National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Natural Resource Condition Assessment

Lake Roosevelt National Recreation Area

Natural Resource Report NPS/UCBN/NRR—2009/106

ON THE COVER

Map of Lake Roosevelt National Recreation Area located in northeast Washington with insets of pictures of various sites in the Park.

Natural Resource Condition Assessment

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Publisher's Note: Some or all of the work done for this project preceded the revised guidance issued for this project series in 2009/2010. See Prologue (p. xiii) for more information.

Executive Summary

This Natural Resource Condition Assessment (NRCA) report and accompanying geodatabase is designed to give the resource managers of Lake Roosevelt National Recreation Area (LARO) a better understanding of the condition of natural resources within and adjacent to their park. Assessment of the natural resources was accomplished by conducting a thorough literature review, evaluating existing data, and also collecting new data on areas of the park where sufficient, reliable data for an assessment was not available. Aquatic and upland habitats were evaluated at pre-identified locations. Selected threats and stressors to LARO's natural resources were evaluated for the entire park. Information gained from this report will form the basis for development of actions to reduce and prevent impairment of LARO's natural resources and assist in the development of desired future conditions through park planning processes.

The study area encompasses thirty-seven 6th level Hydrologic Unit Code (HUC) watersheds with a 5 km buffer. All available geographical information (GIS) were acquired for the study area to create a ArcGIS Map Project File and Geodatabase. The geodatabase was used to analyze geographical data and also to produce all the maps presented in this report. The location of each sampling site is compiled in the Geographic Information System (GIS) geodatabase. Upland rangeland condition data is available in an Access database on the enclosed DVD and all aquatic properly functioning condition data is included in Appendix B.

The upland sites selected for site-specific condition status assessments included six grazing allotments and one historic site. All of the upland sites were evaluated using a rapid, qualitative tool developed by the Bureau of Land Management (BLM) for assessing a moment-in-time status of rangeland health. Evaluators rated 17 indicators to assess 3 ecosystem attributes (soil and site stability, hydrologic function, and biotic integrity) for a given location (Pyke et. al. 2002). Overall, the soil stability and hydrologic function attributes were in good condition, rated none-slight or slight-none departure from reference conditions. The biotic integrity attribute in many sites was in poor condition, rated moderate or in one case moderate-extreme departure. The poor condition was attributed to past grazing practices and conversion of forests to pasture lands.

The shoreline riparian areas selected for site-specific condition status assessments included 21 sites in four park-defined management zones. Sites selected for evaluation were assessed using the "proper functioning condition" (PFC) riparian assessment methodology developed by the Bureau of Land Management for lotic, flowing water, (Prichard et al. 1998) or lentic, standing water, (Prichard et al. 2003). All the aquatic sites sampled were rated "Functional-At-Risk" or "Nonfunctional," 9 and 12 sites, respectively. The poor condition of most sites was attributed to one or more of the following threats; water level fluctuations, invasive riparian species, recreational use, or fine sediment accumulation.

We investigated 21 potential threats and/or stressors (6-natural, 15-human-caused) to upland and aquatic resources at LARO. Emphasis was placed on wildfire, land use change, and noxious weeds because they are directly managed by park staff. The potential for wildfires always exists but we found that overall the vegetation conditions in the project area were mainly in a very low

to low departure from reference conditions. Land use changes, through the conversion of range and forest lands to rural homesites, pose significant threats to the hydrologic and biotic resources in the park. This situation is due in large part to the narrow linear shape of the park. Noxious weeds pose the greatest threat and stress to the biotic resources of the park. All of the 23 species documented on park land will continue to expand if not controlled through active management.

For the aquatic resources 5 threats and stressors were believed to pose serious problems; water level fluctuations, invasive riparian species, recreational use, water pollution, and fine sediments. Of these only invasive riparian species and recreational use can be directly managed by the park to improve the condition of aquatic resources. The difficulty for park staff in managing for the other 3 threats and stressors is the source of the problems lie outside the park and their management authority. Reducing the impact from these threats and stressors will require active cooperation with local, state, federal, and tribal agencies.

The stated goal for resource management at LARO is "(T)he natural, cultural, and scenic resources of the national recreation area are protected and preserved to ensure that the integrity of the environment is not compromised and the quality of the visitor experience is enhanced" (NPS 2000). LARO has many future challenges to achieve this goal. Results of this report should assist park managers in identifying when, where, and how to improve management practices, justify additional resources, and prepare for the changes in the environment that will directly impact LARO natural resources.

Acknowledgements

We wish to begin by thanking Jerald Weaver, Natural Resource Manager at Lake Roosevelt National Recreation Area, for his time and courteous help in all stages of the project. Mr. Weaver was extremely helpful in navigating field crews to remote and difficult-to-find access points on park lands. We owe a great deal of appreciation to our dedicated field staff, including Marilyn Nielson, Northwest Management, Inc., and Nicole Neumiller and Gerald Ladd of AMEC. Vaiden Bloch, GIS Specialist, with Northwest Management, Inc. was invaluable in preparing the Geodatabase and map project files. We would like to thank the many staff at Northwest Management, Inc. for their edits and insightful comments on the manuscript, especially Diane Corrao, Administrative Manager. Finally, we are very thankful for all the support and help from Lisa Garrett, NPS Upper Columbia Basin Network, and Jason Lyon, NPS Nez Perce National Historical Park. They had the vision to develop and implement this project and the professionalism and dedication to guide it to completion.

Prologue

Publisher's Note: This was one of several projects used to demonstrate a variety of study approaches and reporting products for a new series of natural resource condition assessments in national park units. Projects such as this one, undertaken during initial development phases for the new series, contributed to revised project standards and guidelines issued in 2009 and 2010 (applicable to projects started in 2009 or later years). Some or all of the work done for this project preceded those revisions. Consequently, aspects of this project's study approach and some report format and/or content details may not be consistent with the revised guidance, and may differ in comparison to what is found in more recently published reports from this series.

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Introduction

Purpose and Scope

The mission of the National Park Service is "to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations" (National Park Service 1999) To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring (National Park Service 1999). Through the challenge, 270 parks in the national park system were organized into 32 inventory and monitoring networks.

The Upper Columbia Basin Network (UCBN) consists of nine widely separated NPS units located in western Montana, Idaho, eastern Washington, and central Oregon. Parks of the Upper Columbia Basin Network include: Big Hole National Battlefield (BIHO), City of Rocks National Reserve (CIRO), Craters of the Moon National Monument and Preserve (CRMO), Hagerman Fossil Beds National Monument (HAFO), John Day Fossil Beds National Monument (JODA), Lake Roosevelt National Recreation Area (LARO), Minidoka Internment National Monument (MIIN), Nez Perce National Historical Park (NEPE), and Whitman Mission National Historic Site (WHMI).

As part of the Natural Resource Challenge, the NPS Water Resources Division received an increase in funding to assess natural resource conditions in national park units. Management oversight and technical support for this effort is provided by the division's Watershed Condition Assessment (WCA) Program. The WCA Program partnered with the Pacific West Region to fund and oversee an assessment at each park in the Upper Columbia Basin Network (UCBN). This report documents the results of the Natural Resource Condition Assessment (NRCA) completed for Lake Roosevelt National Recreation Area (LARO).

Natural resource condition assessments are broad-scope ecological assessments intended to develop synthesis "information products" readily usable by park managers for: a) resource stewardship planning, and b) reporting to performance measures such as the DOI Strategic Plan's "land health" goals. Three elements are key to making these assessments useful for both planning and performance reporting:

1. Build on data, information, and knowledge already assembled through efforts of the NPS I&M Program, other NPS science support programs, and from partner collaborators working in and near parks;
2. Emphasize a strong geospatial component for how the assessment is conducted and in the resulting information products;
3. Provide narrative and/or semi-quantitative descriptions of science-based reference conditions for park resources that will assist parks as they work to define Desired Future Conditions through park planning processes. These reference conditions will become more refined and quantitative over time.

Information gained from this report will form the basis for development of actions to reduce and prevent impairment of park resources through park and partnership efforts. The goals of the natural resource condition assessment are to:

- Determine the state of knowledge concerning overall natural resource condition
- Identify information gaps and resource threats
- Assess overall ecosystem health
- Sets the stage to establish the context for management actions and collaboration

This report is designed to give park staff a moment-in-time assessment of the natural resources of Lake Roosevelt National Recreation Area. This report will describe the natural resources of the park (both aquatic and upland), determine the state of knowledge on their condition using existing data or new data collected at priority sites for this project, identify information gaps, draw conclusions or hypotheses on the condition of natural resources (unknown, degraded, unimpaired), identify resource threats or potential issues affecting ecosystem health, and recommend further studies.

Study Area

Park Setting

Lake Roosevelt National Recreation Area (LARO) was established as a unit of the National Park Service (NPS) in 1946 by the Secretary of the Interior. With the Secretary's approval, an agreement between the Bureau of Reclamation, the Bureau of Indian Affairs, and the NPS designated the NPS as the manager for the Coulee Dam National Recreation Area. The area included Franklin D. Roosevelt Lake, the reservoir formed behind Grand Coulee Dam, and the "freeboard" lands that where purchased at and above 1,310' elevation. Through over 50 years of changes, including a name change to Lake Roosevelt National Recreation Area in 1997, the NPS now manages approximately 47,438 acres of the 81,389 acres of total water surface, associated shoreline, and 12,936 acres of the 19,196 acres of total freeboard land. Also, in 1990, two adjacent Indian Tribes were included in the Lake Roosevelt Cooperative Management Agreement. The Colville Confederated Tribe and the Spokane Tribe of Indians manage the remaining water surface and freeboard land.

The LARO General Management Plan (NPS 2000) defines the 3 major purposes for the recreation area:

- Provide opportunities for diverse, safe, quality, outdoor recreation experiences for the public.
- Preserve, conserve, and protect the integrity of natural, cultural, and scenic resources.

- Provide opportunities to enhance public appreciation and understanding about the area's significant resources.

LARO offers a wide variety of recreation opportunities in a diverse natural setting on a 154-mile-long lake bordered by 312 miles of publicly owned shoreline. Visitation at the park has fluctuated between a high of 1,784,420 (1990) to a low of 1,081,112 (1996) and has averaged 1,374,797 between 1990 to 2004 (Figure 1). LARO has 5 marinas, 3 with campgrounds, and numerous overnight and day-use campgrounds and points of access around the lake. The recreation area includes the lower reaches of many rivers and streams including the Spokane and Kettle Rivers.

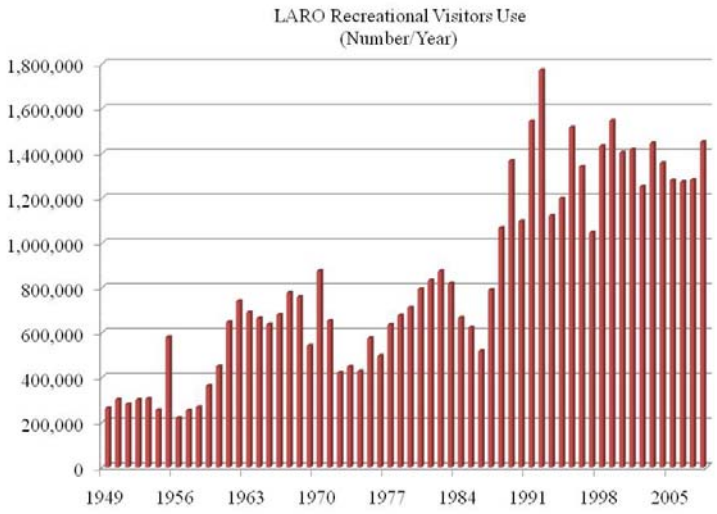

Figure 1. Recreation use (days/year) from 1948 to 2007 at LARO.

Land Cover

Lake Roosevelt contains a large section of the upper Columbia River and a record of continuous human occupation dating back more than 9,000 years. It is contained within three distinct geologic provinces – the Okanogan Highlands, the Columbia Plateau, and the Kootenay Arc – all have been sculpted by Ice Age glaciations and catastrophic floods.

The vegetation at LARO fits primarily into three broad categories; steppe grasslands, shrub-steppe grasslands and transition forest. Other categories include riparian/wetland, mixed-conifer, lithosol areas, rock outcrops, and actively eroded slopes. The southern third of the lake is bordered by often moderate to steep slopes with a northerly aspect. The toe of these slopes have sedimentary terraces with relatively steep down slope sides.

Current vegetation maps were not available at the time of this report but are scheduled to be complete by 2010. Vegetation data was available from the LANDFIRE Program (USFS and USGS 2008). Data was compiled from 2000 Landsat Thematic Mapper satellite imagery and classified into the National Vegetation Classification System (NVCS) Physiognomic Subclasses

(NatureServe 2003). Subclasses are based on predominate leaf phenology for the tree, shrub, and dwarf shrub strata and the average height of the herbaceous strata. The data was clipped, summarized (Table 1), and mapped (Figure 1) for the LARO project area.

Table 1. CVNS Physiognomic subclasses within the LARO project area

NVCS Physiognomic Subclass Acres		Percentage
Annual Graminoid/Forb	141,536	9.25%
Deciduous open tree canopy	894	0.06%
Deciduous shrubland	120	0.01%
Evergreen closed tree canopy	167,468	10.95%
Evergreen dwarf-shrubland	11,544	0.75%
Evergreen open tree canopy	588,457	38.46%
Evergreen shrubland	42,230	2.76%
Evergreen sparse tree canopy	492	0.03%
Mixed evergreen-deciduous open tree canopy	39,368	2.57%
Mixed evergreen-deciduous shrubland	3,763	0.25%
No Dominant Lifeform	12,796	0.84%
Non-vegetated 86,642		5.66%
Perennial graminoid grassland	242,230	15.83%
Perennial graminoid steppe	190,324	12.44%
Sparsely vegetated	2,198	0.14%

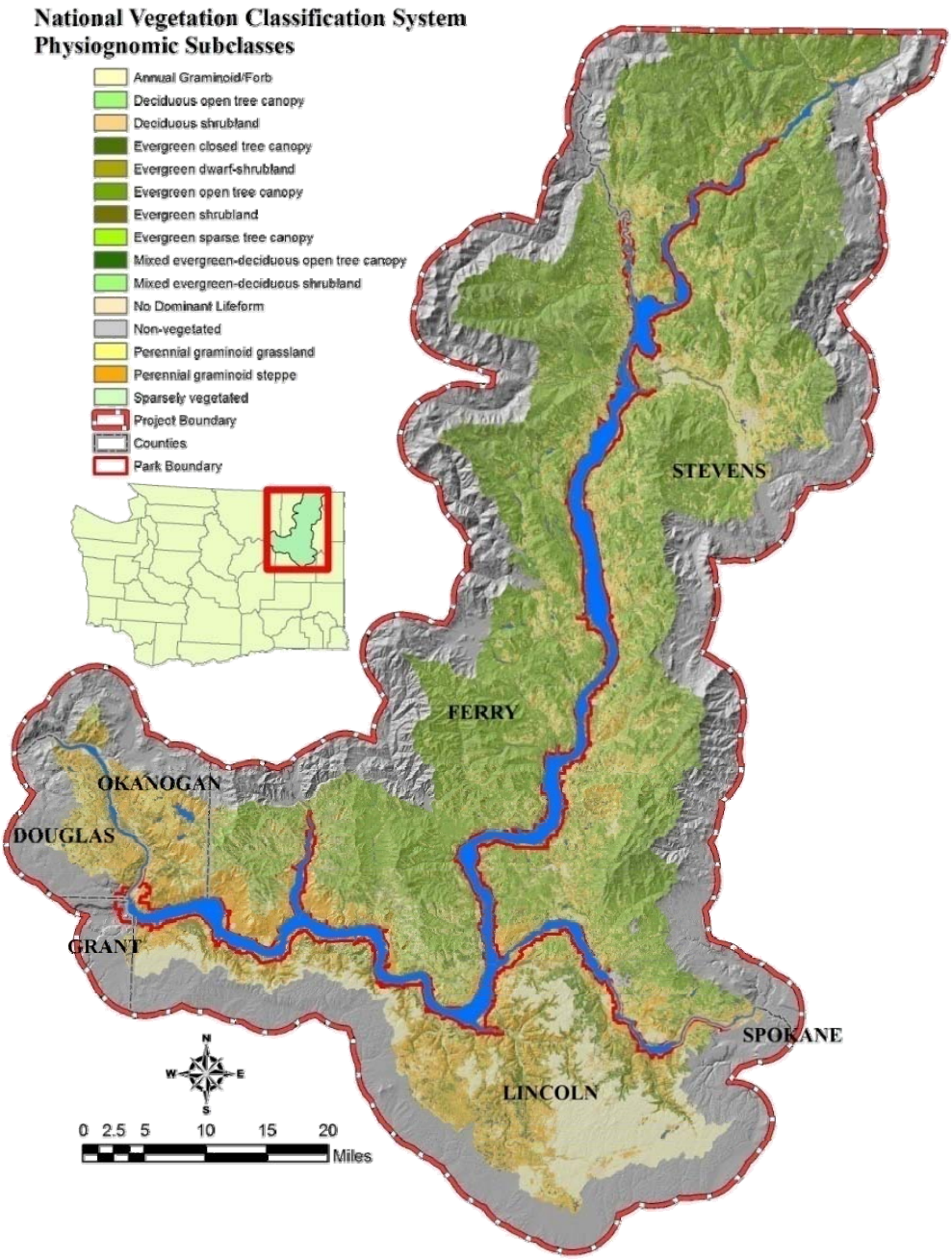

Figure 2. Map NVCS Physiognomic Subclasses in the LARO Project Area.

The common shrubs found in LARO are big sagebrush (*Artemisia tridentate*), rabbitbrush (*Chrysothamnus* spp.), and antelope bitterbrush (*Purshia tridentate*). Some soil types support Douglas fir (*Psuedostuga douglasii*) and ponderosa pine (*Pinus ponderosa*) in shaded aspects and microsites. The common grasses throughout the whole area, particularly the dry sites include bluebunch wheatgrass (*Psuedorogeneria spicata*), Idaho fescue (*Festuca idahoensis*), sand dropseed (*Sporobolus cryptandrus*) and needle and thread grass (*Stipa comata*).

The Northern two-thirds of LARO is either mountain slopes or larger terraces. Both the mountain slopes and the large terraces have sedimentary terraces at their toe with relatively steep sides. The middle third of LARO is predominantly ponderosa pine forests with associated grasses, forbs and shrubs. Common shrubs include antelope bitterbrush, snowberry (*Symphoricarpos oreophilus*), serviceberry (*Amelanchier alnifolia*), ocean spray (*Holodiscus discolor*), and wild rose (*Rosa* spp.).

The upper third of LARO receives more precipitation, which supports a mixed conifer zone with Douglas fir and ponderosa pine. Other trees that occur include Western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), Western paper birch (*Betula papyrifera*), and grand fir (*Abies grandis*). The shrub species are similar in the remainder of LARO with the addition of buffalo berry (*Shepherdia canadensis*), snowbrush ceanothus (*Ceanothus velutinus*), and Pinegrass (*Calamoagrostis rubescens*). The riparian zones, which are most well developed in the northern portion of LARO, are dominated by willows (*Salix* spp.), alder (*Alnus* spp.), black cottonwood *Populus balsamifera)*, water birch (*Betula occidentalis*), and the occasional western red cedar (*Thuja plicata*).

Surveys were initiated in 2003 for two Washington state-listed sensitive plant species Nuttall's pussy-toes *(Antennaria parvifolia)* and Columbia crazyweed (*Oxytropis campestris var. Columbiana)*. Listed as sensitive and threatened by the Washington State Department of Natural Resources Natural Heritage Program, these species were known to exist at LARO. The only known patch of Columbia crazyweed was relocated and mapped. The Nuttall's pussy-toes survey covered 1,487 acres divided into 155 survey zones. Of the zones surveyed, 59 were found to contain populations of this species. This plant was more abundant than originally expected.

Important noxious weeds at LARO include diffuse knapweed (*Centaurea maculosa*), spotted knapweed (*C. diffusa*), yellow star-thistle (*C. solstitialis*), leafy spurge (*Euphorbia esula*), Dalmatian toadflax (*Linaria genistifolia ssp. dalmatica*), and Canadian thistle (*Cirsus canadensis*). LARO staff conducts noxious weed control activities in cooperation with county weed control programs, adjacent landowners, and other affected parties on Lake Roosevelt. In addition the narrow linear nature of LARO and the numerous roads running the length of LARO provide numerous corridors for dispersal of weed seeds into and out of the area.

Upland Habitats/Species

Animals present at LARO are typical for the semi-arid temperate conditions and the resulting vegetation in northeastern Washington. Some species, such as deer, can be considered abundant. Little information is available regarding rare species present at LARO. Given the linear nature of the park, terrestrial habitat for larger wildlife is somewhat limited. Although LARO is too narrow to provide all aspects of a large mammal's range and habitat, it does provide important habitat to some charismatic species.

There are no known threatened or endangered species identified by the U.S. Fish and Wildlife Service present at LARO. The bald eagle was recently delisted as threatened by the U.S. Fish and Wildlife Service and is present in the park. Bull trout (*Salvelinus confluentus)*, a threatened species, is not known to exist in the reservoir according to Spokane Indian Tribal fisheries biologists but does occur in Columbia River tributaries upstream of the reservoir influence.

Forty-one species of mammals were confirmed in or adjacent to the recreation area during an inventory conducted by NPS in 2003 (McCaffrey et al. 2003). A highlight of the 2003 inventory was the discovery of three species of shrews (family Soricidae). This group of cryptic mammals is frequently overlooked and distribution is generally not well-known in the Pacific Northwest.

The Washington Department of Fish and Wildlife's Priority Habitats and Species program has listed areas at LARO as important winter range for deer, both white-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus)*. Large diameter ponderosa pine trees provide critical nesting and roosting habitat for bald eagles.

The abundance of water and adjacent areas of riparian and wetland habitats attract an abundance of avian species. Lake Roosevelt is within the Pacific Flyway and serves as a resting area during migration. One hundred eighty-two species of birds were confirmed in or adjacent to the recreation area in 2003, including 2 species, black crowned night heron (*Nycticorax nycticorax*) and ferruginous hawk (*Buteo regalis*), were documented but not expected to be in LARO (McCaffrey et al. 2003). Several species of raptors nest, roost or forage in the area. Among these the osprey (*Pandion haliaetus*) has been identified for monitoring in the UCBN's monitoring plan (Garrett et al. 2007).

Sixteen species of herpetofauna were confirmed in or adjacent to LARO (McCaffrey et al. 2003). The western toad was rediscovered in the southern portion of the recreation area. This species is believed to be declining in many parts of its range (Corkran and Thoms 1996). The spotted frog (*Rana spp*.) was absent during spring searches in 2003, and may be extirpated in the Lake Roosevelt region due to increasing numbers of introduced game fish and the bullfrog (*scientific name)* (Corkran and Thoms 1996).

Watersheds

River and stream drainages are uniquely identified by hydrologic unit codes (HUC). These are geographic areas based on surface topography containing a major river or a group of smaller rivers. The Pacific Northwest is number 17 of the 21 regions (HUC1) in the United States. The second level divides the 21 regions into 222 subregions. Subregions are areas drained by a river system, a reach of a river and its tributaries, a closed basin, or a group of streams forming a coastal drainage area. The third level subdivides the subregions into 352 basins. There are 2,149 fourth level drainages, referred to as subbasins. The Lake Roosevelt (17020001), Kettle (17020002), Colville (17020003), Sanpoil (17020004), and Lower Spokane (17010307) are 4th level HUCs in the project area. Additional mapping has been completed subdividing subbasins into watersheds, 5th level (10 digits), and subwatersheds, 6th level (12 digits).

There are 38- 6th level HUC basins in the LARO project area that cover 1,532,075 acres (Figure 2). Lake Roosevelt makes up 5.3% (81,389 acres) of the project area and LARO's total land and water area comprise 4.4% (66,634 ac). The land base of the park (19,196ac) accounts for only 1.2% of the project basins and makes up 0.1% of the Upper Columbia River basin. The Columbia River, the Kettle River in the northern portion of the LARO, and the Spokane River in the southernmost portion of the LARO, dominate the Lake Roosevelt inflow contributing 89, 7, and 3% average annual inflows, respectively (Howell et al. 2005). Most of the flows come from glacial ice, alpine lakes, and winter snowfall high in the Canadian Rockies. Grand Coulee Dam

regulates Lake Roosevelt water levels between 1,208 level (minimum pool) and 1,290 feet mean sea level (full pool). The reservoir extends a total of 135 miles (217 km) upstream (USGS 2004), covers 82,300 acres, and stores approximately 9,562,000 acre-ft of water. When the reservoir was initially filled to full pool, over 70,000 acres of land was inundated (Merker 1993). The subbasins include 226 tributaries to the Reservoir (excluding the Spokane River, Sanpoil River, Colville River, and Kettle River).

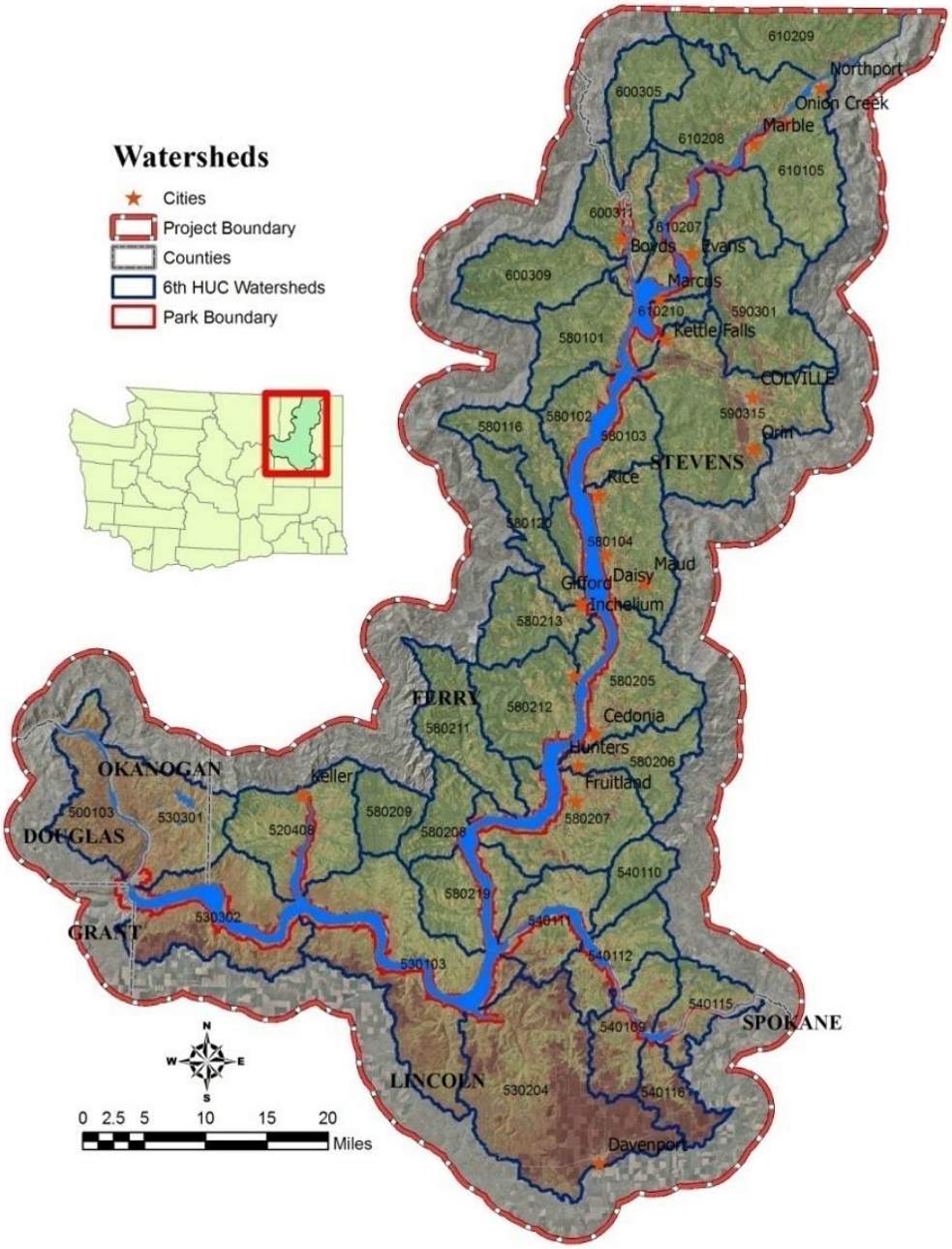

Figure 3. Map of 6th HUC watersheds in the LARO project area.

Aquatic Habitats/Species

Water is the major resource that comprises LARO. Lake Roosevelt is designated by the State of Washington as a class AA water body. This classification requires the highest-level water quality standards. The water quality in Lake Roosevelt is somewhat impaired by both point and non-point pollutants. Studies have revealed that generally the water quality in solution is satisfactory but much of the sediment being transported into the reservoir tends to be toxic due to high levels of heavy metals and organic pollutants.

