
Enjoying nature	64
Birding	51
Hiking	45
Photography	23
Bicycling	12
Walking a dog	6
Running	4

Source: Friends survey, analyzed by EDAW (1999)

The most accurate numbers from RMIS are the EE program numbers. Because of uncertainty and annual fluctuations, Table 3-5 also includes a "Manager's baseline figure" that is the Refuge Manager's best baseline estimate of *current average* annual visitation by use type. Note that because many visitors participate in more than one activity, the total number of visits is smaller than the sum of visits in individual categories.

Wildlife Viewing and Photography

The focus of current Refuge observation and photography activity is the 200+ species of birds, 45 species of mammals, and 7 amphibian and 10 reptile species that can be observed on the Refuge. Visitors coming to the Refuge utilize the Public Use Area, drive or ride bikes on the auto tour route, and hike trails to see and photograph the variety of birds and mammals inhabiting this relatively undisturbed area of the Channeled Scablands. Often visitors use their cars as blinds. Notably, the Refuge has been identified in the Washington Watchable Wildlife Viewing Guide.

Table 3-5. Estimates of Visitation Reported in RMIS, Years 2000-2002, by Activity

	Visit Category	Manager's Baseline Estimate	FY 2002	2002: percent of total visits	FY 2001	2001 percent of total visits	FY 2000	2000 percent of total visits
I.	Total Number of Visits ^a	30,000	23,970	100%	28,184	100%	28,000	100%
II.	Interpretation and Nature Observation (not sum of below)	20,000	20,357	85%	24,590	87%	26,450	94%
	a. Staff / volunteer conducted	1,600	1,678	7%	441	2%	440	2%
	b. Visitor center	6,000	6,176	26%	5,500	20%	7,050	25%
	c. Admin office	8,000	4,404	18%	7,974	28%	9,105	33%
	d. Kiosks ^b	0	10,403	43%	9,581	34%	0	0%
	e. Nature Trails	20,000	16,745	70%	20,996	74%	24,900	89%
	(foot)	12,000	11,677	49%	5,128	18%	24,900	89%
	(auto)	18,000	10,136	42%	18,432	65%	21,700	78%
	f. Towers/platforms/blinds	50	28	0%	28	0%	7,350	26%
	g. Other Wildlife Observation	6,500	6,500	27%	6,500	23%	800	3%
III.	Environmental Education (sum of below)	9,000	9,489	40%	11,149	40%	8,050	29%
	a. Staff / volunteer conducted	5,500	5,237		8,353		2,500	
	b. Non-staff conducted	3,500	4,252		2,796		5,550	
IV.	Recreation ^c	5,000	4,447	19%	5,327	19%	5,700	20%

^a Total number of visits is not equal to the sum of any of the particular categories, since many visitors participate in more than one activity.

^b Fee station visits were counted as kiosk visits in FY 2002 and 2001 but not in FY 2000.

^c "Recreation" category IV includes other non-wildlife dependent recreation such as biking, cross-country skiing, etc.

Interpretation

The Service is revising a 1986 Interpretive Prospectus. This document outlines the media and messages for each interpretive site.

Interpretive trails are generally short trails designed especially for the educational benefit of the casual or new Refuge visitor. Interpretive trails allow people to receive self-guided educational information through multiple signs or other media as they pass along a trail. Currently the Refuge has one interpretive trail at the Boardwalk (West Blackhorse Lake) with five signs. Another interpretive trail is being designed at Kepple Peninsula, with posts sunk

into the ground at key points. Visitors will be able to pick up a brochure which describes the habitats and wildlife that can be seen at each post. The Columbia Plateau Trail also has multiple interpretive signs, but is not short nor likely to be frequented by the casual visitor, thus it is not considered an interpretive trail like the other two mentioned above.

Environmental Education

An important component of recreation on the Refuge is the extensive Environmental Education (EE) program. Although the Refuge has had some form of environmental education for most of its existence, the program has

greatly expanded in the past ten years. Currently 3,500 to 9,500 students are reached annually through Turnbull's EE and outreach programs (dependent on grants, donations, and annual discretionary funding).

The highest use period for EE on the Refuge is late March to mid-June.

Over 85 school groups (K-12) from Spokane County and surrounding areas have participated in the Program. Moreover, numerous civic groups, from preschool children to senior citizens, are provided field trips, night hikes, tours, in-classroom activities, and guided nature walks on the Refuge throughout the year.

An EE classroom with capacity for 50 students and four designated outdoor study sites on the Refuge are the key facilities used and maintained for the EE Program. Each study site is designed to provide nature walks, studies in aquatic ecology, and a seating area for instruction and activities. The outdoor classrooms are used on a rotational basis to minimize disturbance. Classroom sessions preceding or following the outdoor field work have been found to be very helpful in reinforcing the learning objectives.

EE program focus and learning objectives:

The goal of the program is to instill a sense of environmental awareness and responsibility within individuals and communities. The program is designed to motivate participants to make wise decisions concerning the use and

conservation of natural resources. Following are the overall EE program objectives:

1. Involve participants in all areas of the Refuge ecosystem by providing an activity-based curriculum.
2. Inform, involve, and motivate people to be aware of and active in the operation and health of their ecosystems by providing environmental education materials and activities.
3. Build a responsible environmental ethic in our constituency by developing programs and activities for visitors.
4. Increase conservation background knowledge by providing ongoing training for regional teachers, college interns, and volunteers in ecosystem ecology and interpretation.
5. Involve students and educators, interested citizens and U.S. Fish & Wildlife personnel in evaluating the program to better meet the changing needs of the community.
6. Cultivate the program and its partnerships to become a model for regional, state, and national environmental education efforts.

Activities for students of all ages centers on four programs: Turnbull Spring Field Trip, Summer Interpretive Project, From Earth and Sky-The Natural World Fall Field Trip Project, and Discover Wildlife Outreach Project winter activities. Each EE program is designed with a curriculum and specific learning objectives tailored to the different grade levels.

The EE program is overseen by one permanent full-time staff (GS-9 Supervisory Park Ranger). The program is almost completely facilitated

The From Earth and Sky Fall Field Trip

Grades 3 & up learn about the seasonal rounds of Northern Plateau peoples. Students are guided through hands-on activities such as building tule-mat shelters (Summer), hunting (Fall), listening to traditional stories in Salish and English (Winter), and learning about native plants and root-gathering tools (Spring). Throughout, students discover the role that native species play in tribal living and habitat stewardship.

An example learning objective for this project: 80 percent of participating students will understand the term semi-nomadic and the importance of seasonal cycles to the Northern Plateau culture.

with the help of AmeriCorps volunteers, Student Conservation Association volunteers, other local volunteers (e.g., university students, retired educators). Staff focuses effort on training teachers; workshops are offered annually for teachers leading self-conducted classes. Trained volunteer facilitators donate approximately 5,000 hours/year to the EE program. These EE facilitators provide spring field trips, conduct classroom and outdoor activities on the Refuge and provide environmental education and outreach to the public through fairs, expos, and in-classroom presentations to local schools.