Lake Roosevelt and its tributaries support a varied fish community that today is considerably different from the native fish community of the early 1900's. The changes over time were caused by the introduction of nonnative species, habitat alterations such as water pollution, damming of rivers and reservoir drawdowns. Surveys in the 1990's have identified up to 30 species of fish in LARO. Seven of these species were found in low numbers, with many represented by only one individual in one survey out of eight. Biologists believe that these individuals may occasionally wash down from reservoirs and lakes upstream or are introduced by unauthorized introductions. Of the 30 species detected 10 are not native to the Columbia River. The most abundant species include large-scale sucker (*Catostomus macrocheilus)*, smallmouth bass (*Micropterus dolomieui)*, burbot (*Lota lota)*, walleye (*Sander vitreus)*, kokanee salmon (*Oncorhynchus nerka)*, and rainbow trout (*Oncorhynchus mykiss)*. White sturgeon (*Acipenser transmontanus)* are also considered an important species due to recent studies that have determined that sturgeon populations are declining in Lake Roosevelt and the upper Columbia River watershed (Howell and McClellan 2006). Although causes of the decline are not identified specifically, species surveys showing very few individuals younger than 20 years of age in the population suggests that sturgeon recruitment is very low. Cooperative efforts between Canadian and U.S. agencies, First Nations, and tribes, including hatchery supplementation programs and spawning/recruitment studies, are targeted at reversing the declining trend.

The Columbia River above Lake Roosevelt has received 95 years of point pollution from a lead/zinc smelter (now one of the largest of its kind) located in Canada. Tons of effluent and slag have flowed downstream into Lake Roosevelt. In the 1960's, a pulp mill opened upstream of the lake and began to discharge various congeners of dioxins and furans. This material also appeared in the environment of Lake Roosevelt. The largest population centers in eastern Washington and the Panhandle of Idaho are upstream of Lake Roosevelt in the Spokane River watershed. Upstream of these population centers is the Silver Valley Mining District, which operated for over 100 years. The impacts of these sources of pollution are not well defined. Current pollutants identified in the Spokane River portion of Lake Roosevelt have not been tied to any one known pollution source.

Climate

The southwestern portion of LARO is in the Columbia Plateau, which is characterized by a semi-arid climate and consists primarily of sagebrush steppe vegetation interspersed with agricultural lands. The northeastern portion of the recreation area is in the Okanogan Highlands, which experiences a cooler and wetter climate and consists primarily of pine forest. Weather data from a stations located in the towns of Coulee Dam and Northport are shown in Table 2 (Western Regional Climate Center, 2003) Figure 4 shows the gradation in precipitation from south to north.

Table 2. Weather data for the past 30 years from stations at Coulee Dam and Northport, Washington.

Area	Average Precipitation	January			July		
		Mean Temperature (F)	Maximum Temperature (F)	Minimum Temperature (F)	Mean Temperature (F)	Maximum Temperature (F)	Minimum Temperature (F)
Coulee Dam, WA	11"	26°	32° 22	°	72° 86	°	58°
Northport, WA	20"	25° 32	°	21° 69	°	86° 51	°

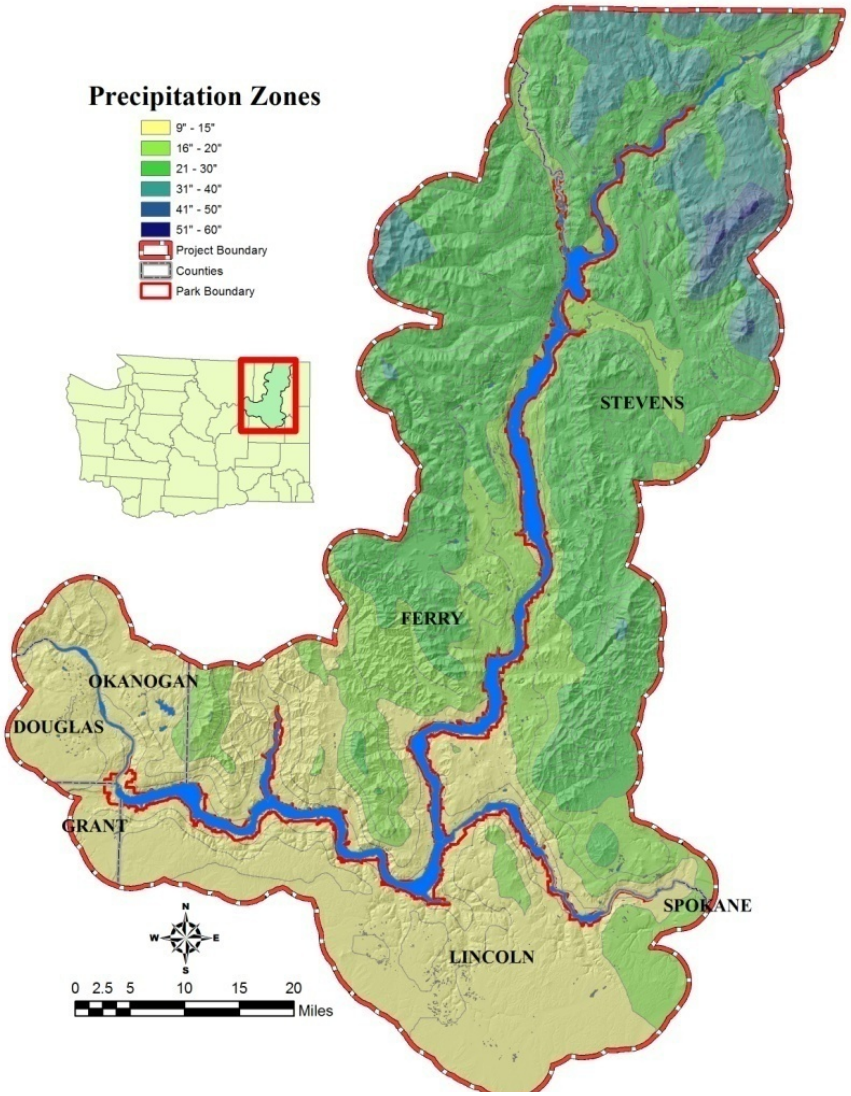

Figure 4. Precipitation zones in the LARO project area.

Methods

GIS and Geodatabases

The majority of data used in this report is Geographical Information System (GIS) data in tabular form tied to spatial features, such as points, lines, and/or polygons. GIS software provides spatial analysis capabilities such as overlay, buffer, extraction, and modeling. Results can then be displayed in map and tabular form. GIS software ARCMap Version 9.3 was used to store, edit, and display data.

A map project file was developed for LARO using ArcMap software and followed the behavioral rules for data in a single Microsoft Access database (Figure 5). Many types of geographic

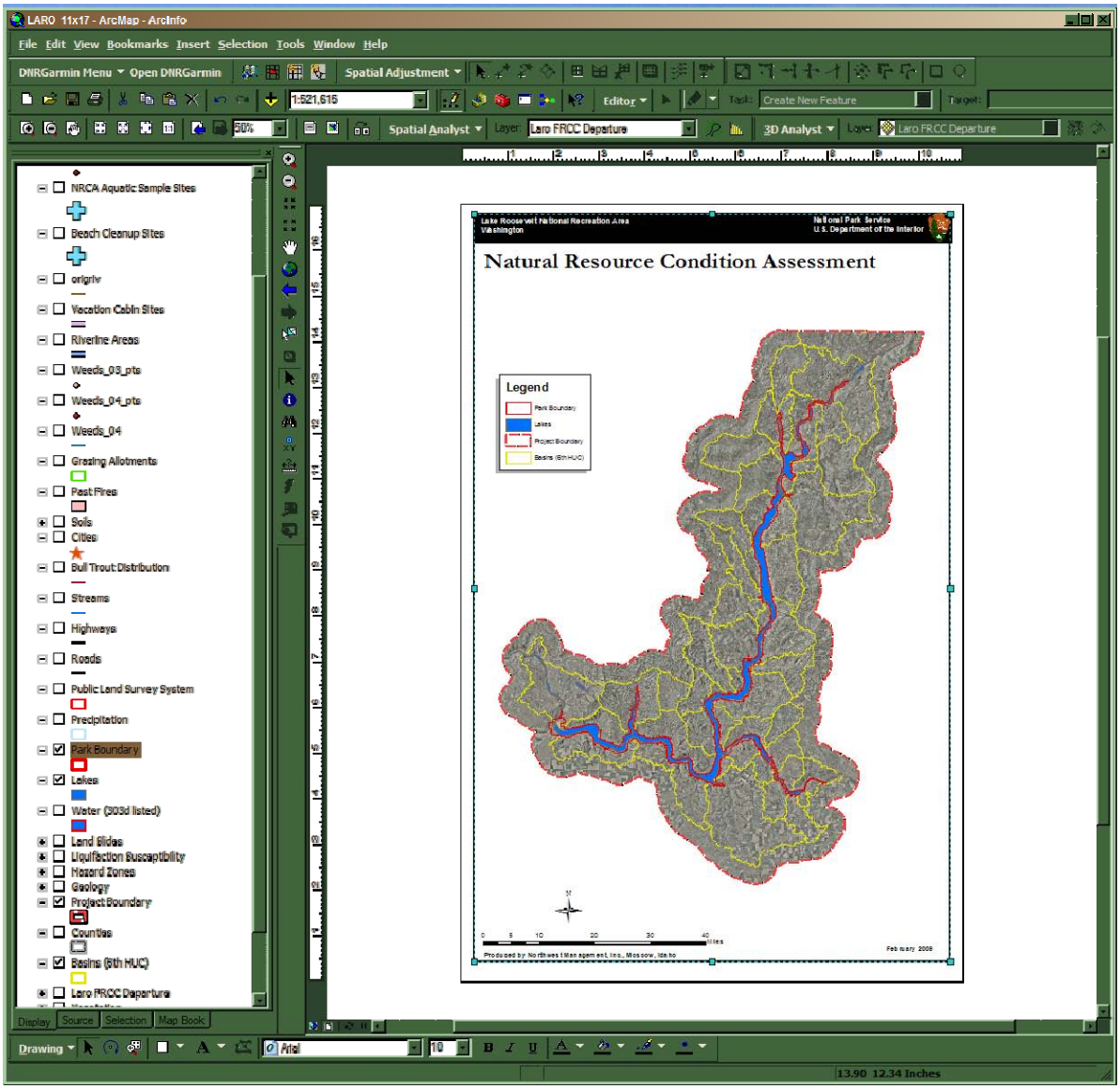

Figure 5. Screen capture of the ArcMap Project file for the LARO project area.

datasets can be collected within a map project file, including feature classes, attribute tables, and raster data sets. The NPS ArcMap 11"x17" template was used in the LARO map project file.

A geographically defined project area was created by selecting 6th level hydrologic unit code (HUC) watersheds adjacent to Lake Roosevelt. A 2 kilometer buffer was added for mapping purposes (2,255,265 ac). General base map layers and aerial photography were developed to the full project area extent. Most layers were clipped to the watershed basin extent for analysis and summarization of attributes (1,530,063 ac).

The map project file was populated with GIS data through an extensive search of NPS sources and a multitude of local, state, and federal web sites. Data determined to be useful and accurate were re-projected into the North American Datum 1983 (NAD83) datum and the Universal Transverse Mercator (UTM) zone 11 projection. Metadata was generated for each layer in Federal Geographic Data Committee (FGDC) compliant format. Metadata describes the source, accuracy, data dictionary, projection, datum, and many other details about an individual layer. Aerial photography was processed and clipped to the project area using LizardTech GeoExpress software and converted into a MG3 (MrSid Generation 3) format file.

Attribute information on the specific data layers clipped to the watershed basin extent were summarized in a spreadsheet based on the various attribute parts, lengths, acreage etc. of the various data layers in the map project file.

All GIS data layers were imported into an ArcGIS File Geodatabase using ArcCatalog ver. 9.3 (ESRI 2006). Feature Data Sets were created based on theme type. A geodatabase is an ArcMap file structure that stores geometry, spatial reference system, attributes datasets, network datasets, topologies, and many others features. This GIS format provides a uniform method for storing and using GIS data and provides the flexibility to add new information as it becomes available.

Map layers were organized into categories based on general theme type. Although data was not available for each theme type, the category directory is included to incorporate data that may become available in the future. The general themes used include:

- Air Resources
- Animal
- Geography
- Geology
- Land Process
- Land Use
- Plant
- Stressors
- Water Resources
- Climate

Aerial photography was not included in the geodatabase due to limitation of processing MG3 file formats. Aerials are included in a separate directory outside the geodatabase. All the data, project file and summary table are included on a DVD disk for distribution with this report. As a by-

product of this search, a Microsoft Access database (included on DVD) was created for websites with documented GIS data that could be downloaded in various formats compatible with ESRI's ArcMap software. The database has a custom query form for doing searches on the 3,000+ entries that cover 3 states; Oregon, Washington, and Idaho.

NPS Data Sources

Additional non-GIS data was acquired from searches on the internet, such as NPS NatureBib (https://science1.nature.nps.gov/naturebib), and from direct contact with local and state government agencies. LARO is in the Upper Columbia Basin Network (UCBN) established under the NPS Inventory and Monitoring Program (NPS 1999). Table 3 is the status of inventories of the species taxa groups for LARO. Available data from completed inventories were utilized where needed in the report otherwise the data is directly available at the UCBN website http://science.nature.nps.gov/im/units/ucbn/inventory/index.cfm#table. Rare plant species inventories, a subset of vascular plant inventories, are in progress while no inventories are available for invertebrates and invasive plant species.

Table 3. Status of inventories of species taxa for LARO maintained by the UCBN.

Species Taxa	Complete	Year Completed	In Progress	Not Complete
Mammals	✓	2003		
Birds	✓	2003		
Amphibians	✓	2003		
Reptiles	✓	2003		
Fish	✓	unknown		
Invertebrates				✓
Vascular Plants	✓	unknown		
Rare Plants				✓
Invasive Plants			✓	

Additional non-biological data sets have been identified by the UCBN as important for park management (Table 4). Both the biologic and non-biologic inventories were considered as baseline information for development of the UCBN vital signs monitoring plan (Garrett et al. 2007). Three data sets have not been completed by the UCBN however some park sites may have data available from other sources.

The UCBN Monitoring Plan (Garrett et al. 2007) identifies a suite of 14 vital signs chosen for monitoring implementation in the UCBN parks over the next 5 years. Vital signs are "a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values" (NPS-UCBN http://science.nature.nps.gov/im/monitor/). Not all vital signs are monitored at each park. LARO has 7 vital signs established for monitoring; surface water dynamics, water chemistry,

invasive/exotic plants, riparian vegetation, sagebrush-steppe vegetation, osprey, and land cover and use (Garrett et al. 2007).

Table 4. Status of inventories of non-biological data for LARO maintained by the UCBN.

Non-Biologic Data sets Co	mplete	Year Completed	In Progress	Not Complete
Air Quality/Emissions				✓
Ozone Risk	✓	2001		
Water Quality	✓	1997		
Landcover	✓	2005		✓
Paleo Resources	✓	2005		
Geology			✓	
Soils				✓
Cultural Landscapes				✓

Wildfire

Washington Department of Natural Resources (WDNR) Wildfire Ignition Data is a database in a GIS compatible format and available at the WDNR GIS web site. The currently available file covers wildfire point locations from 1970 through 2007. This data is only for wildfires occurring on DNR protected lands or fires DNR has provided suppression support. The data was clipped to the LARO project area and summarized by wildfire ignition sources per year and acres burned.

The Fire Regime Condition Class (FRCC) Departure Index data was used to evaluate the condition of vegetation on lands adjacent to LARO. The Departure Index is not directly related to the risk of wildfire but is one indicator of the susceptibility of vegetation to burning if ignited. The index uses a range from 0 to 100% to depict the amount that current vegetation has departed from simulated historical vegetation reference conditions (Hann et al. 2004, Holsinger et al. 2006). The departure results from changes to species composition, structural stage, and canopy closure. The 6th HUC drainage layer was used as the analysis area.

Noxious Weeds

Noxious weeds of importance to LARO were identified in Garrett et al. 2007. A complete list of Washington's noxious weeds can be found at http://www.nwcb.wa.gov/weed_list/weed_list.htm. They are classified into 3 categories based on control requirements; Class A (eradicate), Class B (contain) and Class C (control). GIS data on noxious weeds was acquired from past investigations and placed in the LARO geodatabase under stressors. State and county level databases were searched for noxious weed locations and local county weed superintendents were contacted for unpublished data. Available data have been summarized on maps and recommendations made by species.

Upland Assessment

Seven grazing allotments were selected for evaluation using an assessment method co-developed by the Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS), Bureau of Land Management (BLM), and the United States Geological Survey (USGS). The method is described in the publication "Interpreting Indicators of Rangeland Health" (Pellant et al., 2005). One allotment (Esvelt) could not be legally accessed by land and was dropped from the analysis. The other 6 allotments; Rosenberg, Green, Coffman, Gifford, Matney, and Henslee; along with the Fort Spokane site were assessed using the BLM rapid assessment for rangeland health methodology.

The rangeland health rapid assessment methodology was designed to provide a preliminary evaluation of 3 landscape attributes; soil/site stability, hydrologic function, and integrity of the biotic community at the ecological site level. It was developed to assist land managers in identifying areas that are potentially at risk of degradation and assist in the selection of sites for developing monitoring programs. Definitions of these three closely interrelated attributes are:

> *Soil Site Stability:* The capacity of the site to limit redistribution and loss of soil resources including nutrients and organic matter) by wind and water.
> *Hydrologic Function*: The capacity of the site to capture, store, and safely release water from rainfall, run-on (inflow), and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity following degradation.
> *Integrity of the Biotic Community*: The capacity of the site to support characteristic functional and structural communities in the context of normal variability, to resist loss of this function and structure due to disturbance, and to recover following disturbance.

This technique was developed as a tool for conducting a moment-in-time qualitative assessment of rangeland status and as a communication and training tool for assisting land managers and other interested people to better understand rangeland ecological processes and their relationship to indicators (Pyke at. el. 2002) This method uses soil survey information, ecological site descriptions, and appropriate ecological reference areas to qualitatively assess rangeland health. As part of the assessment process, 17 indicators relating to these attributes are evaluated and the category descriptor or narrative that most closely describes the site is recorded. "Optional Indicators" may also be developed to meet local needs. The critical link between observations of indicators and determining the degree of departure from the ecological site description and/or ecological reference area is part of the interpretation process.

This technique does not provide for just one rating of rangeland health, but based upon a "preponderance of evidence" approach, it provides the departure from the ecological site description/ecological reference area(s) for the three attributes: soil site stability, hydrologic function, and biologic integrity. There are 5 categories of departure recognized, which include "none to slight", "slight to moderate," "moderate," "moderate to extreme," and "extreme."

A slight modification of the methodology was implemented so multiple assessments in each ecological site could be combined for analysis. A rating from 1 (none to slight) to 5 (extreme) was assigned to each category. For allotments with more than one sample per ecological site, an average was calculated for each indicator and then summed for each landscape attribute. There

are 10 indicators for soil site stability and hydrologic function and 9 for biotic integrity. The score for each landscape attribute was the sum of the indicators minus the reference conditions; determined to be 10 for soil site stability and hydrologic function and 9 for biotic integrity, based on a score of 1 for each indicator per attribute. Percent departure for each attribute was a proportion calculated by dividing the score by the maximum departure value; 40 for soil stability and hydrologic function and 35 for biotic integrity; and expressed as a percentage. The results are displayed graphically as a percent departure from the reference condition. For the narrative the percent departure values are converted back into the associated qualitative categories: none to slight (<20%), slight to moderate (20-39%), moderate (40-59%), moderate to extreme (60-79%), and extreme (≥80%).

An access database was developed for digitally storing site data, comments and the 17 indicator values. A GPS point was collected at the center point of each sample site. Sample sites varied from 1 to 20 acres in size as noted in the database. Maps were generated for each allotment depicting evaluation-sites and other land features. The point data was also placed in the geodatabase for future reference.

Aquatic Assessments

The primary objective in evaluating LARO riparian and shoreline habitat was to provide the NPS with a moment-in-time status point for managing land use within their control. The three main objectives were to:

1. Identify existing riparian and shoreline condition.
2. Identify the specific threats and stressors impacting riparian/shoreline functions and values (e.g., wildlife habitat, water quality improvement, aquatic species protection, etc.).
3. Recommend solutions to minimize or eliminate threats and stressors to riparian/shoreline areas and associated aquatic resources.

Riparian areas were selected for assessment since the condition of riparian areas often control and dictate the quality of aquatic and wildlife resources that depend on these important zones of influence. Riparian habitat serves many functions including erosion control, aquatic shading and cooling, insect production, shoreline bank stabilization, and providing woody debris. Riparian areas are often the most diverse habitat areas within a watershed, containing the greatest resource diversity and productivity (Barber 2005). Riparian areas serve as a buffer between aquatic habitats and upland activities that potentially affect those habitats. In addition, these areas often contain wetlands where water is filtered, retained, and slowly released to surface water throughout the year.

On-site evaluation of aquatic resources at LARO included assessment of 21 shoreline riparian sites in four park management zone categories:

1. Day-Use Beach Sites – Ten (10) sites known to receiv e significant recreational use by boaters throughout the summer months;

2. Spokane River Arm Sites – Three (3) representative ar eas along the Spokane River Arm of Lake Roosevelt National Recreation Area;

3. River Mile Sites – Six (6) represen tative reaches of the Colum bia, Kettle, and Spokane Rivers above and below reser voir impacts (3 lotic assessments and 3 lentic assessments); and

4. Special Use Sites – Ricky Creek and Sherm an Creek special use zo nes that receive significant pressure from vacation cabin development and use (2 sites).

This section outlines the Proper Functioning Condition (PFC) methodology applied at each site to evaluate riparian/shoreline condition. Sites selected for evaluation were assessed using the "proper functioning condition" (PFC) riparian assessment methodology developed by the Bureau of Land Management for lotic, flowing water, sites (Prichard et al. 1998) or lentic, standing water, sites (Prichard et al. 2003). All site assessment locations within LARO were recommended by National Park Service personnel (Jerald Weaver, personal communication) due to their unique understanding of use and potential impacts within LARO.

Lotic Riparian PFC Assessment

The lotic PFC method evaluates 17 hydrology, vegetation, and stream geomorphology indicators of riparian condition or "health" and subsequently assigns a functionality rating to each site. The "proper functioning condition" of a lotic riparian area refers to the stability of the physical system, which in turn is dictated by the interaction of geology, soil, water, and vegetation. A properly functioning lotic riparian area is in dynamic equilibrium with its streamflow forces and channel processes. The channel adjusts in slope and form to handle larger runoff events with limited perturbation of channel characteristics and associated riparian plant communities. Because of this stability, properly functioning lotic riparian areas can maintain fish and wildlife habitat, water quality enhancement, and other important ecosystem functions even after large storms. In contrast, nonfunctional systems subjected to the same storm events might exhibit excessive erosion and sediment loading, loss of fish habitat, loss of associated wetland habitat, and so on.

Based on assessments of the hydrologic, vegetative, and geomorphology elements of the lotic riparian areas, one of the following three functionality ratings was assigned to each site:

Proper Functioning Condition (PFC): Streams and associated riparian areas are functioning properly when adequate vegetation, landform, or large woody debris is present to:

1. dissipate stream energy associ ated with high waterflows, thereby reducing erosion and improving water quality;

2. filter sediment, capture bedload, and aid floodplain development;

3. improve floodwater retention and groundwater recharge;

4. develop root masses that stabilize stream banks against cutting action;

5. develop diverse ponding and channel character istics to provide habitat and the w ater depths, durations, temperature regimes, and substrates ne cessary for fish production, waterfowl breeding, and other uses; and

6. support greater biodiversity.

Functional - At Risk: These riparian areas are in functional condition, but an existing soil, water, vegetation, or related attribute makes them susceptible to degradation. For example, a stream reach may exhibit attributes of a properly functioning riparian system, but it may be poised to suffer severe erosion during a large storm due to likely migration of a headcut or increased runoff associated with recent urbanization in the watershed. When this rating is assigned to a stream reach, its "trend" toward or away from PFC is assessed.

Nonfunctional: These are riparian areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, sustaining desirable channel and riparian habitat characteristics, and so on as described in the PFC definition. The absence of certain physical attributes such as a floodplain where one should exist is an indicator of nonfunctioning conditions.

Lotic riparian functional condition was assessed on 3 reaches, including one reach on each of the Columbia, Kettle, and Spokane Rivers immediately above confluences with the reservoir, pooled conditions. Each river reach is discussed in the Aquatic Results section and each assessment is supported by a detailed PFC assessment checklist in Appendix B.

Lentic Riparian PFC Assessment

The lentic PFC method evaluates 20 hydrology, vegetation, and erosion/deposition (soils) attributes and processes to assess the condition of riparian wetland areas. For these areas PFC is a state of resiliency that will allow a lentic riparian/wetland area to hold together during wind and wave action events or overland flow events with a high degree of reliability (Prichard et al 2003). This resiliency provides opportunities to achieve desired values over time such as waterfowl and amphibian habitat, shoreline protection, or wildlife forage.

Based on assessments of the hydrologic, vegetative, and erosional/depositional elements of the riparian/wetland area, one of the following three functionality ratings is assigned to each site:

Proper Functioning Condition (PFC): Lentic riparian/wetland areas are functioning properly when adequate vegetation, landform, or debris is present to:

1. dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, thereby reducing erosion and improving water quality;

2. filter sediment and aid floodplain development;

3. improve flood water retention and ground-water recharge;

4. develop root masses that stabilize islands and shoreline features against cutting action;

5. restrict water percolation;
6. develop diverse ponding characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, water bird breeding, and other uses; and
7. support greater biodiversity.

Functional – At Risk: Riparian/wetland areas that are in functional condition, but that have an existing soil, water, or vegetation attribute that makes them susceptible to degradation.

Nonfunctional: Riparian/wetland areas that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality.

Riparian/wetland functional condition was assessed on 18 lentic sites, including 10 day-use beach sites; 3 Spokane River Arm sites; 3 river mile sites downstream of the reservoir influence on the Columbia, Kettle, and Spokane Rivers; and 2 special use sites at Ricky and Sherman Creeks. Individual LARO lentic assessments are discussed in more detail in the Aquatic Results section below and each assessment is supported by a detailed lentic PFC assessment checklists in Appendix B.

Upland Assessment Results

GIS and Geodatabase

The LARO Geodatabase was populated with 37 shapefiles and images (Appendix A). These are all accessible from the ArcGIS Map Project file located on the DVD included with this report. Additional copies are available from the Upper Columbia Basin Network's website http://science.nature.nps.gov/im/units/ucbn/reports/.

Site Specific Assessments

Site specific assessments were made in the 6 allotments identified in the methods sections. All but the Matney allotment are still actively grazed following approved leases. Grazing in the Matney allotment was discontinued in 2007. The following is an evaluation of each allotment with maps of sample points and soils, which are the basis for the ratings of the 3 landscape attributes. All data collected at the 21 sample points were digitized into a Microsoft Access database and a shapefile was generated from GPS locations. The database is included with the enclosed DVD and the shapefile is located in the LARO Geodatabase under the Geography category called nrca_plots.shp. Appendix A includes a table with all indicator ratings by plot and a species list with canopy cover by plot.

Rosenberg Allotment

The Rosenberg allotment is located in 2 parcels, labeled West and East on the maps. The west parcel is 53 acres with 40 animal unit months (AUM) (Figure 6) and the east parcel is 263 acres with 20 AUM. Both allotments are generally steep-sided slopes grading down to Lake Roosevelt.

Rosenberg Allotment West is dominated by basin big sagebrush with patches of antelope bitterbrush distributed throughout the allotment. Soils were Nespelem (49) and Ewall (37) from the Lincoln County soil survey and the ecological sites were Loamy 9-15PZ (R008XY102WA) and Sandy 9-15PZ (R008XY501WA), respectively. Three points were sampled in the Loamy 9-15PZ (Figure 7). The soil stability and hydrologic function attributes were rated as none-slight departure (15% and 18%, respectively). The biotic integrity attribute was rated slight-moderate (23%) due to the presence of invasive plants and the decadence of shrub species. One sample was taken in the Sandy 9-15PZ (Figure 8). Soil stability and hydrologic function attributes were rated as slight-moderate departure (20% and 25%, respectively). Biotic integrity was rated moderate (46%) due to the presence of invasive plants, reduced litter cover, and the decadence of shrub species, especially antelope bitterbrush.

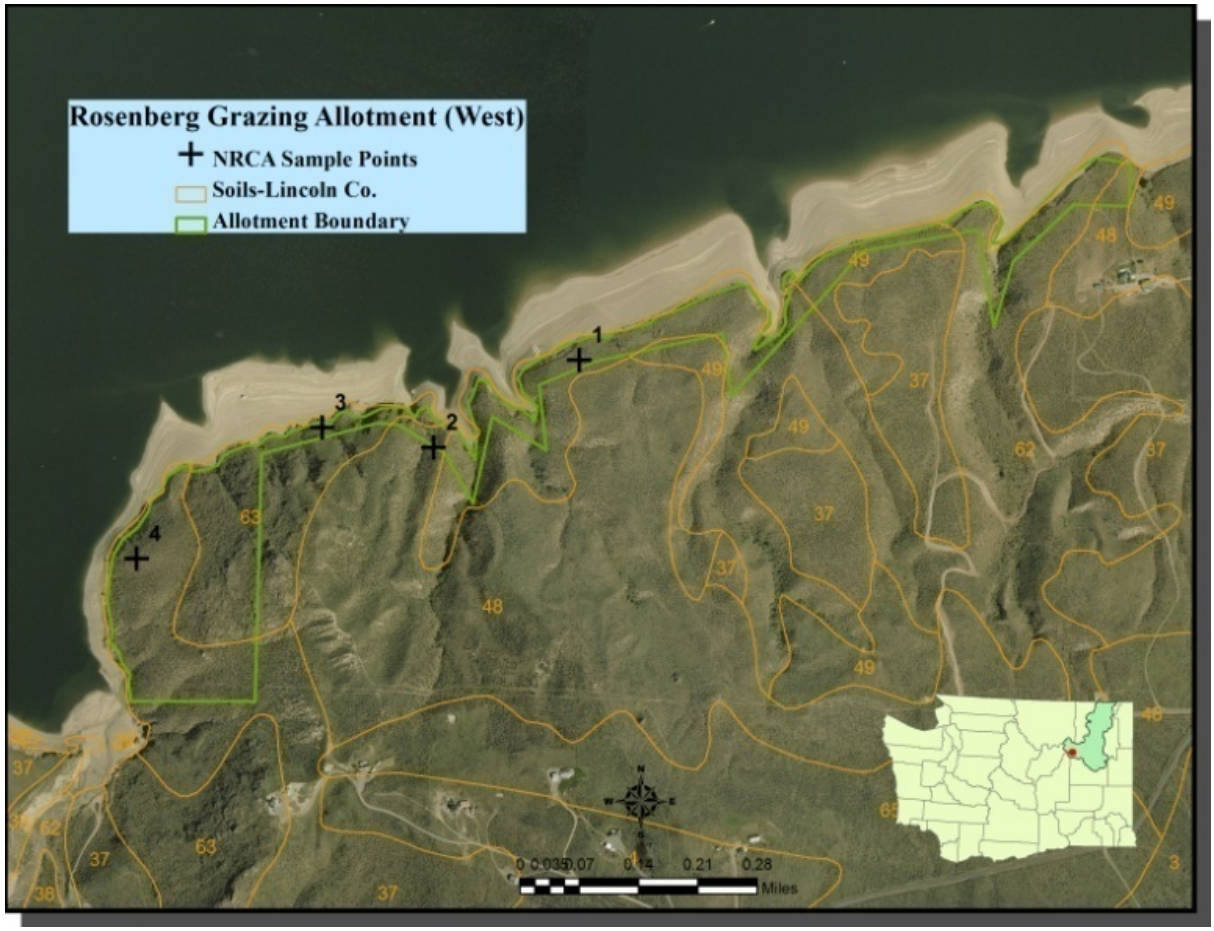

Figure 6. NRCA sample points and soils in the Rosenberg Allotment West, LARO.

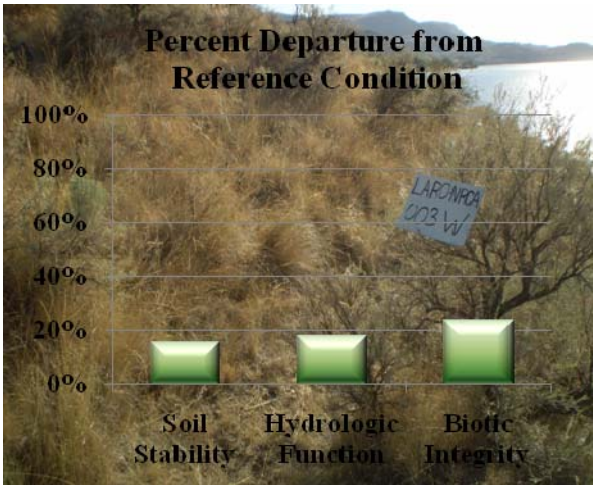

Figure 7. Departure from reference condition of the 3 landscape attributes in the Loamy 9-15PZ ecological site, Rosenberg Allotment West, LARO (background is of plot 3).

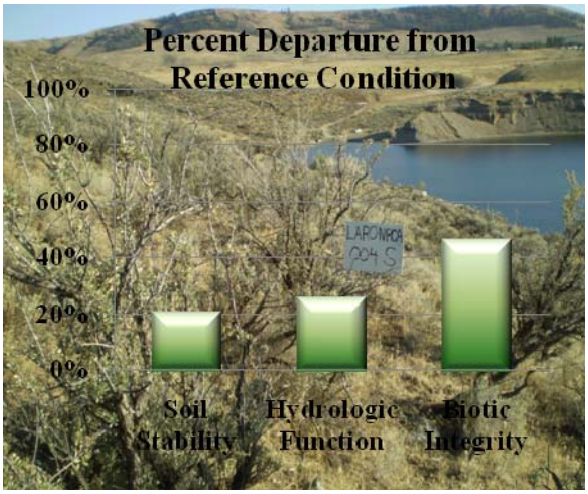

Figure 8. Departure from reference condition of the 3 landscape attributes in the Sandy 9-15PZ ecological sites, Rosenberg Allotment West, LARO (background is of plot 4).

Rosenberg Allotment East was very similar to Rosenberg Allotment West in topography and vegetation (Figure 9). In addition to the soils from Rosenberg West, Nespelem and Ewall, There were 2 additional soils, Conconully (27) and Pedigo (53), with ecological sites of Sandy 9-15PZ (R008XY501WA) and Alkali Bottom 15+PZ (R009XY401WA), respectively. There were 2 sample points in the Loamy 9-15PZ and one sample point in each of the other ecological sites. In all 4 ecological sites, the soil stability and hydrologic function attributes were less than 20% departure from reference condition with a rating of none-slight (Figures 10-13). The biotic integrity for the Sandy 9-15PZ and Loamy 9-15PZ varied between 27-31% departure from reference condition with a rating of slight-moderate. This rating was due to similar conditions in Rosenberg West, with the presence of some invasive species and decadence in the shrub component.

Figure 9. NRCA sample points and soils in the Rosenberg Allotment East, LARO

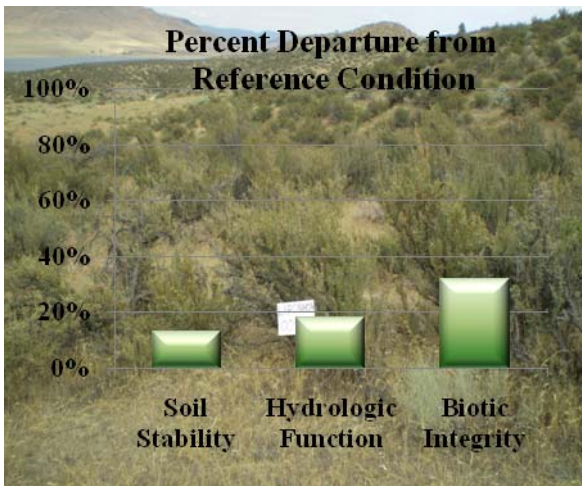

Figure 10. Departure from reference condition of the 3 landscape attributes in the Sandy 9-15PZ ecological sites, Rosenberg Allotment East, LARO (background is of plot 9).

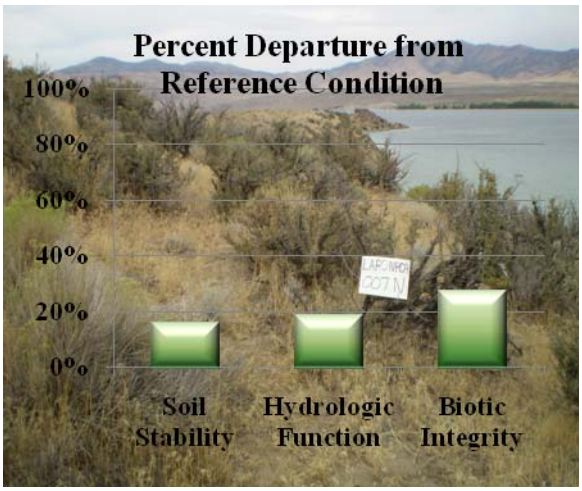

Figure 11. Departure from reference condition of the 3 landscape attributes in the Loamy 9-15PZ ecological sites, Rosenberg Allotment East, LARO (background is of plot 7).

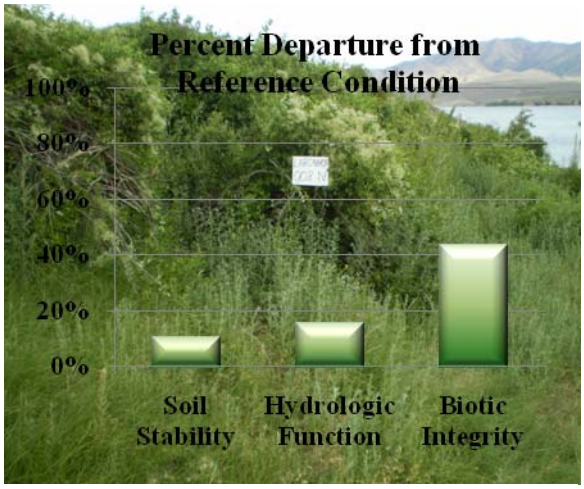

Figure 12. Departure from reference condition of the 3 landscape attributes in the Alkali Bottom 15+PZ ecological sites, Rosenberg Allotment East, LARO (background is of plot 8).

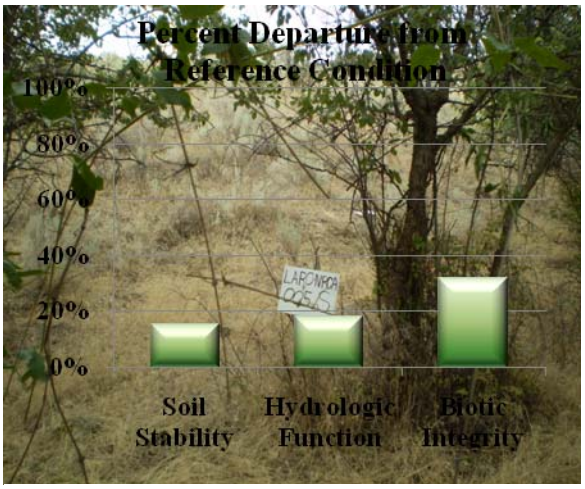

Figure 13. Departure from reference condition of the 3 landscape attributes in the Sandy 9-15PZ ecological sites, Rosenberg Allotment East, LARO (background is of plot 5).

The Alkai Bottom 15+PZ site was located in a draw along the southern portion of the allotment that had a spring, which supported an unusual collection of vegetation (Figure 12). Patches of Wood's rose were surrounded by a dense patch of alkali cordgrass (*Spartina gracilis*) and Kentucky bluegrass (*Poa pratensis*) along with many non-native species. The biotic integrity had a 43% departure from reference conditions and had a rating of moderate. This site may have

been developed in the past, which would explain the presence of numerous non-native species. Impacts from livestock grazing were generally more noticeable on slopes less than 40%. There are many trails that parallel the slope in steep areas but impact to the vegetation is minimal. Wagner et al. (2005) evaluated the allotment in 2004 and had comparable results. Their rating of none-slight for soil stability and hydrologic function are the same and they rated biotic integrity as slight-none, which was the same for 2 of the 4 ecological sites in this study.

Green Allotment

The Green Allotment lies directly south of the Rosenberg Allotment East (Figure 14). The parcel is 121 acres with 15 AUM. The allotment grades from steep dissected slopes in the north to gradual slopes and benches. The southeast portion of the allotment grades back into steeper slopes. Vegetation is dominated by basin big sagebrush with patches of antelope bitterbrush distributed throughout the allotment. Ponderosa pine occurs in the southeast end of the allotment on the steeper slopes.

Soils in the allotment are Ewall (36) and Conconully (27) from the Lincoln County soil survey. Ewall was classified as a Sandy 9-15PZ (R008XY501WA) ecological site and Conconully was

Figure 14. NRCA sample points and soils in the Green Allotment, LARO.

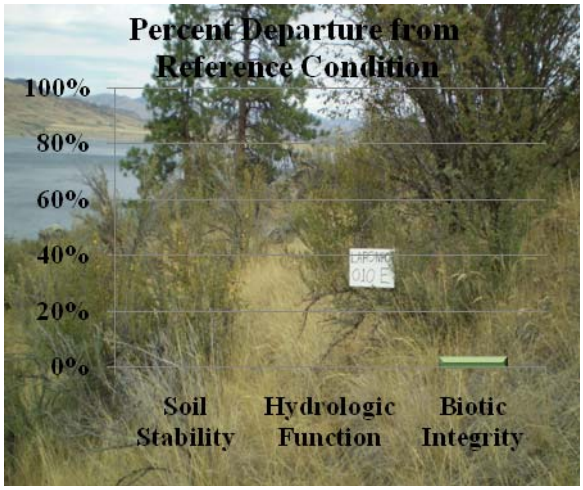

Figure 15. Departure from reference condition of the 3 landscape attributes in the Loamy 9-15PZ ecological sites, Green Allotment - East, LARO (background is of plot 10).

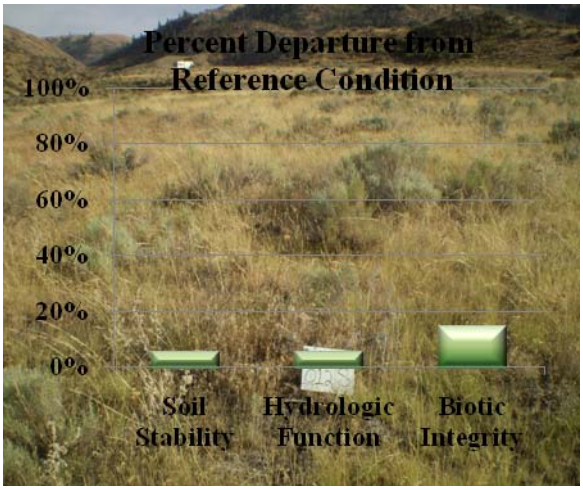

Figure 16. Departure from reference condition of the 3 landscape attributes in the Sandy 9-15PZ ecological sites, Green Allotment, LARO (background is of plot 12).

classed as a Loamy 9-15PZ (R008XY102WA) ecological site. One was sampled in the Loamy 9-15PZ on the steeper slopes and 2 points were sampled in the Sandy 9-15PZ in the lower gradient slopes closer to the lake.

The 1 sample taken in the Loamy 9-15PZ ecological site was in excellent condition. Soil stability, hydrologic function, and biotic integrity were all none-slight departure, <3% (Figure 15). Wagner et al. 2005 rated the allotment the same for the Sandy 9-15PZ ecological site and came up with the same departure ratings but did not consider the Loamy 9-15PZ. There were 2 noxious weeds, Dalmatian toadflax and Russian knapweed, noted at the site however they were only located along a gravel road running parallel with the lake. Once away from the road the vegetation was dominated by native species. In the Sandy 9-15PZ all 3 attributes; soil stability, hydrologic function, and biotic integrity were rated as none-slight departure, 5%, 5%, and 18%, respectively (Figure 16). As indicated on the map (Figure 14), there are few home sites near the allotment, but it was noted that a camping trailer was parked on private land adjacent to the west boundary and south of sample point 12.

Coffman Allotment

The Coffman allotment lies directly east of the Keller-Wilbur Ferry station on the south side of Lake Roosevelt (Figure 17). The parcel is 43 acres with approximately 10 AUM. The allotment is open to the lake and is very flat, 1-2% slopes. An irrigated agricultural field borders the allotment on the south and west boundary. Vegetation varies from a rubber rabbit brush dominated site with a sand dropseed understory to a highly disturbed site dominated by scouringrush horsetail (*Equisetum hyemale*) and cheatgrass. Several small patches of willow (*Salix sp.*) and black cottonwood occur along the high water line of the lake.

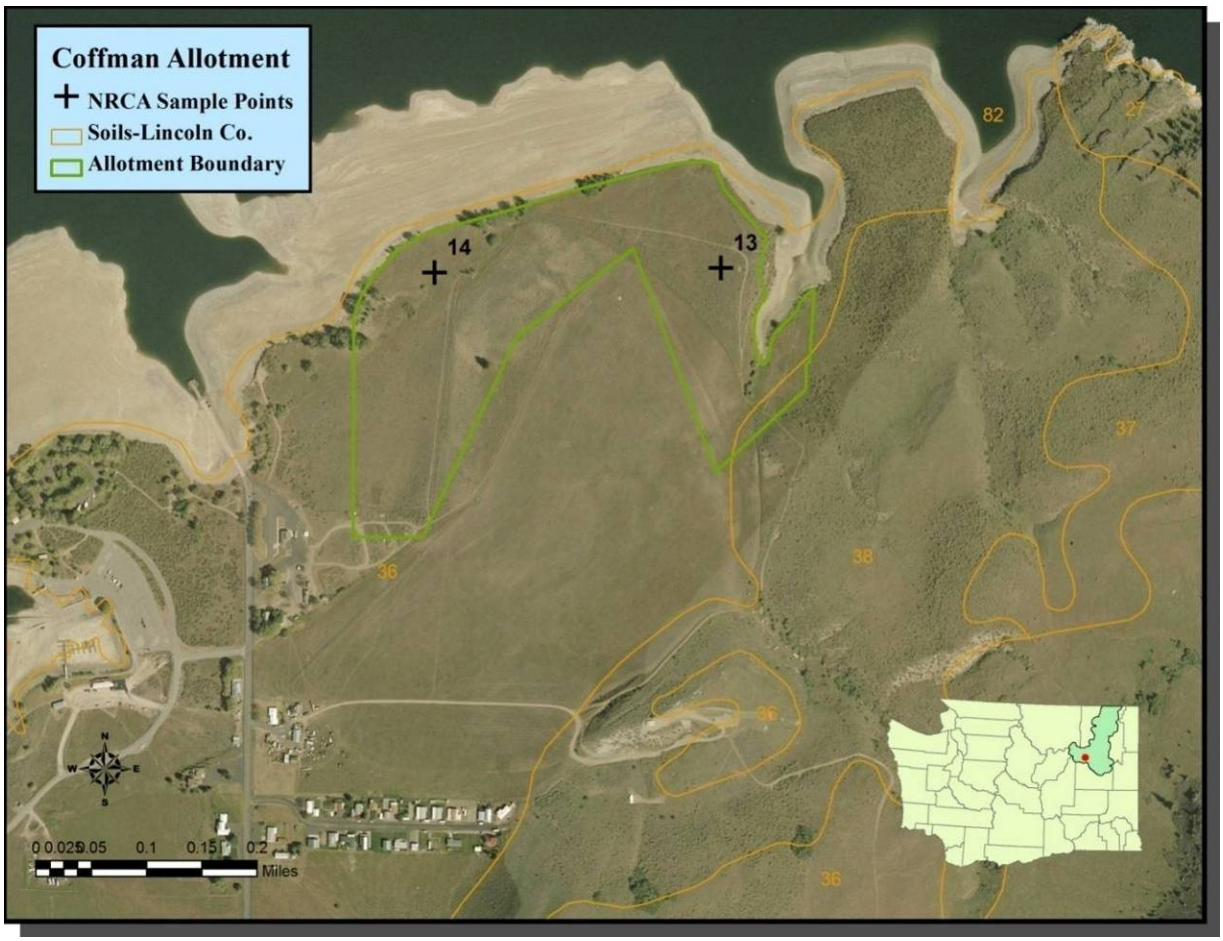

Figure 17. NRCA sample points and soils in the Coffman Allotment, LARO.

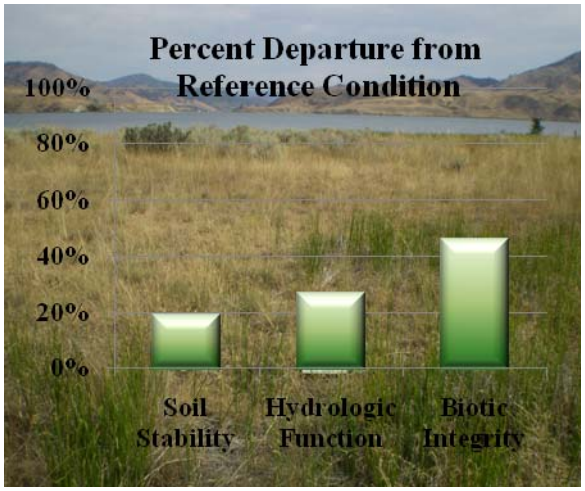

Figure 18. Departure from reference condition of the 3 landscape attributes in the Sandy 9-15PZ ecological sites, Coffman Allotment, LARO (background is of plot 14).

The entire allotment is mapped as a Ewall (36) soil, from the Lincoln County soil survey. Ewall is classified as a Sandy 9-15PZ (R008XY501WA) ecological site. Two points were sampled, one in the more native vegetation and the other in the more disturbed site. The soil stability attribute was rated none-slight departure (19%), while hydrologic function was rated slight-moderate (26%), and biotic integrity was rated moderate departure (46%) (Figure 18). The individual ratings for the sample point were very similar (Appendix A). The biotic integrity rating was due to the large number of invasive plants, and the poor reproductive capability of the native species.

Wagner et al. 2005 did not evaluate this allotment. Grazing and other past uses at this site have reduced the native component of the vegetation and productivity of the site. As can be noted from Figure 16, the allotment is within a quarter mile of a ferry terminal and commercial, residential, and recreational developments. These developments will most likely continue to grow and place more pressure on the natural resource attributes within the allotment, such as increased water runoff and a source for noxious weeds. Agricultural practices, such as fertilization and chemical treatments, on the park and adjacent private lands will have potentially negative impacts to the natural resources in the allotment.

Fort Spokane

Fort Spokane is a historical site located on a flat bench lying south of the confluence of the Spokane and Columbia Rivers (Figure 19). The 100 acre site is bisected by Washington State Highway 25, with all the historical buildings located to the west and a grass pasture lying to the east. The parcel is surrounded on the north and south by mature ponderosa pine forest, a grass pasture to the east and the Spokane River Arm of Lake Roosevelt to the west. Vegetation on both sides of the highway is a mixture of grass from past seedings and native and non-native species naturally seeding in from surrounding areas.

The soil at the site is mapped as a Springdale (73) gravelly sandy loam from the Lincoln County soil survey. This soil is not classified as a rangeland soil and does not have a reference ecological site description. The climax vegetation is ponderosa pine forest with a grass understory, dominated by needle and thread (*Hesperostipa comata*) and bluebunch wheatgrass. One sample point was taken east of the highway (Figure 20). The site was dominated by Sandberg bluegrass with crested wheatgrass (*Agropyron cristatum*), quackgrass (*Elymus repens*) and cereal rye (*Secale cereal*) which were planted on the site in the past. Several annual bromes have invaded the site but accounted for <2% canopy cover. Forbs composed <5% canopy cover due mainly to the site being treated with herbicides for weed control on a regular basis. The site is also mowed several times a year to control weeds and reduced fire hazard.

The Fort Spokane site was evaluated for the 3 landscape attributes by using the published soil descriptions for the Springdale soil series (Donaldson et al. 2004) and published plant composition for the ponderosa pine/bluebunch wheatgrass association (Williams et al. 1996, Lillybridge et al. 1995). Soil stability attribute was rated none-slight departure (5%), while hydrologic function was also rated none-slight (15%), and biotic integrity was rated moderate departure (49%) (Figure 20).

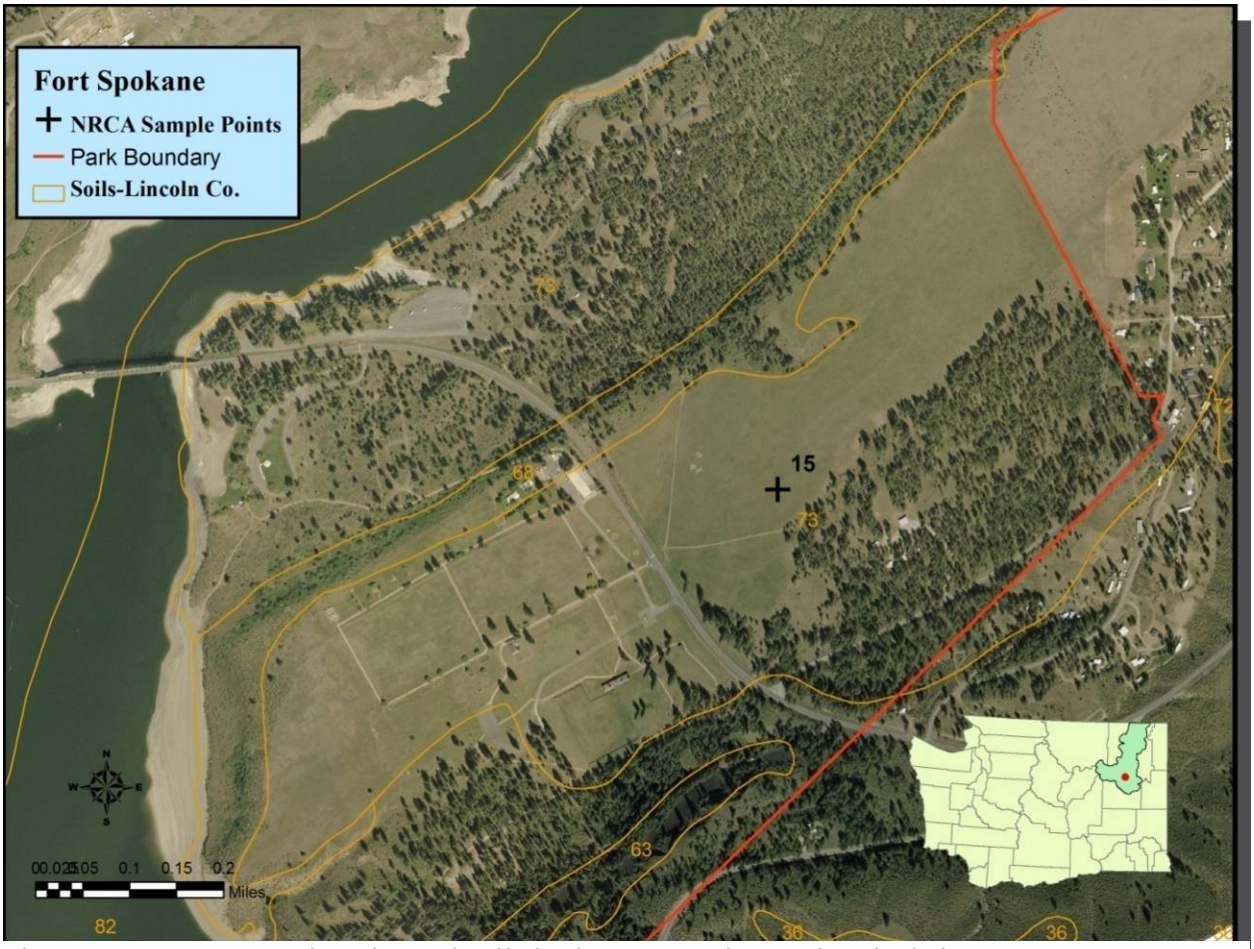

Figure 19. NRCA sample point and soils in the Fort Spokane Historical site, LARO.

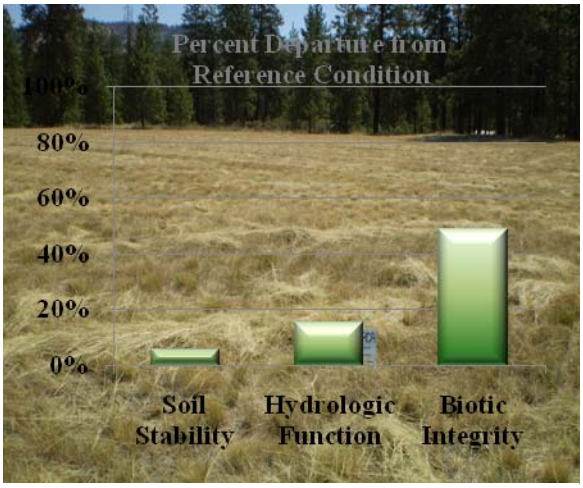

Figure 20. Departure from reference condition of the 3 landscape attributes in the Springdale soil series and Ponderosa pine/bluebunch wheatgrass association, Fort Spokane, LARO (background is of plot 15).

The conversion of the forested site to a grass pasture with the exclusion of grazing has not negatively impacted the soil stability or hydrologic function attributes. The biotic integrity attribute has been greatly changed and would have been rated even higher if departure of soil-related indicators where rated higher. Even though the pasture is not in a native condition, there were few noxious weeds. The site had been recently mowed and many of the plants were cured, which most likely reduced our ability to identify any annual weeds. Since the site is managed for historical values, the field is in reasonable condition. Mowing may be a questionable practice for noxious weed control and can possibly encourage some species of rhizomatous perennial noxious weeds, such as rush skeleton weed. Mowing may be used to maintain the cultural landscape setting of the site or to reduce the risk of fire.

Gifford Allotment

The Gifford allotment lies approximately ½ mile south of the town of Gifford and north of the Cloverleaf Campground (Figure 21). The parcel is 25 acres with 10 AUM. The allotment lies on a bench above Lake Roosevelt and is flat, 1-2% slope. State Highway 25 forms the eastern boundary of the allotment. The allotment is mainly a grass pasture created by removing the native ponderosa pine forest. A 200'-350' band of ponderosa pine dominated vegetation lies on the east and north edge of the grass pasture.

The soil at the allotment is mapped as a Cedonia (46) silt loam from the Stevens County soil survey. This soil is not classified as a rangeland soil and does not have a reference ecological site description. The climax vegetation is a ponderosa pine forest with an understory dominated by common snowberry and pinegrass (*Calamagrostis rubescens*). Two sample points were taken, one in the grass pasture and one in the forest vegetation to the east (Figure 21). The grass pasture was a mixture of perennial grasses, quackgrass and smooth brome (*Bromus inermis*), and an assortment of annual brome grasses (*Bromus tectorum*, *B. japonicas*, and *B. mollis*). Forbs were dominated by sulphur cinquefoil (*Potentilla recta*) a Washington State Class B noxious weed. Total canopy cover was approximately 38% grass and 61% forb. Surface cover was approximately 40% bare ground and 30% litter cover.