The important regional role of the Refuge's EE Program is reflected in the fact that the program typically has far higher demand than it can meet and that school groups have occasionally come from as far away as Yakima to participate in the program. The services offered by the Refuge are a significant component of the environmental education program in these schools, and provide valuable training to educators as well. The popularity of the EE Program is a reflection of the growing importance of environmental education as a component of classroom learning (Everett and Dedrick 2000).

The EE program has operated with a limited amount of annual operational funding from the Fish and Wildlife Service. Much of the necessary funding to support volunteer stipends and contract employees has been obtained through grants and fund raising efforts by the Friends of Turnbull NWR. A secure source of annual funding is necessary to enable this program to expand as future demand increases.

Hunting

Hunting and trapping were once popular activities in the area with settlers before the Refuge was established. Limited information suggests that deer, antelope, or elk hunting could have occurred near or within the Refuge (Holstine et al 1992). In the 1930s when the Refuge was established the prevailing public view was that there should be no hunting at the

Refuge. The original advocates for Refuge establishment included the Spokane Sportsman's Association, who wanted a sanctuary where hunting would not be permitted. They hoped to create a place where wildlife could flourish and act as a source for adjacent hunted lands. Hunting was not then and has never since been permitted at the Refuge.

In 1959, the Washington State Department of Game (WSDG) conducted an informal survey to explore opening a portion of the Refuge to public waterfowl hunting. The WSDG contacted individuals, including the Regional Director of the National Wildlife Federation for the states of Oregon, Washington and Alaska.

A general consensus of those contacted was that the Refuge should remain closed to hunting, at least until fully developed.

The 1966 Refuge Master Plan (USDI 1966) also explored hunting big game, including deer and elk, on the Refuge. After thorough evaluation, the Service determined not to open the Refuge to hunting at that time. The rationale was based on the fact that at that time, there was no biological reason to reduce the big game population on the Refuge. Conflicts that could occur between a big game hunting season and migratory waterfowl hunting season as well as cattle grazing were also noted.

In May, 1987, the State and Service re-visited the issue of opening up the Refuge to white-tailed deer hunting. In response to this hunting proposal, the Refuge received over 1000 responses, with a 7-1 ratio against the idea of allowing hunting inside the Refuge (Cheney Free Press 1987). Because of the overwhelming opposition, the Service decided not to move forward with the proposal.

Some hunting advocates have expressed the desire to see the Refuge opened to elk hunting, primarily as a way to mitigate for some depredation that occurs occasionally on adjacent lands.

Elk: See the Elk Management section above (Section 3.4) for more detail on elk hunting.

Waterfowl: Waterfowl hunting on the Refuge has seldom been an issue with the hunting public. During recent public meetings, participants were nearly unanimous in their opposition to the opening of waterfowl hunting on the Refuge. Although the local officials of the Washington Department of Fish and Wildlife have not approached the Refuge concerning a waterfowl hunt, some interest was expressed for a hunt at the State Office level.

Interest in waterfowl hunting may also be tempered by the relatively low use of the Refuge vicinity by waterfowl in the fall. Fall waterfowl populations on the Refuge are fairly irregular as a result of periodic drought and early freeze up that limits the availability of open water. Waterfowl numbers are considerably lower than occurred in this area historically as a result of the drainage of many of the permanent and semi-permanent wetlands and the development of irrigated agriculture in the arid steppe of Columbia Basin to the west (made possible by the Coulee Dam Project). These changes have shifted the fall migration to the farm fields, reservoirs and wasteways of the lower Basin.

When wetland and weather conditions result in good fall migration habitat, a portion of the southern migration still utilizes the restored wetlands of the Refuge and undrained deeper water habitats of the Study Area. Refuge waterfowl counts indicate that numbers peak in mid-October in most years. In these good years, peak counts of mallards range from 10,000 to 25,000 birds in late October and represent 75 percent of the fall waterfowl populations. Other duck species peak earlier in October. By mid to late November Refuge wetlands freeze up in most years resulting in a forced emigration of most waterfowl with the exception of smaller populations of goldeneyes, Canada geese and a few hardy mallards. This relatively narrow window of available habitat limits waterfowl hunting opportunities in this area.

Turkeys: Only one native upland game bird - ruffed grouse - is found in the area. Other upland game birds inhabiting the area are non-native and have spread from releases.

Information on population size and population growth is lacking with the exception of incidental observations. Observations in other areas where the Rio Grande sub-species has been introduced indicate that populations can build quickly without hunting to remove some of the annual growth. The potential impact this growing population of a non-native gamebird may have on native wildlife is largely unknown. After an extensive literature review Refuge staff found no work done on this subject with regards to wild turkeys.

Fishing

Historically, all Refuge wetlands with the exception of Pine Creek were fishless. This condition resulted in an aquatic ecosystem based on the absence of a significant vertebrate predator. In 1954, the State planted five to six inch rainbow trout in three of the Pine Creek wetlands. A second planting occurred in 1955. In 1956, the State began taking eggs, up to 90,000 total. However, the State subsequently decided to abandon the project for several reasons, including the tendency of spawners to go downstream, a conflict between spawning season and high spring run-off, and a summer die-off due to high water temperatures and low oxygen content (USDI 1966). As a result, the Refuge has never provided notable opportunities for fishing. A few exotic game fish do continue to survive in these lakes. The Refuge has no intention to plant non-native fish again, since maintaining the biodiversity and proper function of Turnbull wetlands requires that they remain fishless as they were historically.

According to a recent study of the area's regional recreational supply and demand, fishing opportunities appear to be sufficiently available in the Refuge vicinity at the many surrounding lakes and rivers (Everett and Dedrick 2000). See more in Section 3.7.

Other Recreation

Some visitors hike or ride bicycles on the Refuge in addition to or as support for wildlife observation activities. Hiking and observation trails were described above. Bicycling is allowed on the entrance road, auto-tour route, and the Columbia Plateau Trail (CPT). Unauthorized bicycle use has occurred on foot trails in the Public Use Area and on service roads in the closed section of the Refuge by obtaining access from the auto tour route, Cheney Plaza Road and the CPT.

A few visitors jog or cross-country ski in the Public Use Area. Additionally, the public may participate in a variety of community service projects, such as trail maintenance, riparian planting, or weed control. Special events are sometimes hosted for the public, including bird walks, volksmarches, and various tours.