The forested sample point was dominated by ponderosa pine (62% canopy cover) with an understory of common snowberry and quackgrass. Canopy cover of shrubs, grasses, and forbs was 8%, 19%, and 3%, respectively. Litter covered approximately 90% of the surface with only 3% bare ground.

Each sample site was evaluated for the 3 landscape attributes by using the published soil descriptions for the Cedonia soil series (Donaldson et al. 2004) and published plant composition for the ponderosa pine/pinegrass association (Williams et al. 1996. Lillybridge et al. 1995). The grass pasture soil stability attribute was rated slight-moderate departure (25%), while hydrologic function was also rated slight-moderate (38%) but was considerable higher in percent departure (Figure 22). The biotic integrity attribute was rated moderate departure (54%) but would have been moderate-extreme without low ratings of the compaction and plant mortality indicators (Figure 22).

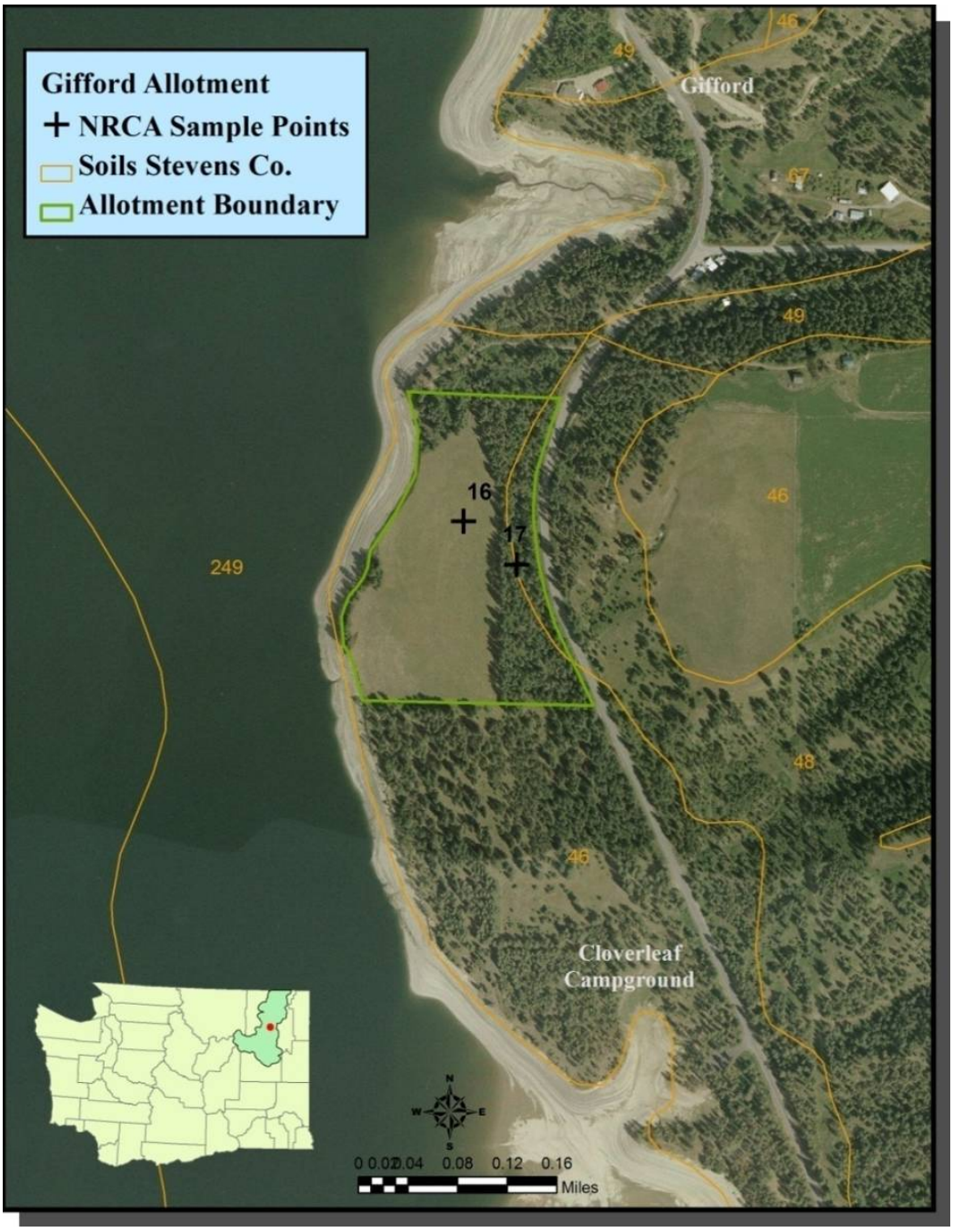

Figure 21. NRCA sample points and soils in the Gifford Allotment, LARO.

The forested sample site had a none-slight departure (0%) for soil stability and hydrologic function was also rated none-slight (5%) (Figure 23). The biotic integrity attribute just crossed into the slight-moderate departure (20%) due to the presence of several non-native and noxious weed understory species that have infiltrated from the adjacent grass pasture (Figure 23).

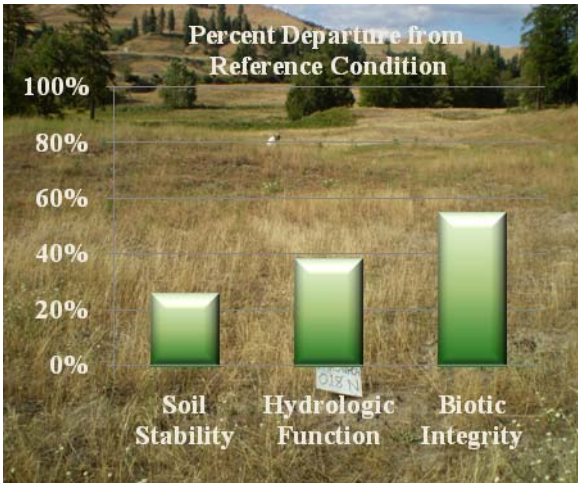

Figure 22. Departure from reference condition of the 3 landscape attributes in the Cedonia soil series and Ponderosa pine/pinegrass association, Gifford Allotment, LARO (background is of plot 16).

Figure 23. Departure from reference condition of the 3 landscape attributes in the Cedonia soil series and Ponderosa pine/pinegrass association, Gifford Allotment, LARO (background is of plot 17).

The conversion of a forested site to a grass pasture with the past grazing regime has negatively impacted the soil stability and hydrologic function attributes on the allotment. The more serious impact is to the biotic integrity attribute. The allotment is dominated by non-native species (67% canopy cover) of which noxious weeds occupy 23% of the canopy cover.

The site will continue to degrade without revegetation efforts and modifications to the grazing practices. If grazing is a goal for management, the allotment could be improved by reseeding to a native/non-native grass seed mix with pre and post herbicide treatments. Grazing would have to be limited for a 3-5 year period post seeding. If grazing were to be eliminated as the management goal, the site could be replanted with ponderosa pine and allowed to recover back to a more native condition, as seen in the adjacent forest stand. The Cloverleaf campground is very close and there were signs of camping along the northern edge of the allotment. The allotment will continue to receive recreational use which will have the potential to spread the existing noxious weeds.

Matney Allotment

The Matney allotment lies along the north shore of Lake Roosevelt across the lake from the town of Marcus (Figure 24). The parcel is 77 acres with 20 AUM. The majority of the allotment lies on a bench approximately 100' above Lake Roosevelt. The western end of the allotment is lower in elevation with developed intermittent stream channel flowing through the allotment. Slopes vary from 1-20%.

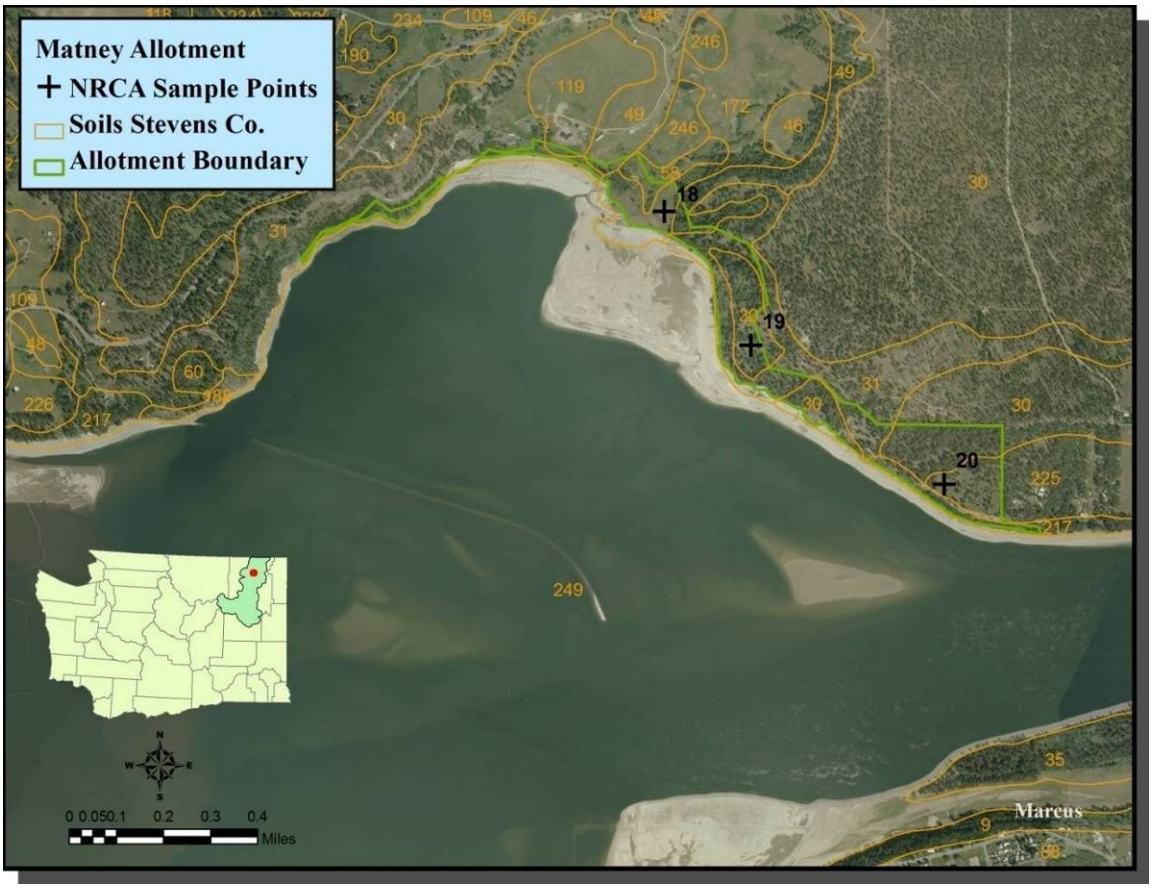

Figure 24. NRCA sample points and soils in the Matney Allotment, LARO.

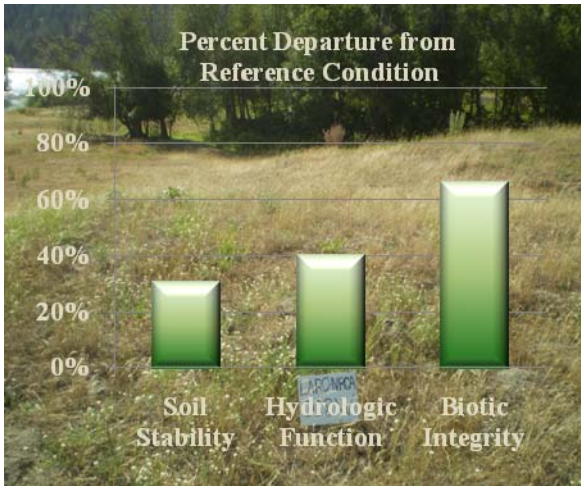

Figure 25. Departure from reference condition of the 3 landscape attributes in the Wet Meadow 15+PZ ecological site, Matney Allotment, LARO (background is of plot 18)

The soil at the west end of the allotment is a Peone (172) silt loam and is classified as a Wet Meadow 15+PZ (R044XY601WA) ecological site. The soils at the other 2 sample sites are Bisbee loamy fine sand, and Springdale sandy loam both from the Stevens County soil survey. These soils are not classified as a rangeland soil and do not have reference ecological site descriptions. The climax vegetation is a ponderosa pine forest with an understory dominated by common snowberry and bluebunch wheatgrass.

The Wet Meadow 15+PZ sample site was dominated by invasive grasses specifically Kentucky bluegrass and quackgrass (each with 30% of the canopy cover). All the other grasses and most of the forbs were non-native. Six noxious weeds occupied 17% of the canopy cover. The soil stability attribute was rated as slight-moderate (30%) departure (Figure 25). The hydrologic function attribute was rated moderate (40%) departure, while the biotic integrity attribute was rated moderate-extreme (66%) departure. Wagner et al.(2005) rated all the attributes as moderate departure. Their recommendation of excluding livestock grazing and active management of noxious weeds is supported by this study. Fencing is being installed around the entire allotment by LARO staff to exclude livestock based on past recommendations.

The soils for the other two sample sites are Bisbee (30) loamy fine sand (plot 19) and Springdale (225) sandy loam (plot 20). Each sample site was evaluated separately for the 3 landscape attributes by using the published soil descriptions (Donaldson et al. 2004) and published plant composition for the ponderosa pine/bluebunch wheatgrass association (Williams et al. 1996. Lillybridge et al. 1995). Soil stability at both sample sites, plots 19 and 20, was rated none-slight departure (13% and 3%, respectively). The hydrologic function was rated slight-moderate (20%) for plot 19 and none-slight (5%) departure for plot 20. Biotic integrity was rated slight-moderate (37% and 26%, respectively) for both plots (Figures 26 and 27).

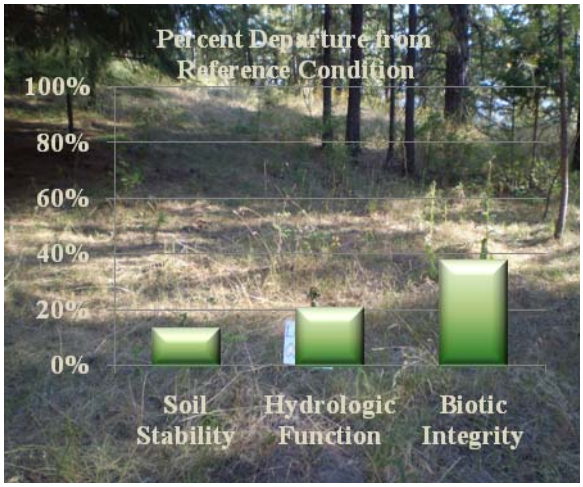

Figure 26. Departure from reference condition of the 3 landscape attributes in the Bisbee soil series and ponderosa pine/bluebunch wheatgrass association, Matney Allotment, LARO (background is of plot 19).

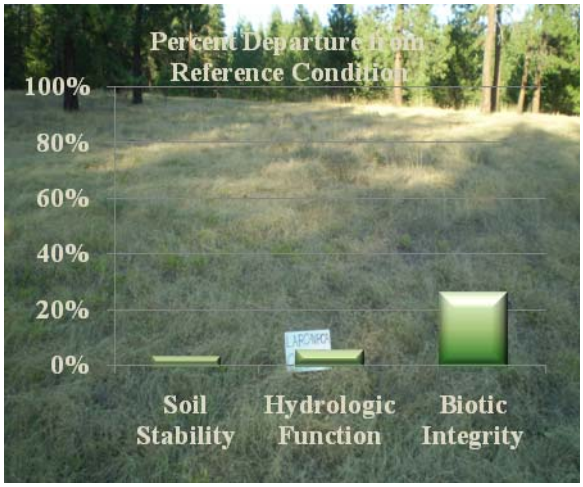

Figure 27. Departure from reference condition of the 3 landscape attributes in the Bisbee soil series and ponderosa pine/bluebunch wheatgrass association, Matney Allotment, LARO (background is of plot 20).

Both sample sites had evidence of grazing by livestock but had not received the intensity of use found on plot 18. These sites were not as productive however they still maintained a ponderosa pine overstory and common snowberry understory. The only noxious weeds found were hoary cress and common St. Johnswort. Hoary cress is a perennial rhizomatous species and should be monitored and or treated to prevent spreading. These sites were not examined by Wagner et al. 2005. If grazing is excluded from the entire allotment, then these sites will recover fairly rapidly due to the presence of native species and the relatively good condition of the soil integrity and hydrologic function attributes.

Henslee Allotment

The Henslee Allotment lies along the east side of the Kettle River, approximately 7 miles upstream from the mouth. The parcel is 37.5 acres with 36 AUM. The allotment is located on a flat bench in an oxbow of the Kettle River (Figure 28) which forms the west and north boundary. Kettle River Road forms the eastern boundary of the allotment and the home of the permittee lies adjacent to the northeast corner. The allotment was created by removing the native ponderosa pine forest and seeding to grasses. The pasture is surrounded by ponderosa pine dominated vegetation on the east and north edge of the pasture.

The dominant grass in the allotment is quackgrass (20% of the canopy cover) and Kentucky bluegrass (10% of the canopy cover) with grasses comprising 46% of the cover. Forbs were dominated by common St. johnswort (15% canopy cover) and woolly plantain (*Plantago patagonica*) (10% canopy cover) with all forbs comprising 48% of the cover. Noxious weeds included; sulphur cinquefoil (Class B), diffuse knapweed (Class C), and common St. johnswort (Class C) made up 22% of the total canopy cover. Surface cover was approximately 50% bare ground and 30% litter.

The allotment was evaluated for the 3 landscape attributes by using the published soil descriptions for the Bisbee soil series (Donaldson et al. 2004) and published plant composition for the ponderosa pine/bluebunch wheatgrass association (Williams et al. 1996. Lillybridge et al. 1995). The pasture soil stability attribute was rated slight-moderate departure (23%), while hydrologic function was also rated slight-moderate (35%) however this attribute was considerable higher in percent departure (Figure 29). The biotic integrity attribute was rated moderate-extreme departure (63%) due to the domination of invasive species, non-native and noxious weeds (54% of the canopy cover).

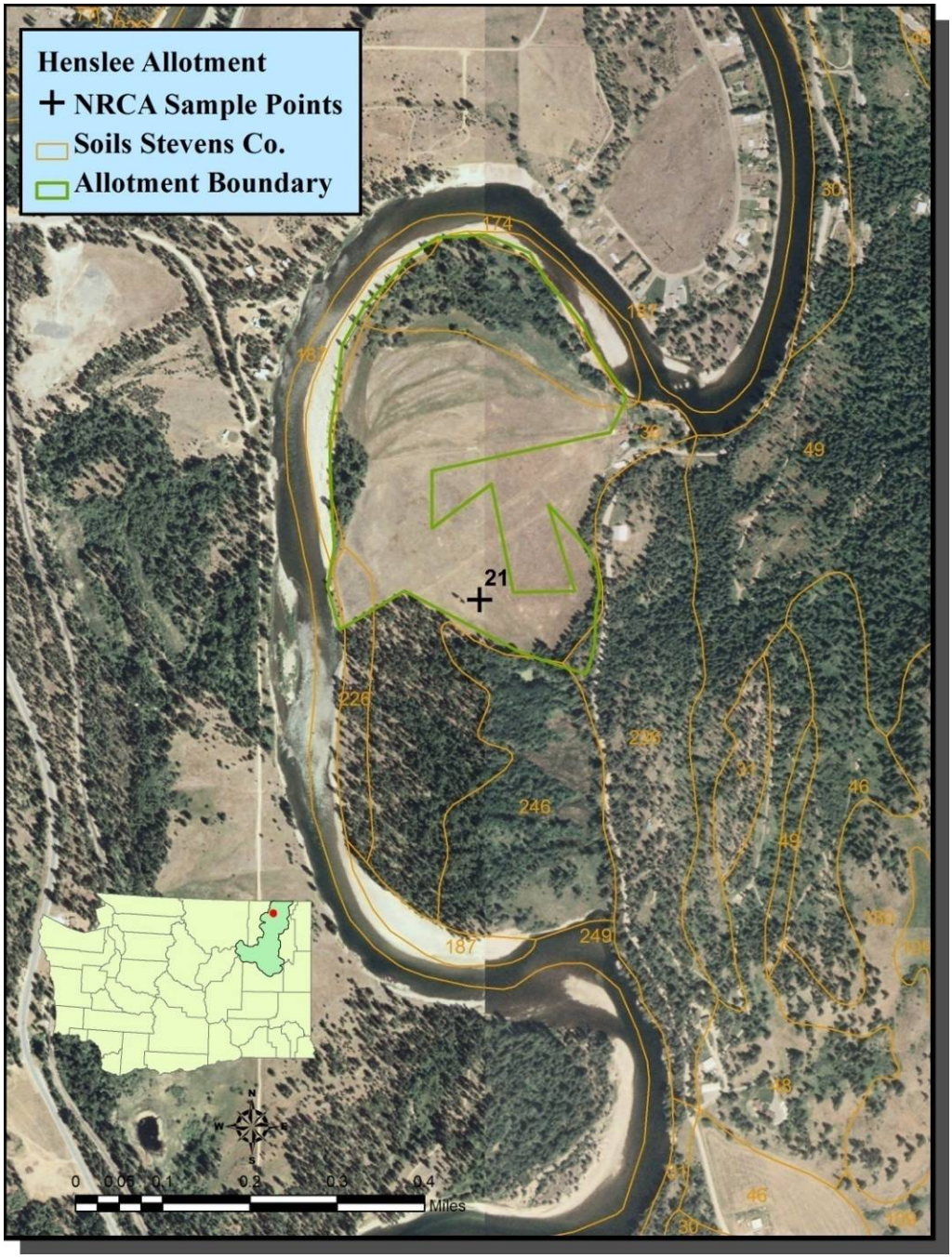

Figure 28. NRCA sample point and soils in the Henslee Allotment, LARO.

The pasture in this allotment was not rated by Wagner et al. (2005) but they did comment on the poor condition of the pasture while rating the adjacent wetlands. They recommended possible changes to the type of livestock use in the pasture from horses and llamas to cattle and /or sheep as a way to improve condition. If grazing is a goal for management, the allotment could be improved by reseeding to a native/non-native grass seed mix with pre- and post-herbicide treatments. Grazing would have to be limited for a 3-5 year period post seeding. If grazing were to be eliminated as the management goal, the site could be replanted with ponderosa pine and allowed to recover to a more native condition, as seen in the adjacent forest stand. The allotment will always be exposed to the activities of the adjacent home site, especially in the control of noxious weeds.

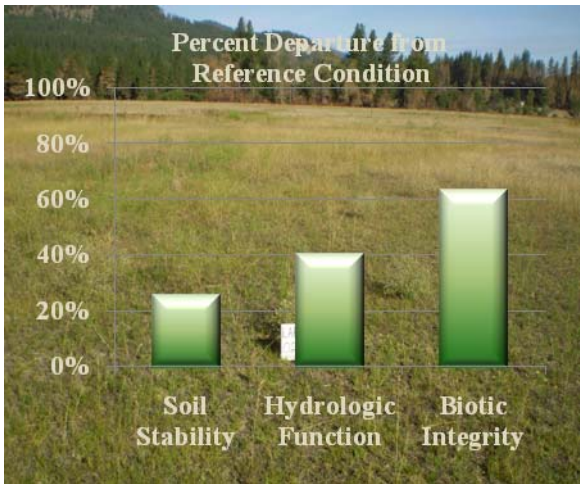

Figure 29. Departure from reference condition of the 3 landscape attributes in the Bisbee soil series and ponderosa pine/bluebunch wheatgrass association, Henslee Allotment, LARO (background is plot 21).

Aquatic Assessment Results

Day-Use Beach Sites

Day-use beach sites were selected by NPS personnel as areas receiving significant recreational use by boaters and other water-users during the summer. These 10 day-use beach sites were assessed using the lentic PFC methodology (Prichard et al 2003).

LARO Beach 1

This site, located in a large embayment just north (i.e., upstream) of the City of Kettle Falls, and was assessed in July 2008 (Figure 30). A small tributary known as Martin Spring enters the embayment just downstream of the assessed reach and receives frequent use by boaters. In addition, the site is accessible by vehicle due to the presence of a primitive dirt road accessed from Highway 25.

Due to seasonal drawdowns of Lake Roosevelt water levels, the LARO Beach 1 riparian area experiences significant periods of de-saturation. This unnatural phenomenon impacts the ability of the riparian area to function at a high level. This site is impacted by land use activities in the upland watershed due to its proximity to Highway 25 and frequent human access. The natural surface or subsurface flow patterns occurring at LARO Beach 1 are altered by human and animal use of the site including hoof action, roads, boating, and camping. On-site riparian vegetation at LARO Beach 1 is dominated by reed canarygrass (*Phalaris arundinacea*) and willow (*Salix* spp.) (Figure 31). There is very little vegetative diversity on-site, with the majority of vegetation consisting of facultative herbaceous and shrub/scrub species. The apparent absence of obligate plant species indicates that soil saturation is limited by seasonal water level fluctuations.

The PFC evaluation of LARO Beach 1 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. In this case, human and animal use of the site is preventing typical vegetative succession expected at the site. Excessive human and animal use prevents establishment of diverse age classes and composition of native vegetation on-site, which has allowed reed canarygrass to become firmly established. As a result, the site is trending away from becoming properly functioning ("downward") and will continue trending downward unless the spread of reed canarygrass can be controlled and human disturbance minimized.

Figure 30. Map of LARO Beach 1 sample site.


Figure 31. Photograph of the LARO Beach 1 sample site.

LARO Beach 2

Due to seasonal fluctuations in water levels within Lake Roosevelt, the riparian area of the LARO Beach 2 site (Figure 32) is frequently de-watered, which results in soil de-saturation, which can limit the diversity of hydrophytic vegetation. This site is influenced by human-induced upland impacts in the watershed, especially due to the presence of Hallam Creek, which conveys sediments and nutrients from upstream sources to Lake Roosevelt. This site is also impacted by the proximity of Highway 25 and experiences frequent human utilization as a mooring location for boats during the summer.

LARO Beach 2 contains very little vegetative diversity and is dominated by reed canarygrass (Figure 33). This is likely due to the quick colonizing tendencies of reed canarygrass along the frequently de-watered Lake Roosevelt shoreline. The absence of obligate hydrophytes indicates that riparian/wetland soil moisture characteristics are not consistently maintained at this site, which is also a direct result of seasonal changes in lake level.

The PFC evaluation of LARO Beach 2 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. In this case, human use of the site and presence of Hallam Creek, which delivers sediment and associated nutrients from upstream sources, is preventing the site from functioning at full potential. Excessive water level fluctuation at this site prevents establishment of a diverse composition of native vegetation, which has allowed reed canarygrass to dominate the hydrophytic vegetation at the site. Although reed canarygrass is an undesirable exotic species, it does provide some protection and energy dissipation properties, which results in the "Functional-At Risk" determination. Another risk at this site is the sediments and associated nutrients being delivered by Hallam Creek. The excessive algal and macrophytic growth at the mouth of the stream is the direct result of what is being delivered by the stream from upland sources. As a result, the site is trending away from becoming properly functioning ("downward") and will continue trending downward unless reed canarygrass, human disturbance, and delivery of nutrients by Hallam Creek can be minimized.

Figure 32. Map of LARO Beach 2 sample site.


Figure 33. Photograph of the LARO Beach 2 sample site near the mouth of Hallam Creek.

LARO Beach 3

Water level fluctuations experienced at Lake Roosevelt is exacerbated at LARO Beach 3 (Figure 34) since its banks slope very gradually toward the channel. This results in a significant portion of the beach area being de-watered, even during summer "full pool" conditions. This site is accessible by road and by boat, which increases human-induced impacts. The upland watershed is contributing to degradation of LARO Beach 3, especially roadway impacts due to the proximity of Highway 25. The natural surface or subsurface flow patterns at this site are altered by hoof and foot action, roads, boats, and unnatural water level fluctuations.

As indicated by the site photo (Figure 35), much of the de-watered riparian area at this site is devoid of vegetation. The vegetation that is present lacks age/class and composition diversity and is dominated by reed canarygrass. Plant species present on-site, which do not include obligate hydrophytes, indicate riparian/wetland soil characteristics are not maintained at this site for significant periods of time. On-site vegetation lacks vigor and appears to show signs of desiccation due to the fluctuation in the water table. Upland vegetation includes ponderosa pine and wild rose.

Woody vegetation is present on-site but during the time of this assessment it was not in a location where it could protect the shoreline from wind and wave energy.

The PFC evaluation of LARO Beach 3 resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. In this case, human use and major fluctuations in water levels have resulted in a shoreline devoid of vegetation capable of dissipating energy from wind and wave action. Any vegetation that is present along the shoreline is comprised almost entirely of reed canarygrass. Seasonal water level fluctuation prevents establishment of diverse age classes and composition of native vegetation on-site, which has allowed the quick-establishing reed canarygrass to dominate the hydrophytic vegetation at the site.