Activities Currently Prohibited on the Refuge

Activities that are not currently permitted on the Refuge include hunting, fishing, boating, off-road vehicle use, horseback riding (except on the Columbia Plateau Trail), camping, and on-ice activities. Typical law enforcement matters deal with unauthorized uses such as trespass into the closed areas, illegal taking of Refuge plants and wildlife, dogs off leash, mock military exercises, artifact collecting, illegal hunting, and overnight camping

3.7 REGIONAL RECREATION PERSPECTIVE

As part of preparation of this CCP, the Service contracted with EDAW consulting firm to understand the current and potential future role of the Refuge related to recreation. This report (Everett and Dedrick 2000) characterized the existing regional supply of compatible recreation relative to the Refuge and also presented state data for future trends in recreation needs. This data is useful in planning for the types of recreation activities and facilities provided at the Refuge over the next

15 years and beyond. The following text in Section 3.7.1 summarizes data from that report.

3.7.1 NEARBY RECREATIONAL OPPORTUNITIES

Within a 2-3 hour drive from Turnbull, there are numerous outdoor recreation opportunities that are managed by a variety of federal, state, local, and private entities. These resources include lakes, rivers, other Refuges, a ski area, interpretive facilities, wildlife management areas, Forest Service and BLM lands, and developed parks. Of the six Refuge-system priority uses, opportunities for viewing wildlife are probably most plentiful in the vicinity, while opportunities for environmental education and hunting are the least plentiful.

A small state agency known as the Interagency Committee for Outdoor Recreation (IAC) advises the State of Washington on matters of outdoor recreation. The IAC conducts inventory of outdoor recreation sites and opportunities, conducts studies of recreational participation and preferences, and periodically releases documents related to overall State Comprehensive Outdoor Recreation Planning (SCORP). The IAC divides the state into 13 regions to present information on regional recreation supply. Turnbull NWR is in Planning District 12, which includes Spokane and Whitman counties. As of 1995, there were a total of 362 local, state, federal, and private recreation sites in this region (6 percent of the state total) totaling 49,753 developed acres (4 percent of the state total). Local entities manage almost 80 percent of the sites, while the State of Washington has the greatest quantity of developed acreage (21,833 acres).

Fishing/aquatic recreation opportunities

The Channeled Scablands provide a unique setting for abundant small-lake fishing, boating, wildlife observation/photography, and camping opportunities. Within 2 to 15 miles from the Refuge, 13 recreational lakes (Chapman,

Philleo, Williams, Amber, Badger, Fish, Fishtrap, Hog, Silver, Clear, West Medical, Medical, and Rock Lakes) provide a diversity of water-oriented public recreational activities including fishing, boating, swimming, and camping.

Closest to the Refuge, Chapman Lake (146 acres) is located 2 miles south of the Refuge and is one of the deepest lakes in northeast Washington. This lake abounds with game fish, including silvers (kokanee), perch, crappies and trout. As such it is popular with anglers and offers a small private resort called Chapman Lake Resort. The State DNR owns the water and some adjacent land, however fishing access is private and not public. The lake is bordered by various landowners but seems to be managed in common to facilitate fishing. Maximum boat speed allowed is 5 mph. A resort located on the lakeshore has camping, cabins, store, and hookups.

Hunting

Many local residents utilize private lands in the area for hunting, negotiating access with friends or neighbors. The nearest community hunting area within the vicinity is located at Philleo Lake, on the eastern boundary of the Refuge. The upper end of Philleo Lake is owned by two private duck clubs who offer hunting and fishing opportunities to approximately six club members.

State and federal lands, some nearby and some located at some distance, provide various hunting opportunities. Bureau of Land Management provides hunting at Fishtrap and Hog Lakes about 10 miles southwest of the Refuge. The US Fish and Wildlife Service offers a range of hunting opportunities at Little Pend Oreille National Wildlife Refuge (90 miles north of Turnbull) and Columbia National Wildlife Refuge (100 miles southwest of Turnbull). Washington Department of Fish and Wildlife provides hunting at Swanson Lakes Wildlife Area (60 miles northwest of Turnbull).

Hunting opportunities are plentiful in other areas of northeast Washington and nearby in the Idaho Panhandle, specifically on the numerous National Forests, Wilderness Areas, and other lakes and rivers in the region.

Environmental Education / Interpretive Centers

Riverside State Park, located 25 miles north of the Refuge in Spokane, offers an interpretive center and wildlife viewing opportunities. Liberty Lake County Park, located about 30 miles northeast of the Refuge, offers interpretive facilities and an accessible boardwalk. This park is also used for EE programs by a local school district. Similar opportunities are available at Heyburn State Park at the south end of Lake Coeur d'Alene in Idaho, about 50 miles east of the Refuge. This State Park features developed wildlife viewing areas, including an interpretive center.

Hiking

All of the nearby larger state and county parks also offer a variety of recreational opportunities including hiking, biking, skiing, wildlife observation/photography, camping, boating, fishing, and swimming. These include Mt. Spokane State Park, Riverside State Park, Liberty Lake County Park, and Heyburn State Park in Idaho. Planning District 12 showed a significantly lower portion of trail mileage than other planning districts delineated by IAC (1 percent of the state total); however, the trail total predated opening of the Columbia Plateau Trail (IAC 1990; IAC 1995).

Wildlife or Nature Observation

Turnbull NWR is the primary location within Planning District 12 focusing on wildlife observation, however incidental wildlife and nature observation are provided in all or most of the other natural areas described above. Spokane County also owns 4,609 acres of open space, which offers some recreational /open space opportunities to area residents (Spokane

County 2002). The County's goal is to manage these areas in a way that preserves and creates natural habitats while enhancing the quality of life for the residents of Spokane County.

Whenever possible, efforts are made to coordinate these objectives with other resource management agencies such as the USFWS, WSPRC, and WDFW.

3.7.2 RECREATIONAL ACTIVITY SPECIFIC TO THE STUDY AREA

Very few developed recreational sites occur within the Study Area designated for this CCP. However, Refuge staff is aware of the following uses:

- Chapman Lake has fishing, boating, and swimming and is described above.
- Hunting occurs by landowner permission, since there are few public lands available for hunting within the Study Area (DNR owns about 875 acres). The kinds of hunting that occur are upland birds, big game, and some limited waterfowl hunting.
- Philleo Lake has waterfowl hunting opportunities as described above.
- The Columbia Plateau Trail traverses the southwest corner of the Study Area. The trail is open for hiking, biking, and equestrian use.
- There is frequent bicycling that occurs on the County roads within the Study Area, including bike meets.
- Waterskiing and jetboat use is infrequent, but may be increasing.
- Swimming occurs in the lakes.
- The Eastern Washington University cross-country track team runs throughout the Study Area.

- There is casual wildlife observation here and there (Philleo Lake has pelicans).
- There is a privately owned horseback riding stable where people board horses. There aren't however, any trails that they maintain for people to use. Except for the Columbia Plateau Trail, there are no other equestrian trails known.
- Hiking and walking may occur in small quantities around the lakes
- There is one balloonist who frequents the area.