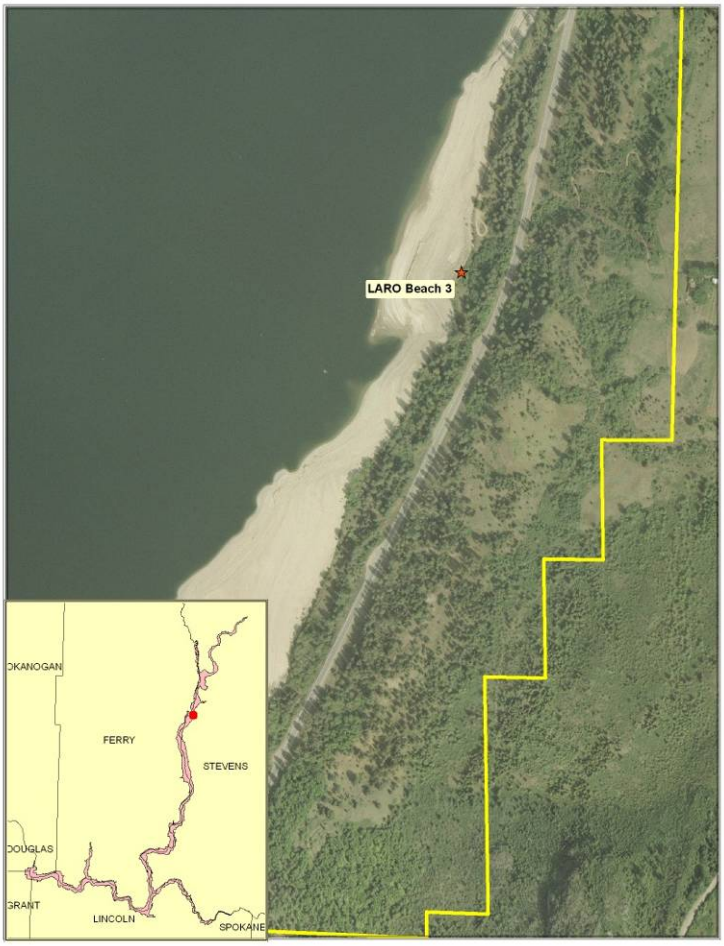

Figure 34. Map of LARO Beach 3 sample site.


Figure 35. Photograph of LARO Beach 3 sample site.

LARO Beach 4

Located approximately 3.5 miles downstream of Porcupine Bay Campground on the Spokane River Arm of Lake Roosevelt, LARO Beach 4 was assessed in July 2008 (Figure 36). This site is located immediately across the reservoir from Orazada Creek.

Water levels at LARO Beach 4 fluctuate seasonally with the drawdown of Lake Roosevelt. This seasonal drawdown of the reservoir causes significant portions of the shoreline to be devoid of riparian vegetation and apparently not reaching its potential aerial extent (Figure 37). The natural surface or subsurface water table flow patterns are altered at LARO Beach 4 by human disturbance (e.g., trampling and clearing vegetation), hoof action, water level fluctuation, and boats.

Riparian vegetation at LARO Beach 4 is dominated by reed canarygrass but also includes horsetail and cattail. Small patches of aquatic macrophytes were present within the shallow LARO Beach 4 embayment during the July assessment. Upland plant species on-site consisted of ponderosa pine, wild rose, and black hawthorn *Crataegus douglasii*.

A significant clay layer underlies the LARO Beach 4 site and is a source of erosion by wave action. As a result, the small embayment contained substantial suspended sediment during the July site visit.

The PFC evaluation of LARO Beach 4 resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. In this case, it was apparent that the site receives significant wave action and human use by boat resulting in erosion. Excessive human use was not only apparent on the beach but was evident by trails and primitive latrines throughout the timber immediately surrounding the site. Human use of the site, as well as water level fluctuation, has left the beach prone to wave action. Obvious erosion of the on-site clay layer by waves was evident during the site visit and the water in the near shore was extremely turbid. There was very little diversity of vegetation along the beach and reed canarygrass dominated the hydrophytic vegetation at the site.

Figure 36. Map of the LARO Beach 4 sample site.


Figure 37. Photograph of the LARO Beach 4 sample site.

LARO Beach 5

Located approximately four miles downstream of Porcupine Bay Campground on the Spokane River Arm of Lake Roosevelt, LARO Beach 5 was assessed in July 2008 (Figure 38). This site is accessible by boat and receives significant day-use by boaters during the summer months.

The LARO Beach 5 site maintains a sandy beach throughout the year. The riparian area lacks sufficient vegetation to be considered at its full potential. The slopes above and adjacent to the LARO Beach 5 site show excessive erosion and the natural surface or subsurface flow patterns on-site are altered by hoof action, boats, human use, and flow fluctuations within Lake Roosevelt.

During the site assessment, on-site vegetation appeared sparse and was dominated by horsetail. Very little age-class and composition diversity of riparian vegetation exists at this site and the plants that are present lack vigor and appear stunted. Soil moisture characteristics do not appear to be maintained at LARO Beach 5 as indicated by the absence of hydrophytic vegetation.

The lack of vegetation at this site leaves the sandy shoreline and adjacent bluffs susceptible to erosion from wave action. Presence of the on-site beach indicates that this site is a depositional area for sediment moving through the reservoir. Lack of a rocky shoreline and large woody debris prevents wave energy dissipation, which would allow vegetation establishment. Human use of the site also limits shoreline large woody debris and vegetation growth.

The PFC evaluation of LARO Beach 5 resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. In this case, it was apparent that the site receives significant human use by boat due to the presence of fire pits and other obvious human disturbance (Figure 39). On-site human disturbance was also evident by trails and primitive latrines throughout the timber immediately surrounding the site. Although some large woody debris and vegetation was present on the beach, it is not enough to prevent significant wind and wave energy erosion at the site.

Figure 38. Map of the LARO Beach 5 sample site.

Figure 39. Photograph of the LARO Beach 5 sample site.

LARO Beach 6

Located approximately 1.5 miles from the mouth of Indian Creek, LARO Beach 6 was assessed in July 2008 (Figure 40). This site is located in a small inlet that receives significant use by boaters along the northern shoreline of the Indian Creek embayment.

Water level fluctuation in the shallow embayment of LARO Beach 6 is excessive throughout the year and dramatically affects the riparian area on-site. The on-site riparian area has not reached its full potential due to bare areas along the shoreline. Extensive human use of this site, including boat moorage and overnight camping is apparent. Slopes above the LARO Beach 6 site show excessive erosion and the narrow strip of vegetation along the shoreline is insufficient to capture sediment prior to discharge into the surface water. The natural surface or subsurface flow patterns on-site are altered by human trails, hoof action, water level fluctuation, boats, and other human uses.

Riparian vegetation at the LARO Beach 6 site is dominated by reed canarygrass (Figure 41). On-site vegetation lacks distribution of age-classes and diversity of composition. Soil moisture characteristics do not appear to be maintained for extended periods of time due to water level fluctuation. The vegetation that does exist at this site is sparsely distributed with numerous bare areas devoid of vegetation and susceptible to erosion.

No ponding or inundation occurs at this site due to the relatively free-draining soils. The presence of free-draining soils also results in water table fluctuation with changes in lake levels. LARO Beach 6 erosion is occurring at a rate that limits establishment of vegetation and riparian area expansion. Although this site is fairly well protected from wave energy, shorelines do not contain enough rock and large woody material to adequately dissipate wave energies from causing erosion.

The PFC evaluation of LARO Beach 6 resulted in a summary determination of “Nonfunctional” (Appendix B). “Nonfunctional” lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. LARO Beach 6 cannot function properly due to the lack of established vegetation, human-induced disturbance of existing shoreline vegetation, and water level fluctuation. In addition, woody debris and rocky structures are insufficient to dissipate wave energy at the site.

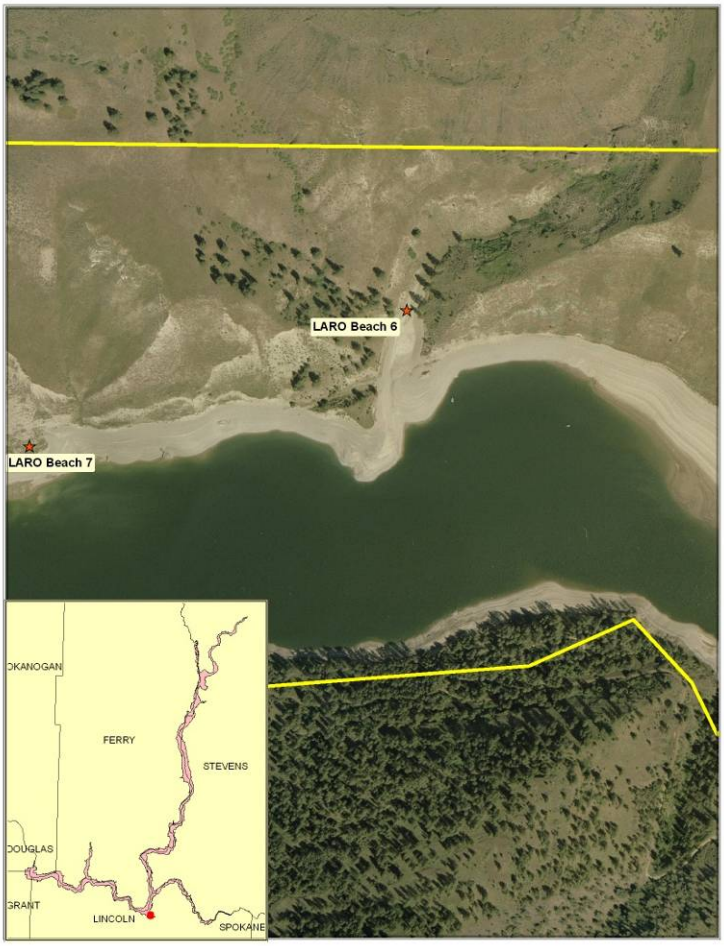

Figure 40. Map of the LARO Beach 6 sample site.


Figure 41. Photograph of the LARO Beach 6 sample site.

LARO Beach 7

Located approximately 0.5 mile from the mouth of Indian Creek, LARO Beach 7 was assessed in July 2008 (Figure 42). This site is located along the northern shoreline of the Indian Creek embayment and receives significant use by boaters during the summer due to the nearby boat launch and relative protection from the wind.

Fluctuation of water levels at LARO Beach 7 is excessive throughout the year due to seasonal releases at Grand Coulee Dam. Because water levels fluctuate seasonally at the site, the shoreline is often bare sand and susceptible to wave erosion caused by wind and boat traffic. The existing shoreline at the LARO Beach 7 site shows excessive erosion, which is partially the result of human use of the site, such as vegetation trampling and creating trails along shoreline (Figure 43).

Riparian vegetation at the LARO Beach 7 site is dominated by reed canarygrass with very little diversity or age-class distribution of vegetation across the site. Soil moisture characteristics within the riparian area are not maintained throughout the year due to water level fluctuations. The absence of obligate hydrophytic vegetation is an indicator that saturated soil conditions do not persist throughout the year.

Sediment is removed or eroded from LARO Beach 7 at a faster rate than the riparian area can expand. The shoreline consists of a fine clay layer that is being rapidly eroded by wave energy. Further exacerbating the impacts is the lack of rocky material or large woody debris to adequately dissipate wind and wave event energies and prevent erosion.

The PFC evaluation of LARO Beach 7 resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. This site's nonfunctional determination is largely a result of the lack of diverse vegetation, rocky material, and large woody debris capable of preventing shoreline erosion. Human use of the site and excessive wave energy caused by boat traffic further degrades this site's potential.

Figure 42. Map of the LARO Beach 7 sample site.


Figure 43. Photograph of the LARO Beach 7 sample site.

LARO Beach 8

Located approximately six miles upriver from the Keller Wilbur Ferry, LARO Beach 8 was assessed in July 2008 (Figure 44). This site is located in the southern shoreline of Lake Roosevelt in a small sheltered embayment that receives significant use by boaters.

During the site assessment, LARO Beach 8 was occupied by a large house boat and a smaller day-use boat. The site is significantly de-watered when Lake Roosevelt is seasonally drawn down to prepare for spring run-off. The site contains numerous beach areas that are used by boaters and campers. Much of the immediate shoreline within the drawdown zone is free of vegetation, which leaves it susceptible to erosion (Figure 45). The slopes above the LARO Beach 8 site are relatively steep and very lightly vegetated. As a result, the slopes show excessive erosion from storm runoff.

Because LARO Beach 8 is in a shallow embayment, it experiences less mixing and is more stagnant than the mainstem reservoir. This has led to more macrophytic plant growth along the shallow shorelines. In addition to aquatic macrophytes, the site is dominated by reed canarygrass in the riparian area and ponderosa pine on the upland slopes. Within the riparian area, there is very little diversity of vegetation and distribution of age-classes. Other than the aquatic macrophytes in the shallow wetted perimeter, obligate hydrophytic plant species are absent, which indicates that water level fluctuations prevent maintenance of a consistent water table within the riparian area. LARO Beach 8 has very little protection from rocks or large woody material, which leaves the shoreline extremely susceptible to wave-induced erosion.

The PFC evaluation of LARO Beach 8 resulted in a summary determination of “Nonfunctional” (Appendix B). “Nonfunctional” lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. The nonfunctional status of LARO Beach 8 is largely due to the lack of vegetative cover, rocky material, and large woody debris capable of preventing shoreline erosion. In addition, human use of the site and wave energy caused by boat traffic further degrades this site’s potential.

Figure 44. Map of the LARO Beach 8 sample site.


Figure 45. Photograph of the LARO Beach 8 sample site.

LARO Beach 9

Located approximately five miles upriver from the Keller Wilbur Ferry, LARO Beach 9 was assessed in July 2008 (Figure 46). This site is located across Lake Roosevelt from Hell Gate Canyon approximately 0.5 miles upriver from the Whitelaw Road community along the southern shoreline.

The LARO Beach 9 riparian/wetland area is affected by water level fluctuations, which result in de-watering the shoreline and deepening of the water table. The natural surface or subsurface flow patterns at the site are potentially altered by hoof action, roads in the watershed, boat traffic, development (i.e., nearby cabin), and human use. Shoreline erosion by wind-induced wave action at the LARO Beach 9 site appears excessive and is tempered somewhat by on-site large woody debris, ponderosa pine root wads, and herbaceous vegetation (Figure 47). The site appears to drain fairly well, which has resulted in a mostly facultative community of plant species, including reed canarygrass, horsetails, willows, and sedges. Upland plants at the site include ponderosa pine and antelope bitterbrush. The hydrophytic vegetation on-site appears to exhibit low vigor due to the seasonal depth of the water table. For example, willows at this site contain extensive dead material and sedges/grasses are short and appear stunted.

The PFC evaluation of LARO Beach 9 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. In this case, LARO Beach 9 hydrology is threatened by the seasonal fluctuation in water table depth, which is affecting its ability to maintain hydric soils and hydrophytic vegetation. As a result of the hydrology-induced reduction in plant vigor on-site, the site is trending away (downward trend) from becoming properly functional.

Figure 46. Map of the LARO Beach 9 sample site.


Figure 47. Photograph of the LARO Beach 9 sample site.

LARO Beach 10

Located in the Neal Canyon embayment approximately 10 miles upriver from Grand Coulee Dam, LARO Beach 10 was assessed in July 2008 (Figure 48). This site is located in a sheltered embayment that receives significant pressure from boaters and grazing cattle.

LARO Beach 10 contains a narrow 5-6 foot green belt riparian area near its high-water mark even though seasonal fluctuations in water levels occur from reservoir drawdown (Figure 49). The riparian area is narrow due to the steepness of the slope on-site, which quickly elevates away from the existing water table. Very few hydrophytic plants were present at this site. Dominant vegetation consisted of wild rose and Oregon grape *Mahonia aquifolium*.

The Lake Roosevelt tributary that enters at this site was dry during our site evaluation; however, it was apparent that the stream is a source of sediment and nutrients to the embayment site. The natural surface or subsurface flow patterns at LARO Beach 10 are altered by hoof action (i.e., deer and cattle), Grand Coulee Dam, roads within the watershed, boats, and other human recreation. The erosion rate at this site appears to be faster than the rate at which the riparian area vegetation can become established, which results in sections of the shoreline being devoid of vegetation. Not enough rocks or large woody material are present at LARO Beach 10 to adequately dissipate wind and wave event energies and reduce erosion. Grazing cattle using this site limit the ability of the shoreline to withstand erosional forces by wave action.

The PFC evaluation of LARO Beach 10 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. This site appeared to be functioning during our site evaluation but is at risk of not functioning properly during lake drawdown periods and use of the site by cattle and humans. As a result, the site is on a downward trend from being properly functioning.

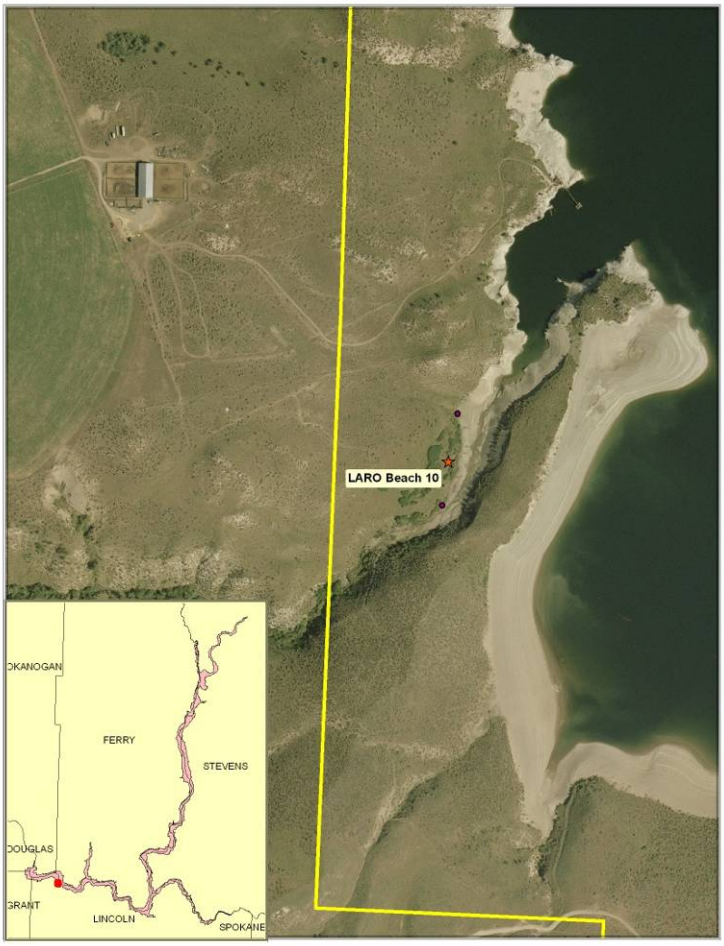

Figure 48. Map of the LARO Beach 10 sample site.


Figure 49. Photograph of the LARO Beach 10 sample site.

Spokane River Arm Sites

Spokane River Arm sites were selected by NPS personnel as representative areas along the Spokane River Arm of LARO. These 3 sites along the Spokane River Arm of Lake Roosevelt were assessed using the lentic PFC methodology (Prichard et al 2003).

Spokane Lentic 2

Located approximately 2.5 miles downriver from Mill Canyon on the Spokane River Arm of Lake Roosevelt, the Spokane Lentic 2 site was assessed in July 2008 (Figure 50). This site is located on the southern shoreline of the Spokane River Arm.

Reservoir drawdown causes seasonal fluctuations in water level at the Spokane Lentic 2 site. Since the site is adjacent to gradually sloping uplands, it appears to maintain contact with the groundwater table to a greater extent than other sites. This has resulted in saturated soil conditions for longer periods of time, ultimately leading to maintenance of hydrophytic vegetation on-site. Dominant Spokane Lentic 2 riparian/wetland vegetation consisted of cattail (*Typha* spp)., willow, reed canarygrass, and sedges (Figure 51).

Due to the significant drawdown of Lake Roosevelt water levels, there is not adequate vegetative cover along the shoreline to dissipate energy during high wind and wave events. This results in an unvegetated strip of beach shoreline that is very susceptible to erosion. Erosion is exacerbated by the lack of rocky material and large woody debris along the shoreline.

The PFC evaluation of Spokane Lentic 2 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. The hydrology attribute is at risk at the Spokane Lentic 2 site due to the dramatic fluctuation of water levels throughout the year. The assessment team could not determine whether this site was tending toward or away from properly functioning since information regarding its condition prior to our site visit was not available. For example, it was very difficult to determine if cattails and other hydrophytes were encroaching upon the upland habitats (i.e., expanding) or if the upland vegetation was encroaching upon the riparian habitat (i.e., shrinking) (Figure 51).

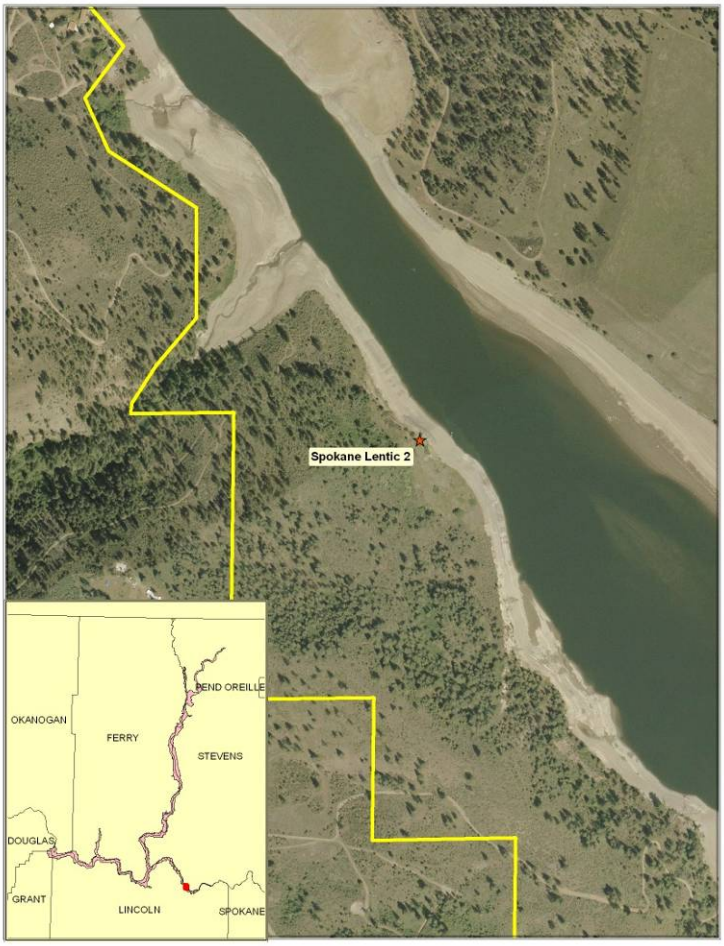

Figure 50. Map of the LARO Lentic 2 sample site.

Figure 51. Photograph of the LARO Lentic 2 sample site.

Spokane Lentic 3

Located on the southern shoreline of the Spokane River Arm of Lake Roosevelt approximately halfway between Porcupine Bay Campground and Mill Canyon, the Spokane Lentic 3 site was assessed in July 2008 (Figure 52).

Reservoir drawdown causes significant seasonal changes in water levels at the Spokane Lentic 3 site. In addition to water level fluctuations, the natural surface or subsurface flow patterns on-site are altered by hoof action, roads, and human use (e.g., boating, beach recreation).

Vegetation within the Spokane Lentic 3 riparian/wetland was dominated by reed canarygrass, and cattails (Figure 53). The presence of hydrophytic vegetation along the shoreline indicates maintenance of soil moisture characteristics, even with dramatic fluctuations in water level; however, there is not adequate vegetative cover along the entire shoreline to dissipate energy during high wind and wave events. In addition, Spokane Lentic 3 does not contain an adequate supply of large woody debris or rocky material to dissipate wind and wave event energies.

The PFC evaluation of Spokane Lentic 3 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. The hydrology attribute is at risk at the Spokane Lentic 3 site due to the dramatic fluctuation of water levels throughout the year. The assessment team could not determine whether this site was tending toward or away from properly functioning since information regarding its condition prior to our site visit was not available. For example, it was very difficult to determine if cattails and other hydrophytes were encroaching upon the upland habitats (i.e., expanding) or if the upland vegetation was encroaching upon the riparian habitat (i.e., shrinking) (Figure 53).

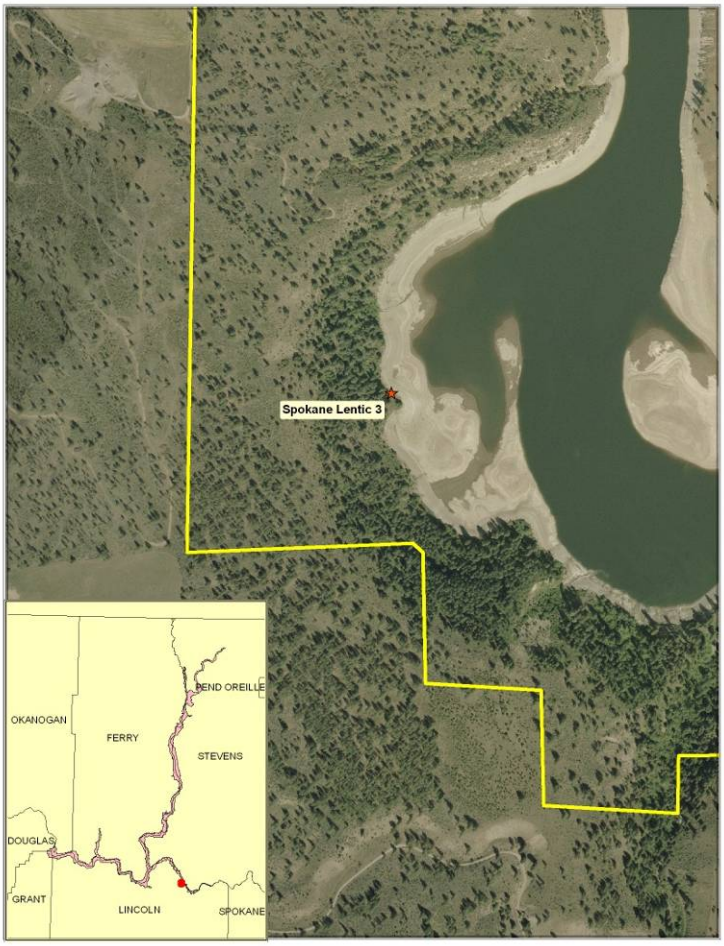

Figure 52. Map of the LARO Lentic 3 sample site.


Figure 53. Photograph of the LARO Lentic 3 sample site.

Spokane Lentic 4

Located approximately two miles downriver from Porcupine Bay Campground on the Spokane River Arm of Lake Roosevelt, the Spokane Lentic 4 site was assessed in July 2008 (Figure 54). This site was located at the mouth of an unnamed stream.

Water level fluctuation within the Spokane Lentic 4 site is excessive due to the seasonal drawdown of Lake Roosevelt. In addition to water level fluctuations, the natural surface or subsurface flow patterns on-site are potentially altered by hoof action, roads within the watershed, and human use (e.g., boaters). Water level drawdown at the mouth of the unnamed stream is causing the stream to headcut, which exacerbates on-site erosion.

Riparian vegetation at the Spokane Lentic 4 site lacks diversity and is dominated by reed canarygrass (Figure 55). Age/class distribution of riparian vegetation at this site is also limited. The presence of reed canarygrass does not necessarily indicate maintenance of soil moisture characteristics, which is likely the cause for limited vegetation diversity. There is not adequate vegetative cover along the shoreline to dissipate energy during high wind and wave events. In addition, rocky material and large woody debris was almost entirely absent at this site, which leaves the sandy shorelines susceptible to erosion.

The PFC evaluation of Spokane Lentic 4 resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and are not reducing erosion and improving water quality. The nonfunctional determination at this site is largely the result of water level fluctuations, which negatively affects site hydrology and vegetation. In addition, human use of the site and minimal amounts of large woody debris and rocky material to protect the shoreline lead to nonfunctional conditions.

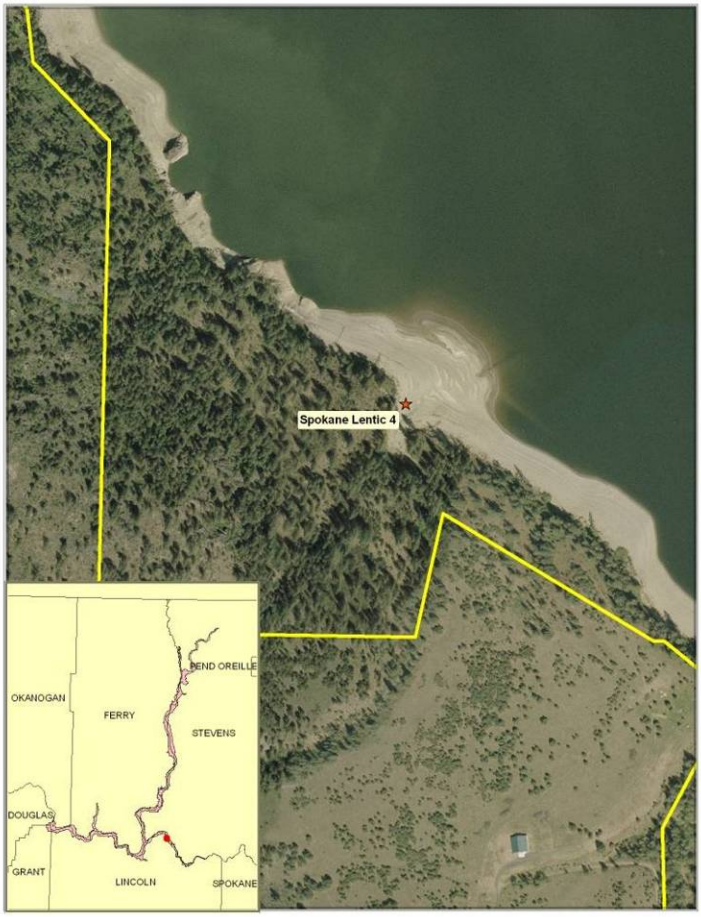

Figure 54. Map of the LARO Lentic 4 sample site.