3.7.3 STATEWIDE AND REGIONAL PARTICIPATION RATES AND TRENDS

Current Participation Rates

The most recently released SCORP Assessment (IAC 2002a) identified 14 major categories of outdoor recreation, subdivided into 170 activities. Of these 14 major categories, walking / hiking and nature activities figure as the two most popular, with 53 percent and 43 percent of Washington state residents participating in these activities, respectively. The IAC also indicated that observing / photographing nature and wildlife have participation rates of 42 percent, and visiting interpretation centers has a participation rate of 7.5 percent.

IAC's 1990 and 1995 reports also provided participation rates, subdividing by Region. Region 4 (Eastern Washington) is a destination for fewer visitors compared to the other three SCORP planning regions in the state. One reason for this is the region's distance from the Puget Sound, where most of the state's residents live.

Compared to other regions in the state, Region 4 attracts the highest statewide percentage of hunters, with about 18 percent of all hunting trips in the state occurring in this region (IAC

1990). Most (94 percent) of all hunting in the state is done by Washington residents.

Forecast of Future Regional Recreation Demand and Key Recreation Needs Identified by IAC

Overall, outdoor recreation activity in most activities continues to increase at high growth rates. In a recent technical report (IAC 2002b), IAC projected future participation in 13 of 14 major outdoor recreation use categories over periods of 10 and 20 years. Nine of these activities will experience double digit growth (see Table 3-6).

These most recent estimates of recreation trends were based on the National Survey on Recreation and the Environment Projections for the Pacific Region (NSRE), which includes Washington State. IAC adjusted the NRSE projections as necessary based on age group participation, estimates of resource and facility availability, user group organization and representation, land use and land designations; and “other factors” including the economy and social factors. Table 3-6 shows the percent change expected for Washington State by activity as reported by IAC.

The 1995 assessment identified trails and environmental education as the two highest outdoor recreation needs in the state. As depicted in Table 3-6, the kinds of uses that are compatible at Turnbull NWR are expected to show increases of 20 percent to 40 percent over the next 20 years. The exception is hunting, in which participation is expected to fall at about that same rate.

If estimates from the 1987-2000 projections (IAC 1990) hold true for this next 10-20 year period, growth in activities will be somewhat lower in Eastern Washington compared to the state as a whole. This smaller percentage increase is due in part to the relatively smaller population growth (in terms of the actual number of people) in this part of the state as compared to the more populous and rapidly growing Puget Sound area. The population growth in the Puget Sound area and elsewhere in the state fuels much of the growth in outdoor recreation activity participation (see discussion in Section 3.11 Demographics / Social Setting for an understanding of population growth within the vicinity and within Washington State as a whole).

Table 3-6. Projected Future Increase in Participation for Selected Outdoor Recreation Activities

Activity	Estimated Change Next 10 Years (2002-2012)	Estimated Change, Next 20 Years (2002-2022)
Walking	23%	34%
Hiking	10%	20%
Nature Activities (includes outdoor photography, observing wildlife and fish, gathering and collecting, gardening, and visiting nature interpretive centers)	23%	37%
Sightseeing (includes driving for pleasure)	10%	20%
Bicycle Riding	19%	29%
Cross Country Skiing	23%	No estimate
Hunting / Shooting	-15%	-21%

Source: IAC (2002b).

3.8 RESEARCH

3.8.1 BACKGROUND

Since the first lands were purchased establishing the Refuge, research projects (ranging from undergraduate class projects to post-doctoral studies) have been completed on the Refuge. In the past decade, the Refuge has hosted between 3 and 6 research projects annually. Research topics covered have included; parasitology of reptiles, wildlife habitat relationships, limnology, nesting ecology of waterfowl and cavity nesting birds, roosting ecology of bats, predator/prey interactions, effects of management actions on wildlife populations and habitats, evolution of predator defenses in zooplankton, insect/plant co-evolution, fire effects on the ecology of individual plant species, plant communities, animal/plant relationships, and impact of herbivory on plant growth and development.

Although researchers from as far away as University of Illinois, the University of Alberta, Canada and the University of California at Santa Cruz have conducted studies on the Refuge, the large majority of researchers have come from local colleges and universities including Eastern Washington University, Washington State University, Gonzaga University, University of Idaho, and the University of Washington. Eastern Washington University, which is just a few miles north of the Refuge in the City of Cheney, has been the most active.

The Refuge has worked with several of these universities to complete research directed at filling information gaps that hinder the development of management strategies to achieve wildlife and habitat objectives. This type of research is given priority in the approval process. The Refuge maintains a research needs list that is shared with potential researchers.

All potential researchers are required to submit a research proposal for review and recommendation by the Refuge Biologist and approval by the Refuge Manager. The Refuge has limited on-going research projects to six per year.

Proposals are reviewed for their potential benefit to the Refuge, Ecoregion and Region, their compatibility with the Refuge purposes, and the possibility of conflicts with on-going studies, Refuge monitoring efforts and management activities. Once a project is approved, a Special Use Permit is issued that may stipulate certain special conditions to minimize impacts to Refuge resources and conflicts.

3.8.2 TURNBULL LABORATORY FOR ECOLOGICAL STUDIES (TLES)

Eastern Washington University has operated a research facility on the Refuge under a cooperative agreement with the Service since 1973. This is the only facility of this type in the National Wildlife Refuge System. Its presence on the Refuge has resulted in a strong research relationship with the University which has resulted in a number of important studies beneficial to the understanding and management of Refuge habitats and wildlife.

The original cooperative agreement signed in 1973 allowed the University to construct and operate a facility within the boundaries of the Refuge for the purposes of conducting classes and environmental and biotic studies that would assist the Service in accomplishing Refuge objectives. The architectural design, plans, exterior colors, specifications, construction and location of the laboratory were all subject to Service approval. The University was required to comply with all Federal and State laws applicable to Turnbull NWR as well as with federal and state water quality standards for release of effluent from the operation. All research and study projects undertaken by the University that involve the use of the Refuge are to be approved in advance by the Service. The Service has the right to restrict the University from engaging in any projects when the Service determines that it is in its best interest to do so. Use of the lands upon which the laboratory is located and all use of the premises outside the building are coordinated with and subject to the approval of the Refuge Manager and will be

compatible with Refuge objectives and operations. The Service may terminate this agreement for failure of the University to comply with any or all of the terms or conditions. This agreement was in effect for a period of 15 years. It was renegotiated in 1988 and was reauthorized in 2004. The University has expressed a desire to expand the facilities which will have to be addressed during the renegotiations.

In order to assure that the University is in compliance with the terms of the agreement, the Refuge meets quarterly with the laboratory directors and the facility is regularly inspected. At the quarterly meetings, the Refuge receives an updates on activities at the laboratory and the Refuge addresses issues associated with reporting on research projects, compliance with Special Use Permits and operational concerns.