Figure 55. Photograph of the LARO Lentic 4 sample site.

River Mile Sites

River Mile sites were selected by NPS personnel as representative reaches of the Columbia, Kettle, and Spokane Rivers above and below reservoir impacts. These 6 River Mile sites were assessed using the lentic or lotic PFC methodology (Prichard et al 2003) depending on whether they were flowing water (lotic) or standing water (lentic) sites.

Columbia Lotic

The left-bank of the Columbia River above reservoir influence was assessed in August 2008 (Figure 56). This site is located on an inside bend in the river and is encroached upon by a railroad grade. The site is characterized by a wide, meandering, steep-sided U-shaped channel. The sinuosity, width-depth ratio, and channel gradient are appropriate and in balance with the relatively steep-sided, low-gradient valley floor. Due to the bedrock-controlled channel and banks this system has little or no potential for a riparian/wetland. To dissipate energy from high flows, this channel type and size is largely dependent on channel morphology and roughened streambanks and less on vegetated streambanks. This channel is subjected to high flows and fairly substantial seasonal fluctuations in water level due to Grand Coulee Dam downstream.

The plant community at the Columbia River lotic assessment site is mostly comprised of upland vegetation due to the bedrock and cobbles that dominate the river bank (Figure 57). On-site riparian plant age class distribution and species diversity is moderate to high and consists of young deciduous trees, including black cottonwood, alder, and willow, as well as coniferous trees dominated by ponderosa pine and Douglas-fir. The presence of these native species provides adequate canopy coverage on-site and root masses capable of withstanding high streamflow events, which protect against erosion of the river bank. In this U−shaped bedrock and cobble channel, significant erosion on-site could only occur after major disturbances, such as fire or very large floods with sufficient energy to uproot existing vegetation. Therefore, new recruitment of willows and cottonwoods is expected to be an infrequent event at this location since large flood events are an infrequent occurrence due to the control of water levels by Grand Coulee Dam.

Bedrock and cobbles on the river bank at this Columbia River lotic assessment site are capable of protecting the bank from erosion during high stream flow events. The lateral movement of the Columbia River channel at this site provides additional dissipation of high flows. The river channel is vertically stable due to the ability of high flows to overtop the river bank on the outside bend of the channel (opposite of the assessment site). No excessive erosion or deposition of sediment is occurring at this site.

The PFC evaluation of this Columbia River reach just upstream of the reservoir influences resulted in a summary determination of “Nonfunctional” (Appendix B). “Nonfunctional” lotic riparian/wetland areas are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, sustaining desirable channel and riparian habitat characteristics, and so on as described in the PFC definition. This site has very little ability to function properly due to the constraints placed on it by its steep rock-filled bank and proximity of the railroad grade, which are outside the control of LARO park managers.

Figure 56. Map of the LARO Columbia lotic sample site.


Figure 57. Photograph of the LARO Columbia lotic sample site.

Columbia Lentic

The Columbia River was assessed in August 2008 at a point just downstream of the lowermost free-flowing (i.e., riverine) section of the river (Figure 58). This site, known as "Columbia Lentic", receives human disturbance by boaters and those who access the site by road due to the close proximity of Highway 25 and a public boat launch.

The Columbia Lentic site experiences seasonal water level fluctuations due to Lake Roosevelt drawdowns, which affect the depth of the water table. In addition, the natural surface or subsurface flow patterns at this site are altered by hoof action, nearby roads, development, boats, and other human uses.

Vegetation within the drawdown zone at the Columbia Lentic site is dominated by reed canarygrass (Figure 59). Other species present include sedge and horsetail. Willows are present within the riparian area upslope of the drawdown zone. Riparian zone vegetation at this site is mostly comprised of very young age classes, which is likely due to the fluctuation of water levels. Obligate vegetation is not present at the Columbia Lentic site, likely indicating that groundwater fluctuates beyond the root zone.

Rocky material and large woody debris are present at the Columbia Lentic site, but not in amounts sufficient to provide protection from shoreline erosion. Use of this site is likely increased due to its proximity to a public boat launch. Presence of the boat launch also affects sediment transport and boating activity within Lake Roosevelt at the site. Increased boat traffic usually results in increased wave-induced shoreline erosion.

The PFC evaluation of the Columbia Lentic site resulted in a summary determination of "Functional-At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. In this case, vegetation at this site is adequate to dissipate wave energy; however, since it is dominated by a monoculture of reed canarygrass, it is susceptible to degradation. In addition, water level fluctuations dramatically affect the hydrology of the site and leave it susceptible to degradation during drawdown periods. The assessment team could not determine whether this site was tending toward or away from properly functioning since information regarding its condition prior to the site visit was not available.

Figure 58. Map of the LARO Columbia lentic sample site.


Figure 59. Photograph of the LARO Columbia lentic sample site.

Kettle Lotic

The left-bank of the Kettle River above reservoir influence (free-flowing reach) was assessed in August 2008 (Figure 60). This site is located near the community of Barstow just off of Highway 395.

The Kettle Lotic site is characterized as having a stable rocky shoreline, young vegetation within the riparian area near the river, and mature woody vegetation within the riparian area furthest from the river. A tributary enters the Kettle River just upstream of the Kettle Lotic assessment reach. This stream flows through a horse pasture before discharging to the river, which increases sediment and nutrient inputs.

The Kettle Lotic site contains a clumpy distribution of vegetation within the high-flow channel (Figure 61). This vegetation consists of young reed canarygrass and other upland grasses. Above the high-flow channel, the riparian area consists of more diverse age-classes of willow, cottonwood, and ponderosa pine. The vegetation at this site is capable of dissipating stream energy during higher flows but is not at full potential due to the prevalence of younger age classes within the high-flow channel.

Large woody debris was almost entirely absent from the high-flow channel at the Kettle Lotic site in August 2008. The presence of large woody species in the riparian and upland zones above the high-flow channel provide a potential source of large woody debris; however, this source is likely not adequate for maintenance or recovery of this site. The presence of a stable rocky shoreline, consisting of gravels and small cobbles, provides some high flow erosion protection at the site. The lateral movement of the Kettle River channel provides additional dissipation of high flows. The river channel is vertically stable due to the ability of high flows to overtop the river bank.

The PFC evaluation of the Kettle River Lotic site resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" riparian areas are in functional condition, but an existing soil, water, vegetation, or related attribute makes them susceptible to degradation. When this rating is assigned to a stream or river reach, then its "trend" toward or away from PFC is assessed. In this case, the Kettle River Lotic site appears to trend toward properly functioning due to the stable rocky shorelines, channel sinuosity, vegetated floodplain, and prevalence of young vegetation within the high-flow channel.

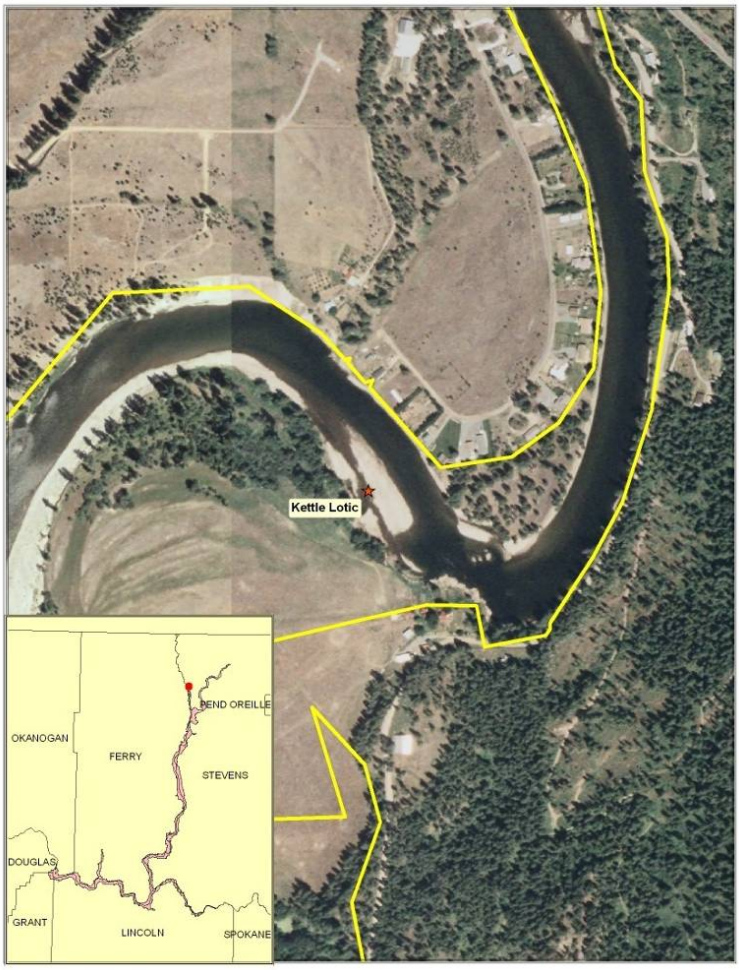

Figure 60. Map of the LARO Kettle lotic sample site.


Figure 61. Photograph of the LARO Kettle lotic sample site.

Kettle Lentic

The Kettle River was assessed in August 2008 at a point just downstream of the lowermost free-flowing (riverine) section of the river (Figure 62). This site, known as "Kettle Lentic", is located on the left bank of the river approximately one mile upstream of the Kettle River Campground.

The Kettle Lentic site experiences significant water level fluctuation due to seasonal drawdowns from Lake Roosevelt. Water level fluctuations on-site have resulted in a riparian/wetland area that has not achieved its full potential. In addition to water level fluctuations, the natural surface or subsurface flow patterns at the Kettle Lentic site are potentially altered by hoof action from wildlife, roads, a boat launch, boats, and human use.

There is little diversity of riparian vegetation at the Kettle Lentic site; reed canarygrass dominates the on-site riparian/wetland. Obligate hydrophytes are absent from the site, which indicates riparian soil moisture (i.e., soil saturation) is not being maintained for significant periods of time (Figure 63). Reed canarygrass is providing shoreline protection and some habitat function at this site; however, the riparian/wetland area will not function at full potential unless vegetative diversity is increased at this site to include native herbaceous plants, woody shrubs, and woody trees.

Very little large woody debris was apparent along the Kettle Lentic shoreline to provide protection from erosion; however, the upland area is a potential source of large woody debris to the outside edges of the riparian area.

The PFC evaluation of the Kettle River Lentic site resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. This site is currently functioning adequately due to the thorough vegetative coverage of shorelines; however, because the vegetation consists almost entirely of reed canarygrass, the site is susceptible to further degradation. The site is trending away (downward trend) from becoming properly functioning since it appears the reed canarygrass is continuing to invade and replace native species.

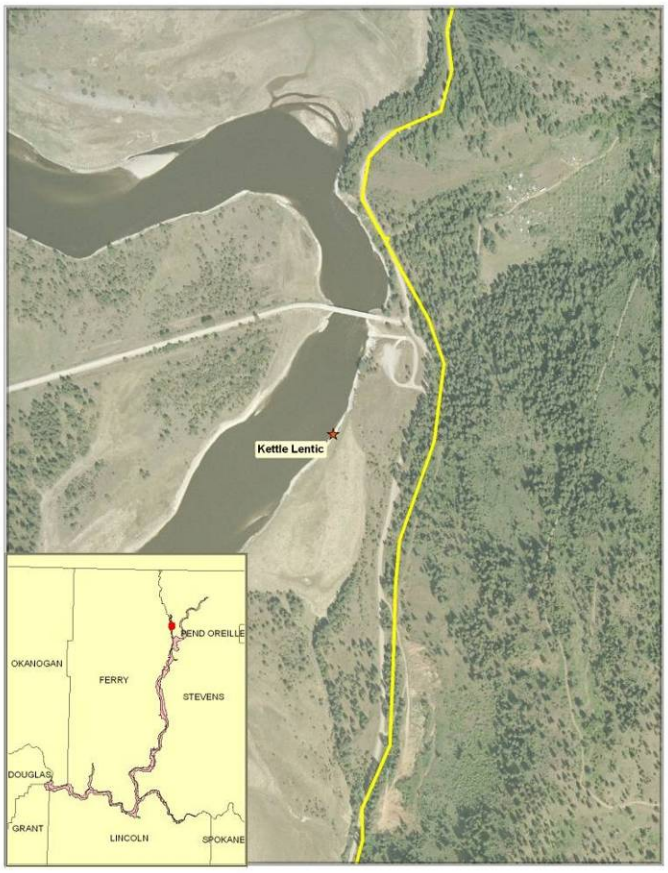

Figure 62. Map of the LARO Kettle lentic sample site.

Figure 63. Photograph of the LARO Kettle lentic sample site.

Spokane Lotic

Located just downstream of the Little Falls Dam on the Spokane River, the Spokane River Lotic assessment site was evaluated in August 2008 (Figure 64). This site is located upstream of the influence of the reservoir.

This reach is characterized by a narrow, meandering, steep sided V‐shaped channel. The team determined that the low sinuosity, low width depth ratio, and moderate channel gradient are appropriate to and in balance with the relatively steep valley gradient. Floodplains do not exist at this site due to the steep channel, which controls stream energy and direction (Figure 65). Road encroachment also affects the stream condition with fill and armament to dissipate energy from high flows. This channel type dissipates flood energy largely through channel morphology, armament, and herbaceous banks. Exposed bedrock on the channel bottom and lower banks provides exceptional vertical stability. This channel is subjected to seasonally high flows due to flow control at Little Rock Dam about 0.25 miles upstream.

Plant diversity is low with young deciduous trees including alder, willow, and ponderosa pine as the dominants species in a diverse riparian tree/shrub community. All of these native species provide sufficient cover and have root masses capable of withstanding high stream flow events (i.e., protection against erosion of stream banks). New recruitment of willows and cottonwoods is expected to be an infrequent event in this watershed due to control of water levels from the upstream dam.

The PFC evaluation of this Spokane River reach just upstream of reservoir influences resulted in a summary determination of “Nonfunctional” (Appendix B). “Nonfunctional” lotic riparian/wetland areas are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, sustaining desirable channel and riparian habitat characteristics, and so on as described in the PFC definition. This site has very little ability to function properly due to the constraints placed on it by its steep rip-rap bank and proximity of Little Falls Dam, which are outside the control of LARO park managers. As a result, the river has very little opportunity to influence or be influenced by its associated riparian area.

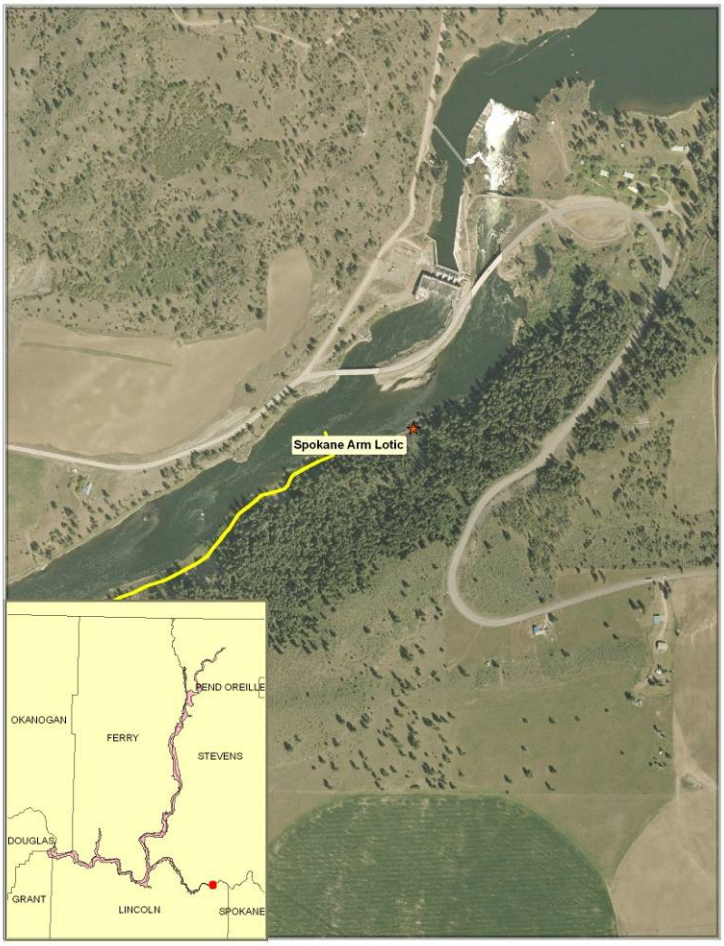

Figure 64. Map of the LARO Spokane lotic sample site.


Figure 65. Photograph of the LARO Spokane lotic sample site.

Spokane Lentic 1

The Spokane River just downstream of its riverine reaches was assessed in July 2008 (Figure 66). This site, known as "Spokane Lentic 1", is located on the left bank of the river near the mouth of Mill Creek.

The Spokane Lentic 1 reach is characterized by a wide, meandering, steep-sided, U‐shaped channel. Low sinuosity, low width depth ratio, and moderate channel gradient are appropriate and in balance with the relatively steep valley gradient. This site is located at the mouth of Mill Creek, a tributary that contributes significant sediment to the site (Figure 67). As a result of the sediment deposition, vegetation has become firmly established at this site. Road encroachment to the Spokane Lentic 1 site and to the Mill Creek drainage affects the stream condition and surface runoff properties of the upland slopes. To dissipate energy from high flows, this channel type dissipates flood energy largely through channel morphology, armoring, and herbaceous banks. This channel is subjected to high flows and large fluctuations of water level due to the seasonal water level changes experienced within Lake Roosevelt and from Little Falls Dam just upstream.

Spokane Lentic 1 plant diversity is low and includes young deciduous trees consisting of mountain alder and willow, as well as ponderosa pine. These native species provide good cover for wildlife habitat and have root masses capable of withstanding high stream flow events (i.e., protection against erosion of stream banks).

The PFC evaluation of Spokane Lentic 1 resulted in a summary determination of "Functional – At Risk" (Appendix B). "Functional – At Risk" lentic riparian/wetland areas are functioning properly, but have an existing soil, water, or vegetation attribute that makes them susceptible to degradation. This site contains a well vegetated delta as a result of Mill Creek discharge. Vegetative cover is currently dissipates wave energies; however, due to the excessive water level fluctuations, the hydrology attribute at this site is very susceptible to degradation. The vegetation attribute is also susceptible to degradation unless the reed canarygrass monoculture can be diversified. The assessment team could not determine whether this site was tending toward or away from properly functioning since information regarding its condition prior to our site visit was not available. The team is unsure if reed canarygrass densities are increasing or decreasing on-site.

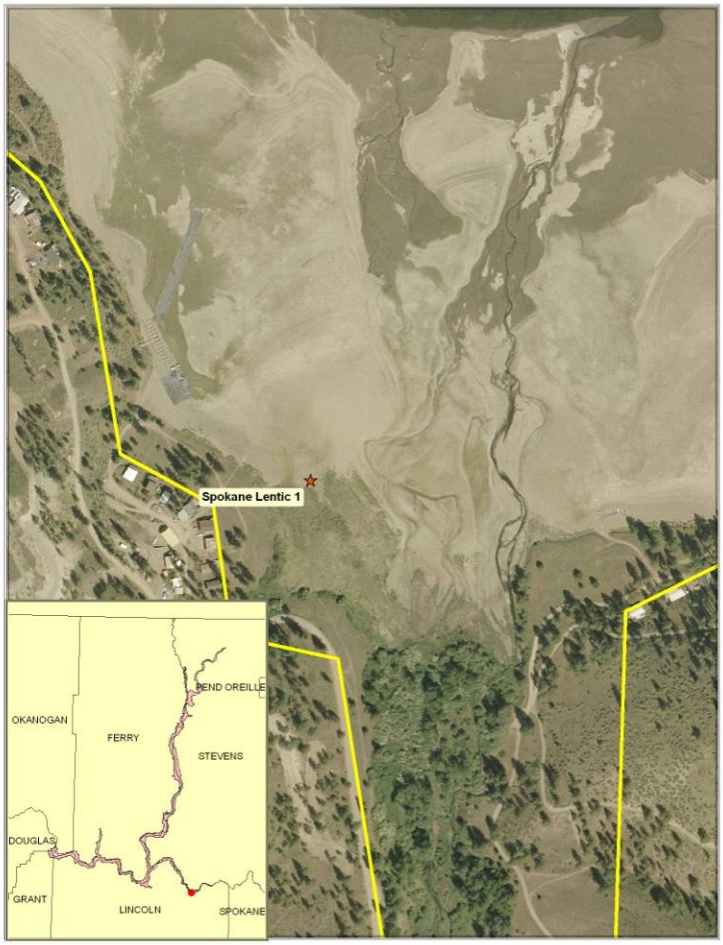

Figure 66. Map of the LARO Spokane lentic 1 sample site.


Figure 67. Photograph of the LARO Spokane lentic 1 sample site.

Special Use Sites

Special-Use sites were selected by NPS personnel as areas that receive significant pressure from vacation cabin development and use. These 2 Special-Use sites were assessed using the lentic PFC methodology (Prichard et al 2003).

Ricky Point Lentic

Located near Ricky Point on the eastern shoreline of Lake Roosevelt, the Ricky Point Lentic site was assessed in August 2008 (Figure 68). This site contains several vacation cabins and camping sites and experiences frequent human use during the summer.

Water level fluctuation is excessive at the Ricky Point Lentic site due to seasonal withdrawals from Lake Roosevelt. Much of this site contains armoring and seawalls due to the encroachment of the vacation cabins and the properties to the shoreline (Figure 69). The armoring and seawalls act as a barrier to expansion of the riparian area. This site is impacted by conditions in the upland watershed, including cabin development, lawns, roads, boat moorage, and human use. As a result, the natural surface or subsurface flow patterns on-site are potentially altered by hoof and foot action, roads, boats, development, and human use.

The Ricky Point Lentic site contains very little vegetation within the water level fluctuation zone. Estimated vegetative coverage approached 15% throughout the site. What vegetation is present is dominated by reed canarygrass, willows, and other small shrub species. Scarcity of vegetation leaves the shoreline susceptible to wave-induced erosion. Upland vegetation is mainly dominated by ponderosa pine.

Groundwater fluctuation at the Ricky Point Lentic site appears to be consistent with the reservoir water fluctuations. The shoreline is relatively free draining and shows no evidence of ponding, even in the man-made bay or wetland. The site does not contain enough rocky material or large woody debris to adequately dissipate wind and wave event energies.

The Ricky Point site also contains a wetland area that was modified and developed with boat docks by local cabin owners likely sometime before the 1980s. The wetland area has not been used in many years, which has resulted in sediment deposition of the site from wind and wave action from storms over the years.

The PFC evaluation of the Ricky Point Lentic site resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, and thus are not reducing erosion and improving water quality. The excessive human use and transformation of this site has caused the site to be extremely susceptible to erosion.

Figure 68. Map of the LARO Ricky Point lentic sample site.


Figure 69. Photograph of the LARO Ricky Point lentic sample site.

Sherman Creek Lentic

Located just upstream (north) of Sherman Creek, the Sherman Creek Lentic site was assessed in August 2008 (Figure 70). This site is located on the right bank, or western shoreline, of Lake Roosevelt just off of Highway 20.

Water level fluctuation is excessive at the Sherman Creek Lentic site due to seasonal withdrawals from Lake Roosevelt. Much of this site contains armoring and seawalls due to the encroachment of the vacation cabins and other properties to the shoreline (Figure 71). The armoring and seawalls act as a barrier to expansion of the riparian area. This site is impacted by conditions in the upland watershed, including cabin development, lawns, roads, boat moorage, and human use. As a result, the natural surface or subsurface flow patterns on-site are potentially altered by hoof and foot action, roads, boats, development, and human use.

The Sherman Lentic site contains very little vegetation within the water level fluctuation zone. Estimated vegetation cover approached 35% throughout the site. What vegetation is present is dominated by reed canarygrass, a few willows, and other small shrub species. Scarcity of vegetation leaves the shoreline susceptible to wave-induced erosion. Upland vegetation is largely dominated by ponderosa pine.

Groundwater fluctuation at the Sherman Creek Lentic site appears to be consistent with the reservoir water fluctuations. The shoreline is relatively free draining and shows no evidence of ponding. The site does not contain enough rocky material or large woody debris to adequately dissipate wind and wave event energies. Additional sediment is supplied just downstream of this site from the mouth of Sherman Creek.

The PFC evaluation of the Sherman Creek Lentic site resulted in a summary determination of "Nonfunctional" (Appendix B). "Nonfunctional" lentic riparian/wetland areas are those that clearly are not providing adequate vegetation, landform, or woody debris/rocky structure to dissipate energies associated with wind action, wave action, and overland flow from adjacent sites are not reducing erosion and improving water quality. The human use and transformation of this site (e.g., cabins, lawns, camping, etc.) has caused the site to be extremely susceptible to erosion.

Figure 70. Map of the LARO Sherman Creek lentic sample site.


Figure 71. Photograph of the LARO Sherman Creek lentic sample site.

Threats and Stressors

Threats and stressors are defined as a condition or situation, occurrence, or factor causing a negative impact to a natural resource. These can be further divided into naturally occurring or human-caused depending on their source. This section reports on 3 upland and 5 aquatic threats and stressors. Climate change is treated as a threat to upland and aquatic natural resources.

Upland Resources

Upland resource threats at LARO include wildfire, land use change, and noxious weeds. Each upland resource threat is described in more detail below as well as discussions of potential strategies to address upland resource risks.

Wildfire

Wildfire is a threat to the upland resources at LARO from fires igniting on park lands. The Washington Department of Natural Resources (WDNR) maintains a database of wildfire ignitions. WDNR data for 2008 covers wildfire point locations from 1970 through 2007. The data is only for wildfires occurring on WDNR protected lands or fires where WDNR has provided suppression support. The data does not represent all fires that may have occurred in the project area but is representative of ignition sources and types of fires common to LARO.

Approximately 18,416 acres burned as a result of 2,069 wildfire ignitions during the analysis period (Table 5). Lightning was the major cause of ignitions followed closely by the miscellaneous category and debris burning. Comparatively, miscellaneous ignitions resulted in the vast majority of acres burned followed by debris burning. An average of 56 fires per year were recorded during this 37 year period.

5. Summary of fire ignitions in the LARO analysis area from 1970-2007.

Cause	Acres Burned	Percent	Number of Ignitions	Percent
Arson	464	2.50%	56	2.70%
Children	212	1.10%	130	6.20%
Debris Burning	3545	19.20%	451	21.70%
Lightning	1958	10.60%	651	31.50%
Logging	283	1.50%	31	1.40%
Miscellaneous	11089	60.20%	451	21.80%
Railroad	95	<1%	47	2.30%
Recreation	519	2.80%	200	9.60%
Smoking	250	1.40%	52	2.50%
Total	**18416**	**100%**	**2069**	**100%**

The “Miscellaneous” category includes ignitions originating from structure fires, burning material from aircraft, burning material from auto (other than smoking), burning vehicle, electric

fence, equipment crash, fireworks (other than children), hot ashes, power lines, sparks from auto exhaust, sparks from cutting torch or welder, sparks from farm tractors, spontaneous combustion (other than sawdust piles), use of fire (other than logging), woodcutting, and an "other" category.

It should be noted that a high percentage of total acres burned during this period occurred in 1991 during "Firestorm 91." During this event 5,915 acres were burned within the LARO project area due to one large wind event in October.

Fire regime condition class was calculated as a percent departure from reference condition into 4 categories; Very Low (0-25%), Low (26-50%), Moderate (51-75%), and High (76-100%). Over half (51.46%) of the LARO project area was rated in the Very Low to Low departure index (Table 6). Only 4.43% of the project area is rated as high departure and these are located mainly in the southeast portion of the analysis area and south of the Spokane Arm (Figure 72).