3.9 SPECIAL STATUS LANDS

Two Research Natural Areas (RNAs) are found within the Refuge: Turnbull Pines and Pine Creek RNAs. Research Natural Areas are part of a Federal system of such tracts established for research and educational purposes. Each RNA constitutes a site where some natural features are preserved for scientific purposes and natural processes are allowed to dominate. Their main purposes are to provide:

- 1) baseline areas against which effects of human activities can be measured;
- 2) sites for study of natural processes in undisturbed ecosystems; and
- 3) gene pool preserves for all organisms, especially rare and endangered types.

It is important to note that research on the Refuge is not limited to the RNAs. Research activity occurs in all areas of the Refuge. The RNAs do not contain enough habitat diversity nor are they large enough to function as complete representations of the Refuge, thus there has never been a compelling scientific reason to confine research to the RNAs.

According to the Standards and Policy Guidelines issued for Research Natural Areas (Dec., 1976 revision):

an RNA is a physical...unit in which current natural conditions are maintained, insofar as possible. These conditions are ordinarily achieved by allowing natural physical and biological processes to prevail without human intervention. However, under unusual circumstances, deliberate manipulation may be utilized to maintain the unique feature that the Research Natural Area was established to protect...Restoration should be initiated on an Area that is no longer valued for its established purpose...Manipulation may be required to restore an Area...

Another guideline states:

Intense recreational use is not compatible with the objectives of Research Natural Areas. There may be some Areas where observational recreation can be conducted without prejudicing Area values. Other recreational activities such as rock collecting, berry picking, hunting, and fishing should not be encouraged, and should be prohibited if they are incompatible with Area objectives.

3.9.1 TURNBULL PINES RNA

Turnbull Pine RNA was established in 1966 to exemplify “nearly pristine ponderosa pine savanna at the transition from forest to grassland and a series of freewater potholes characteristic of the Channeled Scablands” (Franklin et.al. 1972). Measuring a total of 197 acres, it is located along Cheney Plaza Road, surrounding the Turnbull Laboratory for Ecological Studies. The tract is mostly ponderosa pine forest with a few scattered groves of quaking aspen and wetlands.

Turnbull Pines gets more research use due to its greater proximity to the TLES. University class projects are frequently sited there.

While the first round of forest habitat management projects is underway, Turnbull Pines will be managed as a control area (until completion of all other uplands habitat management units - i.e. no tree removal or fire management over the next twenty years). There are a few other control areas on the Refuge, including Kepple Butte and the area north of Turnbull Slough. Once the forest thinning projects prescribed by the Habitat Management Plan have been completed in the rest of the Refuge, the Turnbull Pines RNA may also receive thinning and fuels treatment. In 2002, 40 acres were manually thinned just inside its northern boundary as part of a Wildfire Urban Interface (WUI) project.

3.7.2 PINE CREEK RNA

Located near the eastern boundary of the Public Use Area, the Pine Creek RNA was also established in 1966 to exemplify “relatively undisturbed savanna of ponderosa pine and bunchgrasses found in the forest-grassland transition at the northeastern edge of eastern Washington’s steppes” (Franklin et. al. 1972). This RNA measures 160 acres. Cheatgrass was noted in the southern half of the RNA by authors of the 1972 handbook (Franklin et.al. 1972) and the handbook notes that “the area must be considered disturbed by livestock grazing.”

In 1989, the Washington Natural Heritage Program surveyed the RNA and adjacent Refuge land. The survey report (Gamon 1990) recommended that the existing RNA should be expanded. The rationale stated involved incorporating a greater expanse of ponderosa pine forest, two populations of yellow lady slippers (*Cyproptidia parviflora*, state threatened), a vernal pool with tufted hairgrass, a geologic feature of note known as stonetet scabland, and the complete watershed of one of the larger wetlands. The expansion would have doubled the size of the RNA. Although the Refuge Manager applied to expand the RNA boundaries in 1990, no expansion was authorized.

There is some concern that opening of the stands in forest habitat management may have a negative effect on *C. parviflora*. Under current Refuge management practices, there is an 82-foot zone around the wetlands in which mechanical equipment is not allowed (exceptions are made for particular wetland restoration activities).

C. parviflora populations are usually found within this 82-foot zone and will be protected by this management practice in numerous locations outside the RNA. Thus the expansion of the RNA is not seen as critical for protection of this species.

As part of the HMP planning process, the Refuge examined the features for which Pine Creek RNA was designated. After doing so, the Refuge deemed that certain active management activities were necessary. In particular, overstocked stands of ponderosa pine threatened the long term sustainability of this RNA. As a result, the Refuge obtained permission to thin this RNA in 2001. RNA policy guidelines (Dec. 1976) normally prohibit commercial operation in RNAs, but fire management (without logging to prepare stands) has always been permitted in RNAs. After this thin, the Refuge intends to maintain the RNA stand condition with fire.

3.10 CULTURAL RESOURCES

3.10.1 NATIVE AMERICAN OVERVIEW

Comparisons of point forms and related archeological findings at Turnbull NWR with radiocarbon dated collections from surrounding areas indicates that human presence in the Channeled Scablands of eastern Washington dates back at least 8000 years. At the time of historic contact the area encompassing the Turnbull NWR was within the territory of the Upper Spokane Indians. Their territory included areas around the upper mainstem and tributaries of the Spokane River. They were bordered on the west by the Middle Spokane Indians which occupied the middle portion of the Spokane River and to the east by Coeur d’Alene Indians

which occupied the areas surrounding Coeur d'Alene Lake, Coeur d'Alene River and the upper most portion of the Spokane River. To the south their neighbors were the Palus Indians. The Spokan Indians and their neighbors are considered part of the Plateau Culture whose major characteristics included a heavy reliance on salmon and other aquatic foods; highly developed fishing techniques; joint occupation of resource areas; expansion of kinship ties through intermarriage; development of extensive trade networks; and a simple political organization formed at the village level (Holstine et al. 1992).

The Spokan and other Columbia Plateau people were semi-nomadic, carrying out subsistence hunting, gathering and fishing by making frequent, calculated moves to identified resource areas during different seasons (i.e., seasonal subsistence rounds). This semi-nomadic strategy allowed them to collect food sources for nine months of the year, then live on stored foods for the hardest months of the winter. Semi-permanent winter villages of the Spokan people were often situated adjacent to principal salmon fishing areas while temporary camps were set up at root digging grounds, berry collecting areas, and hunting locations. Salmon resources were not present at Turnbull NWR, and therefore the closest winter villages were located near fishing stations likely at Hangman Creek (Latah Creek) 10 miles east of the Refuge, and along the Spokane River about 15 miles to the north (Holstine et al. 1992). While the Refuge lacks anadromous fish resources, it and adjacent areas had several other major traditional Native American food resources, especially bulbs and roots, waterfowl, waterfowl eggs, turtles, and marmots (Holstine et al. 1992, Bernard 1947). Deer, elk, and possibly antelope were also found here and may have been hunted, although the principal locations for hunting large game as well as for berry collecting were in the highlands north of the Spokane River. The only documented seasonal settlement in proximity to the Refuge was identified at the site of present-day Cheney, Washington. Accounts of local settlers say it was a gathering place during June or July for camas digging and for other activities

including horse racing, gambling, and trading. Most likely many other campsites were also scattered about the landscape (Holstine et al. 1992).

Based on both their abundance and variety, bulbs and roots were probably the most significant resources found at the Refuge. Historically, Indian people from at least two separate groups are known to have harvested plant resources on the Refuge. The Spokan and Coeur d'Alene people came here in the spring to dig the roots of camas, kous, bitterroot, and wild onion (Holstine et al. 1992, Bernard 1947). Land use practices of the early Euro-American settlers, especially draining, tilling, and grazing, reduced the quantity and distribution of camas and other native plant foods both on and off the Refuge (Bernard 1947), however several large stands of camas remain viable today (Holstine et al. 1992). After the creation of the Refuge, Native Americans were allowed to use some of the camas fields until the 1940s when this use was stopped due to concerns of impacting spring nesting of waterfowl (Holstine et al. 1992). More recently permits for root collecting have been granted almost yearly to various Spokans. Today's Native American collecting activities on the Refuge are primarily focused on teaching the younger generation traditional gathering methods.

3.10.2 EURO-AMERICAN OVERVIEW

In the early 1800s, most fur traders avoided the present day Refuge area when they traveled the Channeled Scablands from northeast Washington to the Snake River. All of the major travel routes in eastern Washington bypassed this area because travel through wetlands was always difficult. From 1859-1862 however, the U.S. Army constructed a 624 mile long road between Fort Walla Walla and Fort Benton on the Upper Missouri River in Montana. Named the Mullan Road after Lt. John Mullan who directed its construction, it crossed the southeast corner of the present Refuge. While the Mullan road was infamous for being washed out and rough going, the

portion crossing the open grasslands of the Refuge was probably one of the better stretches and was maintained as a principal route of localized travel for people who later settled along the road (Holstine et al. 1992).

Settlement on the Refuge lands occurred later than other areas of the Pacific Northwest because of the obstacle posed by the wetlands. Daniel Percival became the first settler to own land there when he purchased 120 acres in 1877. Most wetland settlers combined stock raising with grain and hay production to make a living. Many of the early residents hunted or hauled freight to supplement their income. In 1880, a road was built that crossed the northern edge of the Refuge with bridges across the low marshy areas. This new improved road gave the few wetland settlers connections to nearby outposts of civilization, and a stage coach service between Cheney and Spangle began. By 1881 the Northern Pacific Railway Co. had laid track from Portland to Spokane. With it came new economic opportunities for local residents including providing timber for railroad ties and selling oats and hay (Holstine et al. 1992).

Cyrus Turnbull and his wife Mary Jane Williams built a cabin at the north end of Turnbull Slough and lived there with their children from 1880 - 1886 before moving to Idaho Territory. While Cyrus listed his occupation as farmer in the 1885 Auditor's census of Spokane County, family accounts indicate that hunting commanded the greatest share of his energy and interest while he lived on the Refuge (Holstine 1992). His oldest son Oliver distinctly remembered his father's tamed wild geese which were used as decoys (Bernard 1947). It is not known whether Cyrus Turnbull settled in the wetlands for the purpose of making a living from hunting, but in those days skillful hunters could earn a living providing wild meat to the newly established and rapidly growing town of Cheney (Holstine 1992). Cyrus Turnbull was not the first settler of the wetlands, never owned land there, and stayed only six years, yet his contemporaries named the area after him. Perhaps his success as a hunter may have inspired his neighbors to name his

primary hunting grounds after him (Holstine et al. 1992). The foundation of Turnbull's cabin was still visible in 1946 (Bernard 1947), however the site has not been found in recent years.

When the nearby transcontinental railroad line was completed in 1883, settlement accelerated to a flood as emigrants from the Midwest and East Coast arrived to claim or purchase vacant lands for farming and speculation. Settlement decreased during the Depression of 1893 and increased again in the early 1900s. Most of the residents on Refuge lands became subsistence farmers who dug ditches to drain their land. Cooperative drainage districts were later formed to drain more water over a larger area. Most of the drained land was unfit for long-term crop growing (Holstine et al. 1992).

In 1906 the Spokane, Portland, and Seattle Railway (SP&S) started construction on a regional railroad to provide more direct access to Portland for Spokane area produce and passengers. The line went through what is now the western portion of the Refuge. Construction required extensive blasting through basalt rock, which old-timers claimed was responsible for lowering the water table in the wetlands. Sometime during the railroad construction, crews of Italian laborers built rock ovens within the present Refuge. The workers baked bread in the ovens. Another strikingly similar oven is located in the Refuge but not near the railroad. This oven was possibly built by a settler who may have copied the technique used by the Italian laborers or it could have been constructed in association with ditch construction laborers. Dairying made modest profits for Turnbull settlers until the Washington Water Power electric railroad, which shipped milk to creameries in Spokane, was shut down in 1922. The replacement of the horse with the automobile in the 1920s caused a decline in the price of hay which hurt the local economy. As the thin peat soils lost their fertility, profits declined, and the Great Depression approached, many Turnbull area farmers were forced to abandon their lands

(Holstine et al. 1992). The establishment of the Turnbull National Wildlife Refuge was in part made possible because of the failing farm economy (Valentine 2000).

Despite their close proximity to a transcontinental railroad and later a regional railroad, settlers of Turnbull Lakes lived a relatively isolated existence. The roads were unpaved, poorly maintained and frequently impassable. Not a single farm ever received electricity or telephone service. When the government acquired the lands in the 1930s, the hardy descendants of the pioneers who first settled the area were still living out the final phase of the frontier era (Holstine et al. 1992).

3.10.3 CURRENT KNOWLEDGE OF LOCAL CULTURAL RESOURCES

Refuge Cultural Resource Surveys

Cultural resource investigations on Turnbull NWR started in the early 1970s when Refuge personnel made informal efforts to identify a few sites within Refuge boundaries. Beginning in the 1980s formal cultural resource surveys were conducted in association with proposed ground disturbing management projects including pond alterations, fenceline construction, and a new entrance road. A comprehensive survey of the Refuge (Holstine et al. 1992) was conducted by professionals from Eastern Washington University's Archaeological and Historical Services under a grant from the Service. This survey covered an estimated 1500 acres of the Refuge and included a historical records search. The Refuge land holdings total 15,656 acres, of which 2,606 acres (or 17 percent) have been systematically surveyed to date for cultural resources.