6. Fire Regime Condition Class of existing vegetation within the LARO analysis area.

Departure	Index	%	Acres
Very low	0-25%	4.63%	70,854
Low	26-50%	46.83%	716,462
Moderate	51-75%	29.17%	446,292
High	76-100%	4.43%	67,773

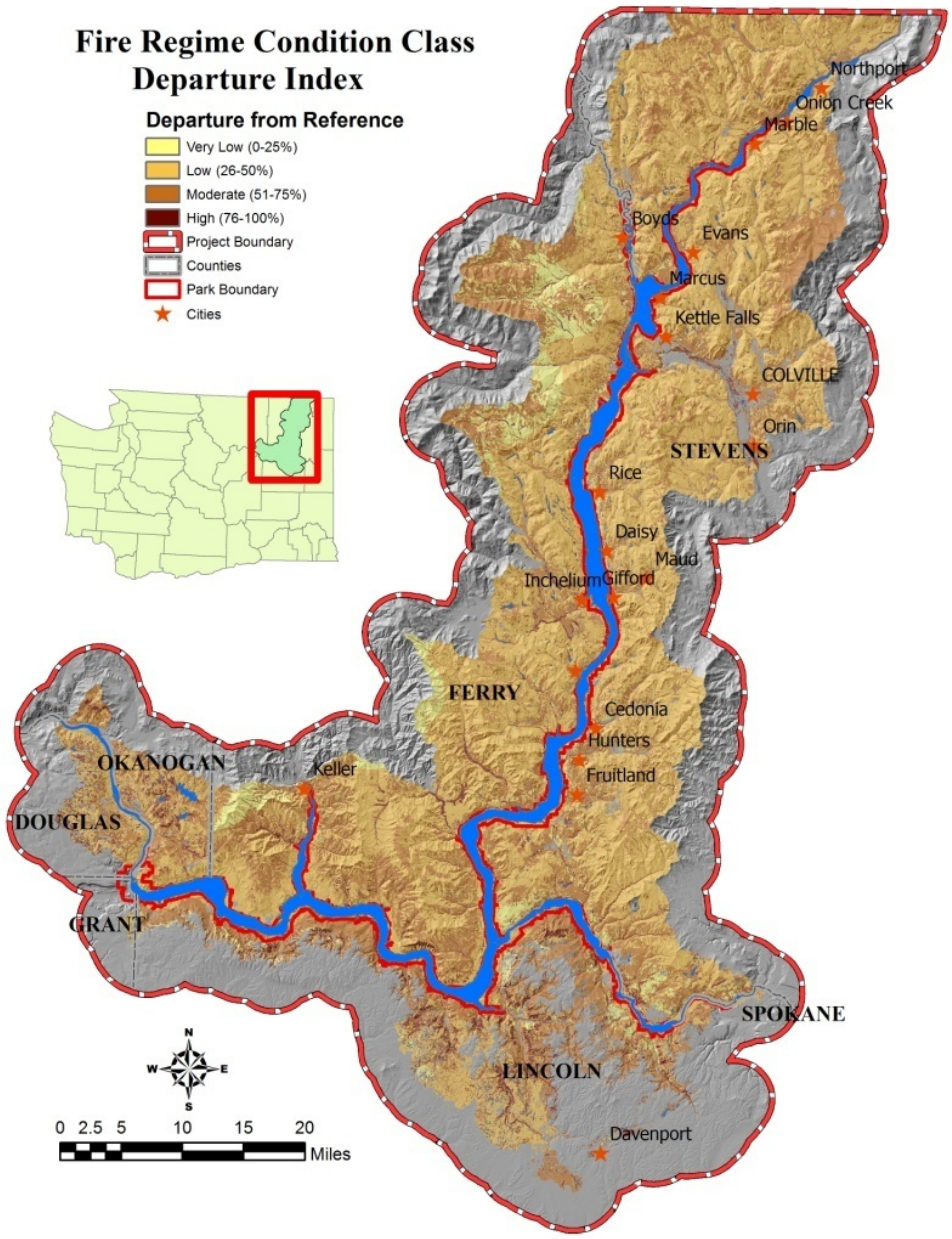

Figure 72. Map of fire regime condition class as a percent departure of vegetation from a reference condition.

Land Use Changes

While conducting the site specific assessments it was very apparent that a major threat to natural resource values in LARO comes from changes in land use on adjacent private lands. Many of the allotments examined had several homes and/or developments adjacent or within approximately .25 miles of the park boundary..

Future development may follow past trends in the growth of the area. The project area includes the Colville and Spokane Indian Reservations and Douglas, Stevens, Lincoln, Ferry, and Okanogan counties. Table 7 is a summary of the population change in the 5 counties from 2000 to 2006 (U.S. Census Bureau 2007). All 5 counties are growing slower than the state average but all have a positive growth rate, especially Douglas and Stevens Counties.

The U.S. Department of Agriculture – Economic Research Service classified all counties into 1 of 9 Rural-urban Continuum Codes. Rural-urban Continuum Codes form a classification scheme that distinguishes metropolitan counties by size and nonmetropolitan counties by degree of urbanization and proximity to metro areas with 1-3 being metro areas and 4-9 decreasing in rankings of rural areas (Brown et al. 1975). Only Douglas County has a rating of 3 and the other 4 counties are rated >6 (Table 7).

7. Demographics for the 5 counties in the LARO project area.

		Population						
County	Rural-Urban Continum Code	2000	2006	% Change	Persons /mi^2	Building Permits 2006	Building Permits/1000 people	Size - mi^2
Douglas	3	32,603	35,772	9.7%	17.9	339	0.11	1,820
Ferry	9	7,260	7,560	4.1%	3.3	24	0.32	2,209
Lincoln	8	10,184	10,376	1.9%	4.4	48	0.22	2,311
Okanogan	6	39,564	40,040	1.2%	7.5	269	0.15	5,268
Stevens	6	40,066	42,632	6.4%	16.2	204	0.21	2,478
Washington State		5,894,121	6,395,798	8.5%	88.6	50,033	7.82	66,544

Future growth in rural areas such as Lincoln and Stevens Counties are predicted to occur in areas outside of existing towns. Figures were not directly available for these counties to examine developments adjacent or near the park boundary. Because park lands will not be developed and are near Lake Roosevelt, many private land developers will find adjacent lands attractive for development into future home sites. Additional homes and other developments, such as roads and recreation facilities, increase susceptibility to invasive plants and negatively impact the use of park lands by sensitive wildlife species. Future developments could also negatively impact surface water flows. Land developments change natural landscape patterns through excavation and construction that can concentrate surface water flows and harden surfaces, which prevent water infiltration and increases overland flow. Trespass issues may also increase in areas where the park boundaries are not well marked.

Noxious Weeds

Garrett et al. 2007 developed a list of important noxious and non-native plant species based on the knowledge of NPS park staff. This report added additional noxious weed species identified and mapped by other professionals and our site specific assessments. This report examined past inventories, the data collected for the LARO vegetation mapping project conducted in 2007, and the field work for this report to assess site specific conditions.

An intense inventory of noxious and non-native weed species was conducted in 2003 by the University of Idaho (Prather 2003). The following year Wright (2004) conducted invasive plant inventories on burned sites from the previous year. In 2007, Northwest Management, Inc. collected vegetation data on 431 plots throughout the park in conjunction with developing a vegetation map (unpublished report). During the site-specific field investigations a complete species lists was developed for each plot and the occurrence of noxious weeds was extracted from the list.

Table 8 summarizes the occurrence of noxious and invasive species for each study. Three species in Table 8 are not found in the official vascular plant list for LARO (http://science.nature.nps.gov/im/units/ucbn/inventory/index.cfm#table). Longspine sandbur (*Cenchrus longispinus*) was identified as important species to watch by park staff in Garrett et al. (2007), jointed goatgrass was found in 2 vegetation plots in 2007, and Kochia (*Kochia scoparia*) was identified in the Green and Gifford allotments during the site specific assessments.

Prather (2003) documented 181 acres infested with weeds on the 1,233 acres surveyed (Figure 73). Several species were limited in distribution with a total of less than 2 acres infested and would be inexpensive to eliminate. Species with less than two acres include: bighead knapweed (*C. macrocephala*), Canada thistle (Cirsium arvense), Italian thistle (*Carduus pycnocephalus*), houndstongue (*Hieracium cynoglossoides*), Kochia (*Bassia prostrata*) and sulphur cinquefoil (*Potentilla recta*).

Other species had fewer than 30 acres and included spotted knapweed, diffuse knapweed, leafy spurge and rush skeletonweed (*Chondrilla juncea*). Prather 2003 noted that Dalmatian toadflax (131 acres) was probably a candidate for biological control due to the large area infested. He also recommended special attention should be paid to bighead knapweed, Italian thistle, houndstongue and sulphur cinquefoil. Figures 74 and 75 are examples of the noxious weed mapping project in the Fort Spokane and Hawk Creek Campground management units (Prather 2003).

Table 8. List of noxious and non-native weeds in LARO, wih 'X' indicating the source and ranking by the state of Washington.

Common Name	Scientific Name	Washington State Class	Monitoring Plan	Inventory 2003	Inventory 2004	Vegetation Plots 2007	NRCA Plots 2008
Russian Knapweed	Acroptilon repens	B	x	x		x	x
Italian thistle	Carduus pycnocephalus			x			
Longspine Sandbur[1]	Cenchrus longispinus	B	x				
Diffuse Knapweed	Centaurea diffusa	B	x	x		x	x
Spotted Knapweed	Centaurea maculosa	B	x	x	x		
Yellow Starthistle	Centaurea solstitialis	B	x			x	
Bighead knapweed	Centurea macrocephala			x			
Rush Skeletonweed	Chondrilla juncea	B	x	x		x	x
Canada Thistle	Cirsium arvense	C	x	x		x	x
Houndstongue	Cynoglossum officinale	B	x	x		x	x
Leafy Spurge	Euphorbia esula	B	x	x			
Toadflax	Linaria spp.	B	x	x	x	x	x
Sulphur cinquefoil	Potentilla recta	B		x	x	x	x
Russian Thistle	Salsola kali		x	x			x
Punctureving Tribulus	Tribulus terrestris	B	x				
Common Mullein	Verbascum thapsus		x				x
Whitetop	Cardaria draba	C				x	x
Bull thistle	Cirsium vulgare	C				x	x
Field bindweed	Convuvulus arvensis	C				x	x
Common St. Johnswort	Hypericum perforatum	C			x	x	x
Kochia[1]	Kochia scoparia	B					x
Scotch thistle	Onopordum acanthium				x		
Jointed goatgrass	Aegilops cylindrica	C				x	
Common Tansy	Tanacetum vulgare	C				x	
Canary Reed Grass	Phalaris arundinacea	C				x	

[1] = Species not found in the current LARO plant Species list.

In 2003 and 2004, Wright (2004) conducted inventories for noxious and non-native weed species on 7 sites that had previously been treated with prescribed fire (Figure 76). He documented 11 different species. The study did not list the number of acres infested with weeds or the acres surveyed. He concluded that the burned areas were not infested but that roads and powerlines were the sources for many of the species found on the surveyed areas. Figures 77 and 78 are examples of the noxious weed mapping project in the Fort Spokane and Hawk Creek Campground management units.

Figure 73. Areas survey for noxious weeds in 2003 at LARO.

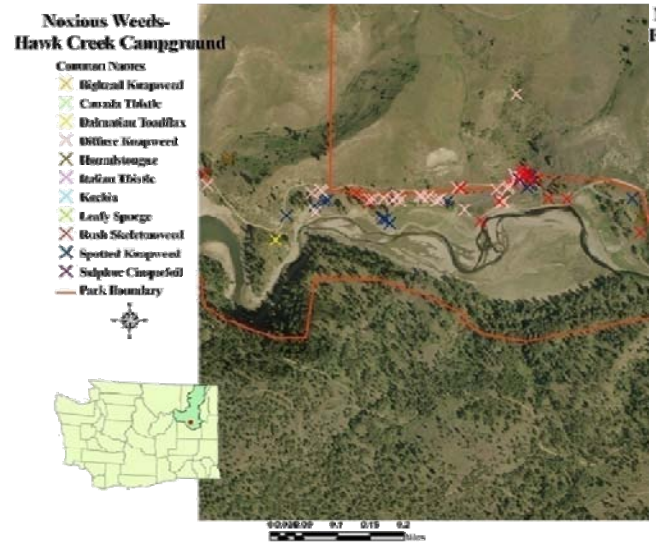

Figure 74. Map of Hawk Creek Campground, LARO, weed mapping project in 2003.

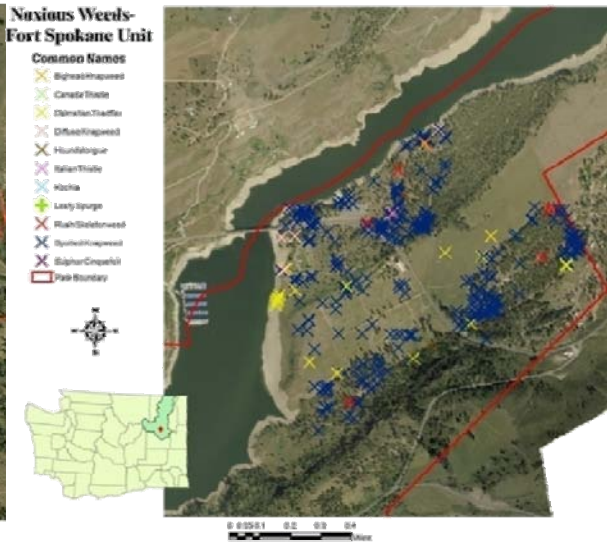

Figure 75. Map of Fort Spokane, LARO, weed mapping project in 2003.

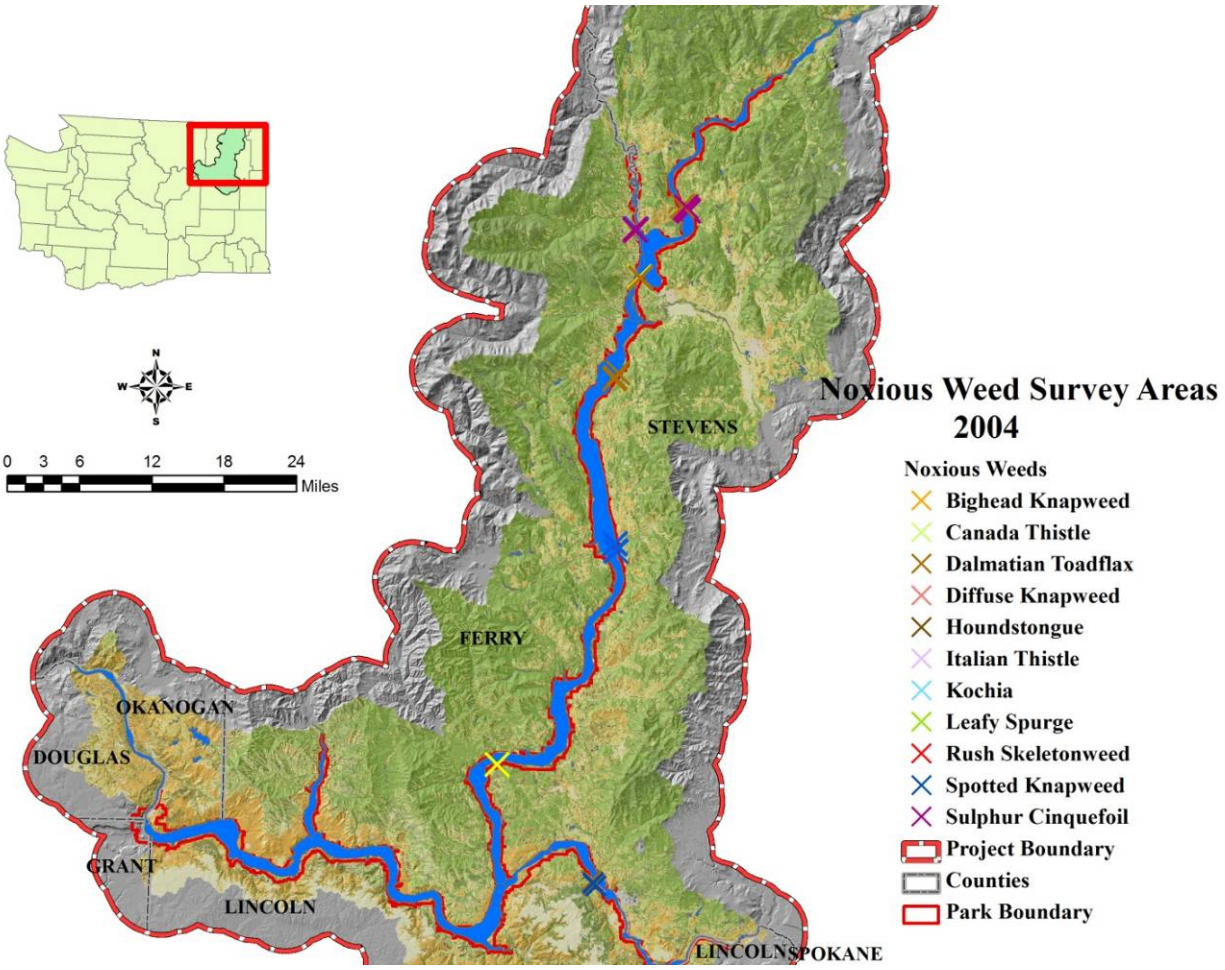

Figure 76. Areas survey for noxious weeds in 2004 at LARO.

Figure 77. Map of Evans Campground, LARO, weed mapping project in 2004.

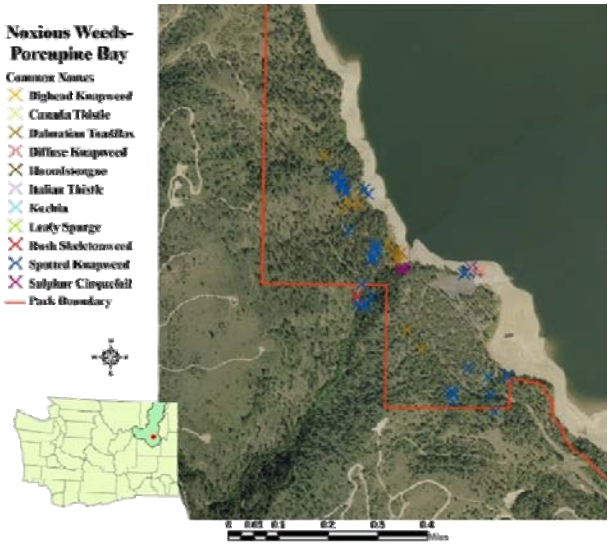

Figure 78. Map of Porcupine Bay, LARO, weed mapping project in 2003.

Table 9 lists the 21 noxious weed species and their state classification found in the LARO vascular plant list. Seven species were not found in the vegetation plot data from 2007 and of the 14 remaining species, 7 species had <2% frequency of occurrence.

9. The frequency of occurrence of noxious weeds listed on the LARO plant species list found in vegetation plots sampled in 2007.

Common Name	Species Name	Washington State Noxious Class	# of plots	Frequency of Occurrence
Russian Knapweed	Acroptilon repens	B	0	0.00%
Diffuse Knapweed	Centaurea diffusa	B	51	11.83%
Spotted Knapweed	Centaurea maculosa	B	0	0.00%
Yellow Starthistle	Centaurea solstitialis	B	1	0.23%
Rush Skeletonweed	Chondrilla juncea	B	5	1.16%
Houndstongue	Cynoglossum officinale	B	17	3.94%
Leafy Spurge	Euphorbia esula	B	0	0.00%
Dalmatian Toadflax	Linaria dalmatica	B	44	10.21%
Canada Thistle	Myriophyllum spicatum	B	0	0.00%
Sulphur Cinquefoil	Potentilla recta	B	17	3.94%
Puncturevine	Tribulus terrestris	B	0	0.00%
Jointed Goatgrass	Aegilops cylindrica	C	2	0.46%
Hoary Cress	Cardaria draba	C	4	0.93%
Canadian Thistle	Cirsium arvense	C	10	2.32%
Bull Thistle	Cirsium vulgare	C	7	1.62%
Field Bindweed	Convolvulus arvensis	C	7	1.62%
St. Johnswort	Hypericum perforatum	C	99	22.97%
Reed Canarygrass	Phalaris arundinacea	C	21	4.87%
Curly Leaf Pondweed	Potamogeton crispus	C	0	0.00%
Common Tansy	Tanacetum vulgare	C	4	0.93%
Spiny Cocklebur	Xanthium spinosum	C	0	0.00%

St. Johnswort was the most common noxious weed (22.97%) and is found mainly in the north half of LARO (Figure 79). It is an annual that occupies mainly disturbed areas in and around conifer dominated plant communities. Diffuse knapweed was the second most common noxious weed found in vegetation plots (11.83%). Diffuse knapweed had a similar geographical distribution as St. Johnswort and was also found primarily in the north half of LARO (Figure 79). Dalmatian toadflax is a perennial noxious weed that occurred on 10.21% of the vegetation plots. It had a broader geographical distribution being found throughout LARO (Figure 79). Sulfur cinquefoil is a perennial noxious weed found in 3.94% of vegetation plots located in the northern quarter of LARO (Figure 79).

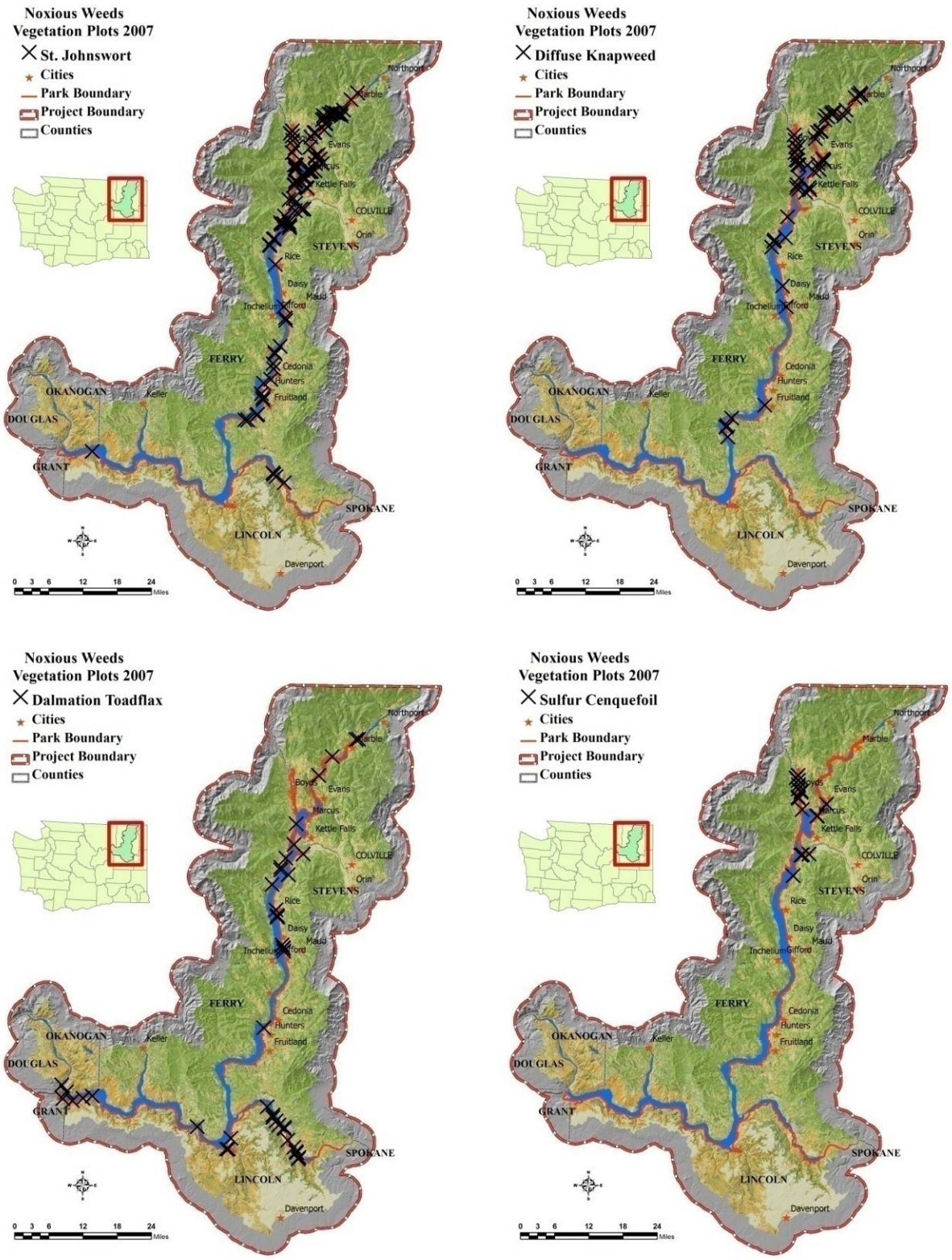

Figure 79. Maps of vegetation plot locations in LARO where St. Johnswort, diffuse knapweed, Dalmatian toadflax, and sulfur cinquefoil occurred.

Of the remaining species from Table 9, the distribution of yellow starthistle and rush skeletonweed should be significant to managers. They are both relatively rare compared to other species but in other locations in the Northwest they are very invasive and occupy millions of acres. Figure 80 is a map of the 2 species with all known locations found by all researchers. Rush skeletonweed was found only on the Spokane Arm of LARO while yellow starthistle was only found on one vegetation plot just north of Kettle Falls on the east side of the lake.

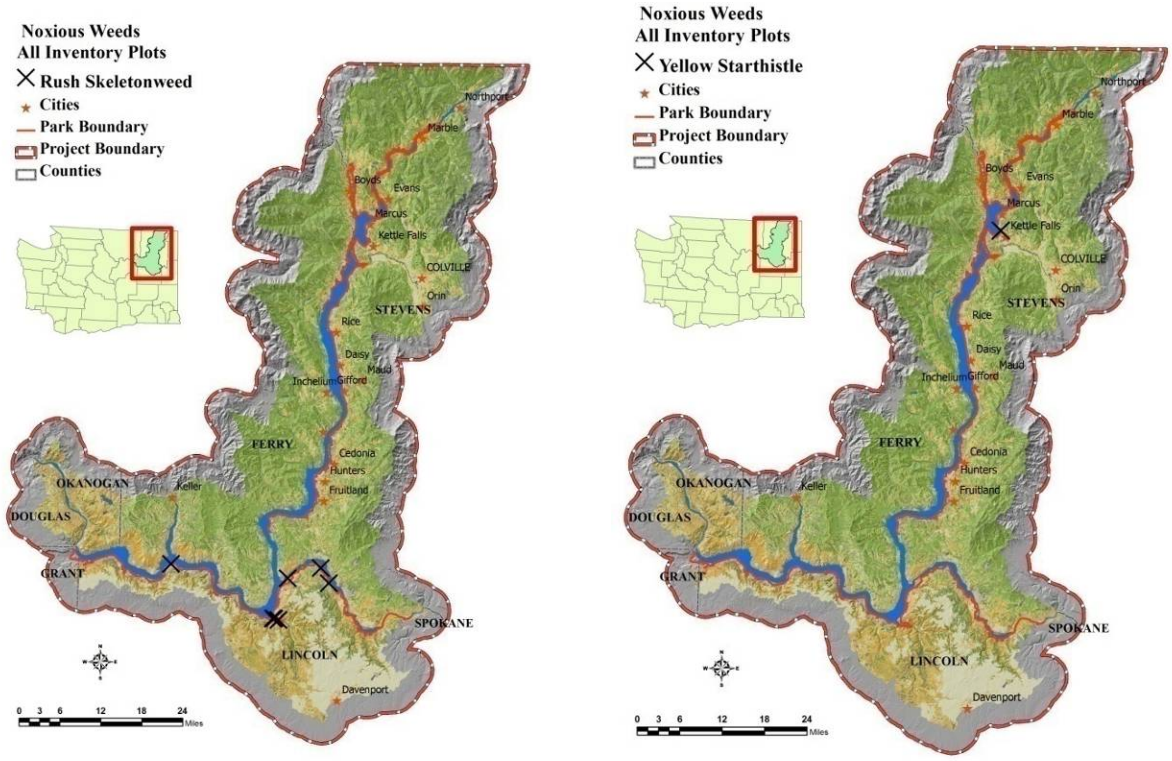

Figure 80. Maps of all known locations in LARO where rush skeletonweed and yellow starthistle occurred.

Management of all species of noxious weeds is important for good stewardship of natural resources. Some species pose greater threats to the natural resources of LARO and are not necessarily the most abundant at the present time. The Pacific Northwest Weed Management Handbook (Peachey 2008) describes 5 major management options for land managers. Below is a summary of the options:

1. Prevention is the most cost effective method for management of noxious species.
2. Biological management is the use of other organisms against noxious or invasive weeds.
3. Cultural management techniques integrate numerous components to minimize the impact of noxious weeds.
4. Mechanical management physically manipulates the noxious weed directly or the ground to kill or prevent sprouting.

5. Herbicides are chemicals used in many forms, liquid or solids, to directly kill or prevent germination of noxious weeds.

Prevention is the most cost effective management option. All management planning involving ground disturbing activities should include a section on revegetation and invasive weed control. Most noxious and invasive weed species become initially established on disturbed sites so that preventing colonization should always be the goal. Another prevention option is to be actively involved with outside organizations focused on weed management. In Washington each county has a County Weed Board (CWB) responsible for noxious weed control on private lands in their jurisdiction. Complete descriptions of all CWB can be found at http://www.nwcb.wa.gov/links.htm. Cooperation with adjacent landowners, private and public, is the most effective method to prevent and control noxious weeds. To this end, LARO staffs participate in the Greater Lake Roosevelt Cooperative Weed Management Area, which has members of local, state, federal, tribal, and private organizations. This coordinated effort will reduce the cost of noxious weed management and increase the effectiveness of prevention and control activities.

Aquatic Resources

Aquatic resource threats at LARO include water level fluctuations, invasive riparian species, recreational use, poor water quality, and excessive fine sediments. Each aquatic resource threat is described in more detail below as well as discussions of potential strategies to address aquatic resource risks.

Water level fluctuations

Due to seasonal inflows from rain and snow and outflows at Grand Coulee Dam, Lake Roosevelt can experience greater than 80-foot elevation changes in water level throughout the year. It is understood that these fluctuations in water level are outside the control of NPS managers; however, understanding the impacts of seasonal water level fluctuations is important to adequately manage aquatic resources within this park unit.