A limitation of all surveys on the Refuge is poor ground surface visibility, especially in forested areas and areas where Mt. St. Helen's ash was deposited in 1980 (Holstine et al. 1992). That, combined with different survey techniques and purposes, can result in undiscovered sites even on previously surveyed areas. It is highly

probable that over the coming years additional archeological and historical sites will be exposed by human actions or natural causes. Forested uplands are more likely to contain as yet undiscovered prehistoric lithic debris sites. Wetlands and agricultural fields are less likely to contain intact prehistoric sites due to intensity of disturbance during historic and recent times.

Refuge Cultural Resource Sites

Turnbull NWR has some truly unique, interesting prehistoric and historic properties. Refuge surveys have resulted in several recorded prehistoric sites. There are three rockshelters, naturally formed by flood-eroded basalt faces, on the Refuge. These are large enough to provide human shelter but their most important use was probably food storage. At least nine rock pits in four different locations have been found on the Refuge. These pits probably held caches of either dried meat or plant foods, particularly roots. This storage method reduced the quantity of food lost to burrowing animals and the air circulation within the rocks helped reduce spoilage. Caches of this type were intended to blend into the surrounding rock to prevent raiding by other families or groups. Foods were commonly stored near collection areas and extracted in late winter/early spring when food supplies were low. These storage pits were probably used within the last 200 years since these types of structures are destroyed over time due to rock creep/movement (Holstine et al. 1992). Evidence of a roasting oven probably used for camas and dating back as much as 1,000 years has been found on the Refuge (Lyons 1993). Small lithic debris scatters that are estimated to be between 2,000 and 3,000 years old have been found. These are presumed to have been in locations of temporary food gathering camps. These sites, combined with information collected in other areas of eastern Washington, support the theory that during prehistoric times Refuge lands were used primarily on a seasonal basis for hunting and gathering (Holstine et al. 1992).

There are many historic sites on the Refuge including 38 farmsteads which have been recorded and several others known but not located. House foundations, fence jacks, and domestic detritus from the first quarter of the twentieth century including milk and tobacco cans, glass bottles, canning jars, and various metal objects remain to tell their story. More of these types of physical remains of historic sites are likely to be discovered throughout the Refuge. Two rural schoolhouse sites also occur on Refuge lands. It is not known when the schools were first built but they were probably in use during the late 1800s and continued until 1923 when students in the Turnbull Lakes area began attending school in Cheney. Just over one mile of the Mullan Road, one of the Pacific Northwest's most significant historic travel routes crosses the southeast corner of the Refuge. Another historic road that may have been an alternate route during wet seasons crosses the Refuge about a half mile east of the Mullan Road. The SP&S railroad grade still exists, and evidence from its 1906 construction, like the rock ovens built by Italian laborers, can be found along its length. Many water control structures in the form of dikes, ditches, and a tunnel under the SP&S railroad bed were constructed by early settlers, drainage district crews, and WPA workers in their efforts to improve agricultural production by draining the wetlands. After the Refuge was established in 1937, some of the original ditches were modified and other water control structures added for the opposite purpose of retaining water in the wetlands to enhance waterfowl habitat.

Cultural Resource Surveys and Sites within the Study Area

A record search conducted in January 2000 found that only four systematic cultural resource surveys have been conducted in or near the study area outside of Refuge lands. There are no recorded prehistoric sites, however, four historic sites have been formally recorded in this area. The four sites are as follows: 1) Mullan Military Road Marker monument - constructed in 1926 - indicating that remnants of this road are in the

study area as well as on the Refuge; 2) Campsite of General William T. Sherman during a 1877 tour. Sherman was visiting to site new military posts so as to quell Indian unrest of the times. 3) Dybdall Grist Mill, a custom wheat mill which operated from 1897 until 1955, and is listed on the National Register of Historic Places; and 4) Company Ditch - a portion of this canal is also within the Refuge and is currently used to move water into the wetlands that it was originally constructed to drain.

The higher density of recorded historic and pre-historic sites located in Turnbull NWR is due to federal ownership and the mandates to survey federal lands. The density of sites within the Study Area may be similar, but fewer surveys have been done (Valentine 2000).

3.11 REFUGE BUDGET AND REVENUE SHARING

3.11.1 ANNUAL FUNDING

In FY 2002 Turnbull Refuge was allocated \$455,100 in 1261 funds, \$260,850 in 1262 funds, \$1,500 in 1231 funds, \$12,000 in 6860 funds, \$5,000 in 1121 funds and \$735,700 in fire program accounts. The large fire program at the Refuge receives 50 % of the total allocated funds, and these are used for Pre-suppression, Hazardous Fuel Reduction and Wildland Urban Interface (funds used to reduce the wildfire hazard on private lands and along the boundary of the Refuge).

3.11.2 REVENUE SHARING

When private lands are acquired by the USFWS they are removed from the tax rolls. This is because the United States Government, like city, township, county, and state governments, is exempt from taxation. However, under provisions of the Revenue Sharing Act, the county receives an annual revenue sharing payment which often equals or exceeds the amount that would have been collected from taxes in private ownership. The revenue sharing

fund consists of net income from the sale of products or privileges. Some examples are timber sales, grazing fees, permit fees, oil and gas royalties, etc. If there is not enough money in the fund to cover the annual payments, Congress is authorized to appropriate money to make up the deficit. Should Congress fail to appropriate such funds, payments to the county are reduced accordingly.

The Refuge Revenue Sharing Act provides for a payment of the greater of 25 percent of net receipts, or 3/4 of 1 percent of the adjusted purchase price for purchased land, or \$0.75 per acre. Payments can not be less than \$0.75 per acre for all purchased and donated land. All lands administrated solely or primarily by the USFWS qualify for revenue sharing. USFWS lands are reappraised by the Service at least once every 5 years. Payments to counties can be used for any governmental purpose. Spokane County has traditionally used the payment for the support of roads, schools and fire suppression.

3.11.3 ENTRANCE FEE PROGRAM

The Refuge currently has a seasonal entrance fee program. Visitors pay a daily fee of \$3/car to enter the Refuge between March 1 and October 31. Visitors can also use the Federal Passport System's Golden Eagle, Golden Access, or Golden Age Passports which are annual passes to all open federal lands. The Federal Duck Stamp at \$15/year allows entrance to all National Wildlife Refuges that charge an entrance fee, or visitors can use an annual \$12 Refuge Annual Pass specifically for Turnbull NWR. Entrance fees currently generate about \$6,000/year at Turnbull NWR. With a 30% increase in visitation expected over the next decade, the Service expects this amount to rise to at least \$8,000/year. Consideration could be given toward requiring an entrance fee year around instead of seasonally. These funds are used to purchase additional Refuge brochures, signs, and pay for other public use supplies and activities.

3.11.3 VOLUNTEERS

Volunteers provided 16,000 hours of service to the Refuge in FY 2002 at a value of \$236,000. This is the equivalent of 7.7 full time employees. The hours provided were categorized as follows: 4,108 hours in habitat and wildlife monitoring support, 1,756 hours in habitat management, 722 hours in fish and wildlife management, 2,455 hours in resource protection, 6,359 hours in public use and recreation, 55 hours in planning and 2,883 in maintenance.

3.12 LOCAL SOCIAL AND ECONOMIC SETTING

The Refuge is situated entirely within Spokane County, in Northeast Washington. The nearest town, Cheney, sits just north of the Refuge's northern boundary. The City of Spokane, Washington's second largest city, is approximately 20 miles to the northeast.

3.12.1 POPULATION, HOUSING AND INCOME

County-wide data

Population and social statistic data for Spokane County, and comparisons with the State of Washington as a whole, are shown in Table 3-7.

Spokane County has grown rapidly in recent years with a 15.7 percent increase in population since 1990, making it the third fastest growing county in the state during the 1990s.

Census figures of Spokane residents from the year 2000 show that 91.4 percent identify themselves as White. Persons of Latino or Hispanic origin represent the largest other racial category, with 2.8 percent reporting themselves in this category. An additional 2.8 percent identify themselves as of two or more races.

Slightly over 11 percent of the entire population of Spokane County identify themselves as college graduates, compared with 12 percent in the State as a whole.

Median household income is lower in Spokane County than in the State as a whole. Correspondingly, the poverty rate is slightly higher in Spokane County than in the State of Washington as a whole.

Rural Areas

The Refuge and the Study Area are both located within Census Tracts 142 and 143. The City of Cheney is located within Census Tract 140.

Within Spokane County, several subareas were designated for the purposes of calculating population. Rural subareas encompass more than one Census Tract. The Refuge is situated within County Subarea “South Rural” and is just adjacent to the County subarea “West Rural.”

Table 3.8 shows population and housing data for these areas.

Urban Areas

Population data, and changes since 1990, are presented for several local towns in Table 3-9.

The current population of the City of Spokane, located 20 miles (32 km) northeast of the Refuge, is 195,629 people, making it the second largest city in Washington State (U.S. Census 2000) (Table 3.9). This represents a 10 percent increase since 1990, a faster growth rate than either Seattle or Tacoma. The population of Cheney, just adjacent to the Refuge, has also increased at a rapid rate since 1990 (Table 3-9).

Table 3-7 *Population and Associated Social Statistics, Spokane County and Washington*

	Spokane County	Washington
Population, 2000	417,939	5,894,121
Population, percent change, 1990 to 2000	15.7%	21.1%
Persons under 18 years old, percent, 2000	25.7%	25.7%
Persons 65 years old and over, percent, 2000	12.4%	11.2%
High school graduates, persons 25 years and over, 1990	192,761	2,620,607
College graduates, persons 25 years and over, 1990	47,096	716,969
Housing units, 2000	175,005	2,451,075
Homeownership rate, 2000	65.5%	64.6%
Households, 2000	163,611	2,271,398
Persons per household, 2000	2.46	2.53
Households with persons under 18, percent, 2000	34.7%	35.2%
Median household money income, 1997 model-based estimate	\$35,691	\$41,715
Persons below poverty, percent, 1997 model-based estimate	12.2%	10.2%
Children below poverty, percent, 1997 model-based estim.	17.1%	15.2%

Source: U.S. Census, 2000 (<http://quickfacts.census.gov/qfd/states/53/53063.html>)

Table 3-8. Summary of Population and Housing by County Subarea

Subarea	Census Tracts included	2000 Population	2000 Housing
West Rural (includes City of Cheney),	104, 140, 139, 141	32,046	10,799
South Rural	133, 135, 142, 143	11,897	4,953 estimated

Source: Spokane County (<http://www.spokanecounty.org/BP/Census/2000/2000cntysum.asp>)

Table 3-9. Recent Population Growth in Selected Cities near Turnbull NWR (1990-1999).

Location	Population (1990)	Population (2000)	Percent Change (1990-2000)
Spokane	177,196	195,629	10.0
Cheney (adjacent to Turnbull NWR)	7,723	8,832	14.3
Medical Lake	3,664	3,758	2.5
Spangle	229	240	4.8

Source: US Census Bureau

(http://factfinder.census.gov/servlet/GCTTable?_lang=en&-geo_id=04000US53&-box_head_nbr=GCT-PH1&-ds_name=DEC_2000_SF1_U&-format=ST-7)

Table 3-10. Estimated Population (2015) and Population Change (1999-2015) in Selected Locations.

Location	Estimated Population (2015)	Percent Change (1999-2015)
Spokane	242,744	28.3
Cheney	11,235	31.4
Spokane County	510,971	23.3
Washington State	7,142,144	24.1

Source: OFM (1999)

Future Trends

The population increases observed over the last 10 years are forecasted to continue beyond 2015. By 2015, the population of Spokane County is expected to increase 23.3 percent to 510,971 while the population of Washington State will increase 24.1 percent to 7,142,144 (OFM 1999) (see Table 3-10). These increases in population are expected to be mirrored by similar growth in many of the communities surrounding the Refuge.

3.12.2 EMPLOYMENT AND BUSINESS

Table 3-11 shows some basic business and employment data for Spokane County, with comparison to Washington State as a whole.

3.12.3 ENVIRONMENTAL JUSTICE

In February 1994, the President of the United States issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations. This Executive Order requires all

federal agencies to seek to achieve environmental justice by identifying and addressing disproportionately high and adverse human health or environmental effect of its programs, policies, and activities on minority and low-income populations.

Activities related to Refuges usually do not have a high risk of adversely affecting human health and the environment. In reviewing the demographics of Spokane County, less than 10 percent of the county identified themselves as a minority and just over 12 percent of the population is estimated to be living below the poverty level.

Table 3-11 *Employment and Business Data*

Business Facts	Spokane County	Washington
Private nonfarm establishments, 1999	11,717	162,932
Private nonfarm employment, 1999	162,962	2,209,129
Private nonfarm employment, percent change 1990-1999	29.1%	25.4%
Nonemployer establishments, 1998	20,937	315,472
Manufacturers shipments, 1997 (\$1000)	3,994,582	78,852,486
Retail sales, 1997 (\$1000)	4,122,561	52,472,866
Retail sales per capita, 1997	\$10,165	\$9,363
Minority-owned firms, percent of total, 1997	5.1%	9.6%
Women-owned firms, percent of total, 1997	22.9%	27.5%
Housing units authorized by building permits, 2000	2,094	39,021
Federal funds and grants, 2000 (\$1000)	2,132,792	33,896,997
Local government employment - full-time equivalent, 1997	11,717	185,152

Source: U.S. Census, 2000 (<http://quickfacts.census.gov/qfd/states/53/53063.html>)