The focus of the aquatic natural resource condition assessment in LARO was shorelines and riparian wetland habitats. Fluctuations in water level within wetland habitats have documented impacts on invertebrate and amphibian habitat (Sheldon et al 2005). Both groups of wildlife exhibit reduced species richness and abundance when wetlands are subject to increased fluctuations in water levels. Water level fluctuation impacts to the suitability of wetlands as habitat for mammals, fish, and birds have not been documented. Increasing fluctuations in water levels also reduce plant richness in wetlands. This was very apparent in the 2008 assessment results. At most sites, reed canarygrass (*Phalaris arundinacea)* dominated the riparian wetland habitats, which can have negative effects on wildlife diversity, sediment stabilization, and water quality.

Significant amounts of fish habitat within the littoral zone of Lake Roosevelt is reduced due to reservoir drawdown. In addition, exposure of spawning habitat can occur due to drawdown. Seasonal drawdown can also inhibit access to spawning tributaries by certain Lake Roosevelt species. For example, kokanee salmon adults migrating to the base of the waterfall on Hawk

Creek can be delayed if water level elevations are not 1275-ft above mean sea level (McClellan et al 2006).

Aquatic invertebrate populations with poor abilities to follow receding waters are also affected by water level fluctuations. For example, gastropods (i.e., snails) and *Gammarus* crustaceans are often severely reduced by fluctuating water levels, and destruction of aquatic vegetation in the drawdown zone reduces populations of benthos by eliminating refuge and food. Gastropods are shown to be a very important component of rainbow trout diets in Lake Roosevelt (Scofield et al. 2007).

Invasive Riparian Species

Reed canarygrass dominates the hydrophytic vegetation in the riparian area of most sites assessed in LARO during the 2008 field season. In addition, vegetation plots surveyed by Northwest Management Inc. in 2007 identified reed canarygrass as a common threat at many shoreline sites along Lake Roosevelt (Figure 81). Changes in the plant community from native species to monotypic stands of exotic species can be expected to result in changes to all the invertebrates and microscopic organisms that are associated with diverse native species. Reed canarygrass is a concern because it forms large, single-species stands, with which other native species cannot compete. Prevention of new reed canarygrass invasions is the most efficient and cost effective method of invasive species management and control. Prevention of reed canarygrass can be most efficiently accomplished through maintaining complex native herbaceous canopies, since reed canarygrass seed germination is dependent on amounts of light penetration to the soil surface. In other words, “shading out” reed canarygrass prior to infestation is the most effective means of control. Even after reed canarygrass infestation has occurred, artificial hummocks (i.e., mounds of soil and inorganic debris) can be created and planted with native shrubs that will help diversify existing vegetation and eventually help shade out stands of reed canarygrass.

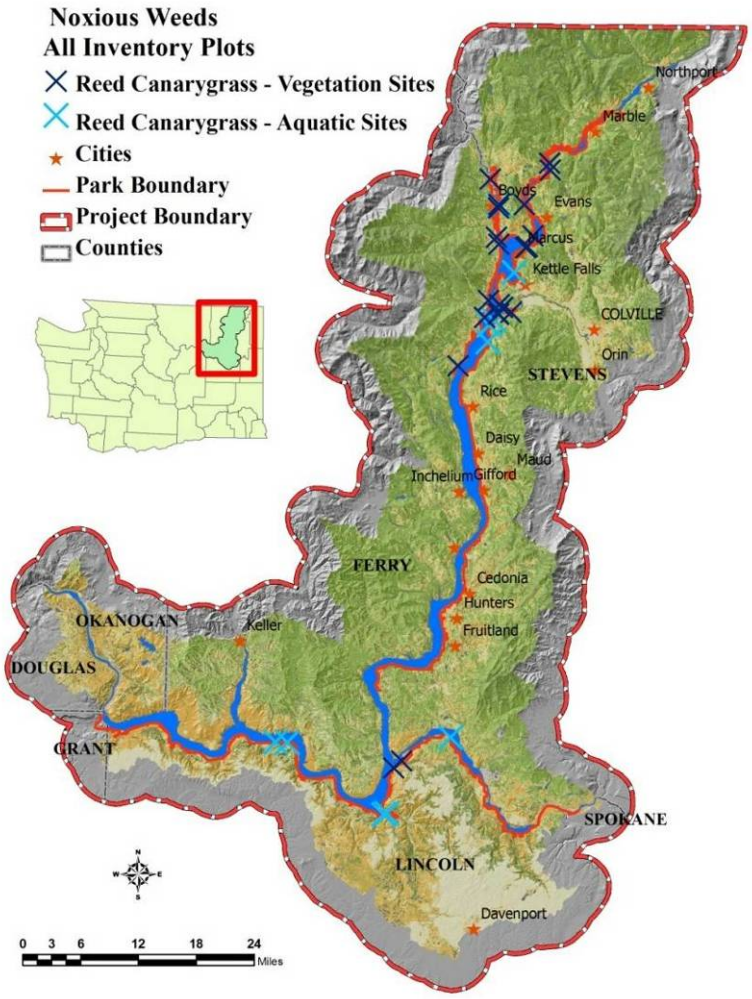

Figure 81. Map of reed canarygrass in LARO.

Recreational Use

Recreational use of Lake Roosevelt is widespread, especially by boaters and other water-users during the summer months. Most sites assessed during the 2008 study showed some type of human use that has affected natural processes within the shoreline and riparian zone. Most frequently cited impacts include man-made toilets and potential fecal contamination, garbage disposal, vegetation trampling, shoreline trailing, large woody debris removal, and erosional bank sloughing.

One way to minimize human impacts along the shoreline is through the education of water users. For example, resource managers could select portions of one or two popular beach sites to use as shoreline restoration case studies. These small sections of riparian shoreline could be fenced-off from human use and restored through invasive plant removal, native vegetation planting, and large woody debris augmentation. Signs could be placed at the site(s) to describe the importance

of shorelines to aquatic species and habitat and also a way for the public to see how the sites are being restored. Flyers could then be produced and distributed to boaters at Lake Roosevelt marinas and boat launches as a way to encourage wise-use of lake shorelines and riparian areas. This is just one way managers could affect use of on-site aquatic resources in a way that educates the public without compromising the overall use of the shoreline.

Water Quality

The U.S. Environmental Protection Agency (EPA) is studying hazardous waste contamination in the Columbia River from the U.S./Canada border to the Grand Coulee Dam and surrounding upland areas. The study is called a Remedial Investigation and Feasibility Study (RI/FS). Past studies by federal, state, and tribal agencies have shown increased levels of hazardous waste contamination in Upper Columbia River sediments, including heavy metals such as cadmium, copper, lead, mercury and zinc, and other contaminants like dioxins and furans. These previous studies identified the primary source of the contamination to be a lead-zinc smelter owned by Teck Cominco, a Canadian company with U.S. subsidiaries, on the Columbia River in British Columbia just upstream from the international boundary. Since the 1950s, the smelter had discharged several hundred tons of furnace slag and effluent per day into the Columbia River. In August 1999, the Colville Confederated Tribes petitioned EPA to conduct an assessment of environmental contamination in the Upper Columbia River. The petition expressed concerns about risks to people's health and the environment from contamination in the river. In 2001, EPA collected samples of river sediment to learn more about the types and amounts of pollution that exists. The results showed that contamination is present in the lake and river sediments, and that a more detailed investigation is needed to evaluate possible risks to human health and the environment.

A sediment core study was conducted in 1999 to evaluate temporal changes in heavy metal content of lower Columbia River sediment following terminated or reduced soluble heavy metal loading from the lead-zinc smelter owned by Teck Cominco (Johnson et al 2005). The sediment cores were collected from two fine sediment depositional sites (~600 km downstream) in August 1999 and were analyzed for total metal content, texture, and age/dating parameters. Once soluble metal releases are reduced or terminated, the solute half-time in Columbia River water is months versus approximately 20 years for adsorbed metals on surficial (or resuspended) bed sediments. The much slower rate of decline for sediment, as compared to the solute phase, is attributed to resuspension, transport and redeposition of irreversibly bound metals from upstream sedimentary deposits. This implies downstream exposure of benthic or particle-ingesting biota can continue for years following source remediation and/or termination of soluble metal releases.

Fish from Lake Roosevelt were first reported to contain elevated concentrations of contaminants in the early 1980's, with mercury, dioxins and furans, and polychlorinated biphenyls (PCBs) identified as being of most concern to human health (Munn 2000). In the early 1990's, industrial discharges to the Columbia River above the international boundary decreased. Comparison of fish tissue contamination levels before and after the apparent decrease showed that the concentrations of contaminants in fish that were identified as a potential threat to human health have either not changed or has decreased slightly. Additional fish tissue sampling by U.S. EPA is ongoing.

Heavy metals, such as those introduced to Lake Roosevelt by smelter discharge, can be directly toxic to invertebrates (Sheldon et al 2005). Metals can also impact invertebrate communities by altering the species composition and abundance of algae and aquatic plants upon which invertebrates depend for food and shelter. Growth, larval development, and reproduction of invertebrates can also be harmed by long-term exposure to sublethal concentrations of trace metals. Because invertebrates are an important prey item for fish populations within Lake Roosevelt, heavy metals can indirectly affect fish populations.

Additional sediment and fish tissue contamination studies are being carried out by USGS and can be accessed online at http://wa.water.usgs.gov/projects/roosevelt/publications.htm. Additional Lake Roosevelt fisheries publications can be accessed online at http://www.lrf.org/Links.html#Anchor-STUDIES-48213

Fine Sediments

Increasing sedimentation will decrease plant richness and tends to favor the more invasive types of vegetation that tolerate disturbance (e.g., reed canarygrass). Sediments often adsorb nutrients. As a result, nutrient contamination often follows sediment contamination, especially at the tributary mouths. This appeared to be the case at many of the 2008 assessment sites located at the mouths of streams (e.g. LARO Beach 10, Spokane Lentic 4, etc.). At these sites aquatic macrophyte and attached benthic algae densities increased. Excessive algal growth is unsustainable, and when the algae blooms die, their decomposition causes the available dissolved oxygen to be consumed, which can have dramatic negative effects on fish populations. Impacts of increased amounts of sediment on the habitat functions of wetlands have been documented for invertebrates, amphibians, and fish. All of these groups generally have reduced species richness and abundance when wetlands are subject to increased sedimentation (Sheldon et al 2005).

Excessive sediment and nutrients at tributary sites throughout Lake Roosevelt are difficult to manage since they are most often the influence of land use in the upper watershed outside of the control of NPS resource managers.

Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is a scientific intergovernmental body set up by the World Meteorological Organization and by the United Nations Environment Program. The IPCC Working Group II focuses on climate change impacts, adaptation, and vulnerability. Parry et al. (2007) published a technical summary of their most recent findings. Listed below are a few of the notable findings from the report:

- Observational evidence from all continents and most oceans show that many natural systems are being affected by regional climate changes, particularly temperature increases.
- A global assessment of data since 1970 has shown it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems.
- Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.

- Some large-scale climate events have the potential to cause very large impacts, especially after the 21st century.
- Impacts of climate change will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs which will increase over time as global temperatures increase.
- Vulnerability to climate change can be exacerbated by the presence of other stresses.
- Future vulnerability depends not only on climate change but also on development pathway.
- Many impacts can be avoided, reduced or delayed by mitigation.

The IPCC Working Group II published reports on many areas of the world. North America was addressed by Field et al. (2007) and they documented three observable connections between climate change and terrestrial ecosystems. They found changes in seasonal timing of life-cycle events and phenology, plant growth or primary production, and biogeographic distribution. They also noted that direct impacts on organisms have indirect effects on ecological mechanisms (competition, herbivory, disease) and disturbance (wildfire, hurricanes, human activities).

Plants green-up and flower earlier in the spring and leaf fall occurs later in the fall. Primary production has increased in North American forests over the past 10 years (Boisvenue and Running, 2006). Nesting and breeding occurs earlier, migration is earlier for migratory species, and some species are shifting home ranges to higher elevations or to more northern latitudes.

A warming climate encourages wildfires through a longer summer period that further reduces fuel moisture, promoting easier ignition and faster spread (Running, 2006). Westerling et al. (2006) found that in the last three decades the wildfire season in the western U.S. has increased by 78 days, and burn durations of fires greater than 1000 hectares in area have increased from 7.5 to 37.1 days, in response to a spring/summer warming of 0.87°C.

The Joint Institute for the Study of Atmosphere and Oceans (JISAO) is cooperative institute between the National Oceanic and Atmospheric Administration (NOAA) and the University of Washington. JISAO has published a report titled “Impacts of climate variability and change in the Pacific Northwest” (Mote et al. 2005). Their modeling predicts warmer, wetter winters, an increase of 3.1° F. by 2030 and a 5% increase in precipitation. Precipitation would come more in the form of rain with smaller snow packs.

The predicted climate changes project little change in the annual flow of the Columbia River, but seasonal flows will shift markedly toward larger winter and spring flows and smaller summer and autumn flows (Hamlet and Lettenmaier, 1999). The changes in flows will likely coincide with increased water demand, principally from regional growth, but also induced by climate change. Climate change is also projected to impact urban water supplies within the basin. For example, a 2°C warming projected for the 2040s would increase demand for water in Portland, Oregon by 1.5 billion gallons per year with an additional demand of 5.5 billion gallons per year from population growth, while decreasing supply by 1.3 billion gallons per year (Mote et al., 2003). The 43 sub-basins in the Columbia River basin have their own sub-basin management

plans for fish and wildlife but none comprehensively addresses reduced summertime flows caused by climate change.

The direct and indirect impact of these predicted changes in climate on natural resources at LARO is complex and difficult to manage. Changes could be positive or negative depending on the ecosystem processes, communities, and/or species under consideration. From this review we recommend that plant and animal communities and/or species of special interest to LARO managers should be addressed individually. Where possible, plans could be developed to mitigate potential negative impacts to communities and/or species.

Summary and Recommendations

Upland Resources

This report examined 7 site-specific areas in LARO, allotments and a historic site, using a rapid resource assessment methodology (Pellant 2005). The results and recommendations for each site is found in the results section of this report. General threats/stressors thought to be the most important to management of LARO's natural resources were examined using available information. These were land use change, wildfire, and noxious weeds for upland habitats and water level fluctuations, invasive riparian species, recreational use, water quality, and fine sediments for aquatic habitats. Climate change was considered capable of affecting both habitats.

Due to the lack of consistent quantitative information on these threats/stressors we had to evaluate their impacts in a qualitative manner. Table 10 is an overall estimate of the potential impact to the 3 major resource areas; soil, hydrologic, and biotic, in LARO. The actual impact from these threats/stressors to any specific site will vary depending on the existing natural resource and landscape setting.

10. Potential impact from selected threats/stressors to the major resources/processes at LARO.

Threats/Stressors	Major Resources/Processes		
Upland Habitats	**Soils**	**Hydrologic**	**Biotic**
Land use change			
Wildfire			
Noxious weeds			
Aquatic Habitats			
Water Level Fluctuation			
Invasive Riparian Species			
Recreational Use			
Water Quality			
Fine Sediments			
All Habitats			
Climate Change			
Key to Rating for Threats/Stressors			
Potential impact to resource	High	Moderate	Low

Table 11 is a summary of the potential impacts to LARO natural resources from the threats/stressors identified by Garrett et al. (2007). Rankings were based on literature and database research and professional judgment of the authors. There is in fact very little documented information available to assess possible threats/stressors to LARO natural resources.

Table 11 . Matrix of threats/stressors to major resources areas with ratings for potential impacts and the knowledge base for estimates in LARO.

Threats/Stressors	Major Resources/Processes			
Natural Disturbances	**Soils**	**Hydrologic**	**Biotic**	**Air**
Wildfires	2	2	1	3
Flooding	3	3	3	3
Drought	4	3	2	4
Landslides	2	1	4	4
Exotic diseases	4	4	2	4
Climate Change	4	2	3	4
Human-cause Disturbances				
Invasive plants/noxious weeds	2	2	1	4
Livestock grazing	1	1	1	4
Fire management practices	3	2	1	2
NPS management activities	3	3	3	4
Forest management practices	2	1	1	4
Visitor use	3	2	1	3
Landscape/landuse changes	2	1	2	3
Exotic animals	4	4	1	3
Hunting	4	4	2	4
Rural development	3	2	2	4
Air pollution	3	3	4	2
Water pollution	4	1	1	4
Utilities/industry	3	2	2	2
Air traffic	4	4	3	3
Heavy metal contamination	2	1	2	4

Key to Rating for Threats/Stressors

Potential impact to resource	High	Moderate	Low	Unknown
Knowledge Base	1 = Good	2 = Fair	3 = Poor	4=Inferential

Aquatic Resources

This section provides a summary of PFC assessment results of conditions encountered at each assessment site. Of the ten day-use beach sites assessed, six sites received a functional rating of "Nonfunctional" while the other four sites received ratings of "Functional-At Risk" with a downward trend (i.e., moving away from functional) due to significant threats (Table 12). Of the 3 Spokane River Arm Sites assessed, 2 received "Functional-At Risk" ratings with no apparent trend and the other site received a "Nonfunctional" rating. The Columbia, Kettle, and Spokane River lentic sites, as well as the Kettle River lotic site, were rated "Functional-At Risk." The Columbia and Spokane River lotic sites were rated "Nonfunctional." Both the Ricky Point and Sherman Creek vacation cabin special use sites received "Nonfunctional" ratings.

Table 12. Summary of PFC Assessments for the 21 aquatic sample sites.

Site	Functional Rating	Trend for Functional –At Risk
Day use Beach Sites		
LARO Beach 1	Functional –At Risk	Downward
LARO Beach 2	Functional –At Risk	Downward
LARO Beach 3	Non-Functional	
LARO Beach 4	Non-Functional	
LARO Beach 5	Non-Functional	
LARO Beach 6	Non-Functional	
LARO Beach 7	Non-Functional	
LARO Beach 8	Non-Functional	
LARO Beach 9	Functional –At Risk	Downward
LARO Beach 10	Functional –At Risk	Downward
Spokane River Arm Sites		
Spokane Lentic 2	Functional – At Risk	Not Apparent
Spokane Lentic 3	Functional – At Risk	Not Apparent
Spokane Lentic 4	Non-Functional	
River Mile Sites		
Columbia Lotic	Non-Functional	
Columbia Lentic	Non-Functional	
Kettle Lotic	Functional – At Risk	Upward
Kettle Lentic	Functional – At Risk	Downward
Spokane Lotic	Non-Functional	
Spokane Lentic 1	Functional – At Risk	Not Apparent
Special Use Sites		
Rickey Point Lentic	Non-Functional	
Sherman Creek Lentic	Non-Functional	

Data Gaps

Many types of information were not available for this report. We have summarized below important data that would improve natural resource management by LARO staff. We did not estimate cost or indicate agency responsibility due to the extensive nature of the data. This hopefully will provide guidance to LARO staff on future data collection efforts within and outside the park.

1. Accurate and standardized land cover/use mapping for the project area that meets National Map Accuracy Standards (± 40') and is repeatable over time. This information is very important for any watershed modeling of water quality attributes and other resource values.
2. Land ownership maps in digital format, like county parcel maps, with information on owner name and address and any records on what has been developed on the parcel. This information could allow LARO staff to be proactive in monitoring land development adjacent to the park in a cost efficient and timely manner.
3. Noxious weed maps in digital format on adjacent private and public lands within the project boundary. Currently no county, state, federal, or other organization collect and map noxious weed locations in the LARO project area. Managers would be more aware of possible new invaders and could develop better management strategies for existing species with this information.

Literature Cited

Anglin, Donald, Darren Gallion, Marshall Barrows, Coutney Newlon, and Ryan Koch. 2008. Current Status of Bull Trout Abundance, Connectivity, and Habitat Conditions in the Walla Walla Basin. U.S. Fish and Wildlife Service.

Barber, Mike. 2005. Walla Walla Watershed WRIA 32 Level 1 Assessment. Economic and Engineering Services, Inc.

Bates, B.C., Z. W. Kundzeqicz, S. Wu and J. P. Palutikof, Eds. 2008. Climate Change and Water. Technical paper of the Intergovernmental Panel on Climate Change. IPCC Secretariat.Geneva. 210 pp.

Biggam, P., J. Wagner, M. Martin, and B. Bobowski. 2005. Trip Report for Travel to Lake Roosevelt National Recreation Area June 22−24, 2004. Technical report prepared for National Park Service. February 28, 2005. 52 pp.

Bonneville Power Administration. 2004. Walla Walla Subbasin Plan. Northwest Power Planning Council. Portland, Oregon.

Bonneville Power Administration. 2004. Intermountain Province Subbasin Plan. Northwest Power Planning Council. Portland, Oregon.

Boisvenue, C. and S.W. Running, 2006: Impacts of climate change on natural forest productivity - evidence since the middle of the 20th century. Global Change Biololgy, 12, 862-882.

Brown, David L., Fred K. Hines, and John M. Zimmer. 1975. Social and Economic Characteristics of the Population in Metro and Nonmetro Counties. U.S. Department of Agriculture, Economic Research Service.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia

Corkran, C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing, Renton, Washington.

Donaldson, Norman C., Joseph T. DeFrancesco, and Don W. Barron. 2004. Soil Survey of Stevens County, Washington. U.S. Department of Agriculture, Natural Resource Conservation Service. 283 pp.

Environmental Systems Research Institute. 2006. ArcGIS 9, Using ArcGIS Desktop. Environmental Systems Research Institute

EVS Environmental Consultants. Benthic Macroinvertebrate Study of the Greater Lake Washington and Green-Duwamish River Watersheds: Year 2002 Data Analysis. Prepared for King County Water and Land Resources Division. 61 pp.

Field, C.B., L.D. Mortsch,, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott. 2007. North America. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 617-652.

Fore, L.S., J.R. Karr, and R.W. Wisseman. 1996. Assessing invertebrate responses to human activities: evaluating alternative approaches. Journal of the North American Benthological Society 15: 212-231.

Garrett, L. K., T. J. Rodhouse, G. H. Dicus, C. C. Caudill, and M. R. Shardlow. 2007. Upper Columbia Basin Network vital signs monitoring plan. Natural Resource Report NPS/UCBN/NRR—2007/002. National Park Service, Fort Collins, Colorado.

Hamlet, A. and D. Lettenmaier. 1999. Effects of climate change on hydrology and water resources in the Columbia River Basin. Journal of American Water Resources Association, 35, 1597-1623.

Hann, W.; Shlisky, A.; Havlina, D.; Schon, K.; Barrett, S.; DeMeo, T.; Pohl, K.; Menakis, J.; Hamilton, D.; Jones, J.; Levesque, M.; Frame, C. 2004. Interagency Fire Regime Condition Class Guidebook. Last update October 2007: Version 1.3. Online.

Hayslip, Gretchen, editor. 2007. Methods for the collection and analysis of benthic macroinvertebrate assemblages in wadeable streams of the Pacific Northwest. Pacific Northwest Aquatic Monitoring Partnership, Cook, Washington.

Holsinger, L, R.E. Keane, B. Steele, M. Reeves, and S.D. Pratt. 2006. Using historical simulations of vegetation to assess departure of current vegetation conditions across large landscapes. Pp. 315-366 in: Rollins, M.G. and C.K. Frame, tech. eds. 2006. The LANDFIRE Prototype Project: nationally consistent and locally relevant geospatial data for wildland fire management. Gen. Tech. Rep. RMRS-GTR-175. Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Howell, Matthew, Jason McLellan, "Lake Roosevelt White Sturgeon Recovery Project", 2004-2005 Annual Report, Project No. 199502700, 113 electronic pages, (BPA Report DOE/BP-00022571-1).

Johnson, V.G., R.E. Peterson, and K.B. Olsen. 2005. Heavy Metal Transport and Behavior in the Lower Columbia River, USA. Environmental Monitoring and Assessment. 110: 271-289.

Karr, J.R. and D.R. Dudley. 1981. Ecological perspectives on water quality goals. Environmental Management. 5: 55-68.

Lillybridge, Terry R., Bernard L. Kovalichik, Clinton K. Williams, and Bradley G. Smith. 1995. Field Guide for Forested Plant Associations of the Wenatchee National Forest. General Technical Report PNW-GTR-359. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon. 343 pp.

Mahoney, Brian, Craig Contor, Stacy Schumacher, and Jesse Schwartz. 2007. Fluvial Movement of Radio Tagged Adult Bull Trout in the Walla Walla River, northeastern Oregon - Draft. Confederated Tribes of the Umatilla Indian Reservation and Oregon Department of Fish and Wildlife.

Mahoney, Brian, Michael Lambert, Preston Bronson, Travis Olsen, and Jesse Schwartz. 2007. Walla Walla Basin Natural Production Monitoring and Evaluation Project. Confederated Tribes of the Umatilla Indian Reservation and Walla Walla Community College, Prepared for US Department of Energy.

McCaffrey, M. T. Rodhouse, and L. Garrett. 2003. 2003 Vertebrate Inventory Lake Roosevelt National Recreation Area. University of Idaho, Moscow, Idaho. 61 pp.

McClellan, H.J., A.T. Scholz, and R. LeCaire. 2006. Hatchery kokanee investigation in Lake Roosevelt, 2005. Annual Report Submitted to Spokane Tribe of Indians. BPA Project Number 1994-043-00. 51 pp.

McLellan, Holly, Allan Scholz, Richard LeCaire, Chuck Lee. 2006. Lake Roosevelt Fisheries Evaluation Program; Contributions to Fisheries Management in Eastern Washington State, Number 12. Bonneville Power Administration Report DOE/BP-00024144-1.

Morley, Sarah Ann. 2000. Effects of urbanization on the biological integrity of Puget Sound lowland streams: Restoration with a biological focus. Thesis in fulfillment of Master of Science degree. University of Washington School of Fisheries.

Mote, P. W., E. A. Parson, A. F. Hamlet, W. S. Keeton, D. Lettenmaier, N. Mantua, E. L. Miles, D. W. Peterson, D. L. Peterson, R. Slaughter, and A. K. Snover. 2003. Preparing for climatic change: the water, salmon, and forests of the Pacific Northwest. Climate Change, 61, 45-88.

Mote, P.W., E.P. Salathé, V. Dulière, and E. Jump. 2008c. Scenarios of Future Climate Change for the Pacific Northwest. Report prepared by the Climate Impacts Group, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle.

Munn, M.D. 2000. Contaminant trends in sport fish from Lake Roosevelt and upper Columbia River, Washington, 1994 – 1998. U.S. Geological Survey Water-Resources Investigations Report 00-4024. 13 pp.

National Park Service (NPS). 1999. Natural resource challenge: the National Park Service's action plan for preserving natural resources. US Department of the Interior National Park Service, Washington D.C. Online (http://www.nature.nps.gov/challengedoc.html).

National Park Service (NPS). 2000. Lake Roosevelt National Recreation Area – General Management Plan. U.S. Department of the Interior, National Park Service, Denver, CO.

National Park Service (NPS). 2003. Live Stock Management Plan and Environmental Assessment, Lake Roosevelt National Recreation Area, Washington, US Department of the Interior NPS.

Pacific Groundwater Group. 1995. Initial Watershed Assessment Water Resources Inventory Area 22 Walla Walla River Watershed. Open-File Technical Report 95-11. Walla Walla Watershed Initial Assessment, Draft 1995, WR-95-159.

Parry, M.L., O.F. Canziani, J.P. Palutikof and Co-authors. 2007. Technical Summary. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 23-78.

Peachey, Ed. 2008. Pacific Northwest Weed Management Handbook. Oregon State University. Online. (http://weeds.ippc.orst.edu/pnw/weeds). Accessed 1 January 2009.

Pellant, M., Patrick Shaver, David A. Pyke, and Jeffrey E. Herrick. 2005. Interpreting Indicators of Rangeland Health. Technical Reference 1734-6. U.S. Department of the Interior, Bureau of Land Management, Denver, Colorado. 122 pp.

Prather, T. 2003. Lake Roosevelt Invasive Plant Inventory. University of Idaho, Moscow, Idaho. 7 pp.

Prichard, D., J. Anderson, C. Correll, J. Fogg, K. Gebhardt, R. Krapf, S. Leonard, B. Mitchell, and J. Staats. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. TR 1737-15. Bureau of Land Management, BLM/RS/ST-98/001+1737, National Applied Resource Sciences Center, Denver, CO. 136 pp.

Pyke, D. A., J. E. Herrick, P. Shaver, and M. Pellant. 2002. Rangeland health attributes and indicators for qualitative assessment. Journal of Range Management. 55:584-297.

Rollins, Matthew G.; Frame, Christine K., tech. eds. 2006. The LANDFIRE Prototype Project: nationally consistent and locally relevant geospatial data for wildland fire management. Gen. Tech. Rep. RMRS-GTR-175. Fort Collins: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 416 p.

Running, S.W., 2006: Is global warming causing more larger wildfires? Science, 313, 927-928.

Scofield, B., C. Lee, D. Pavlik-Kunkel, and K. Fields. 2007. Lake Roosevelt Fisheries Evaluation Program. 2005 Annual Report *prepared for* U.S. Department of Energy, Bonneville Power Administration *by* Spokane Tribe of Indians, Wellpinit, WA. 195 pp.

Sears, Sheryl, "Lake Roosevelt Rainbow Trout Habitat/Passage Improvement Project", Bonneville Power Administration, Project NO. 199001800, 2006 Annual Report.

Seaber, Paul R., F. Paul Kapinos, and George L. Knapp. 1987. Hydrologic Unit Maps. U.S. Geological Survey Water Supply Paper 2294.

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. 2005. Wetlands in Washington State - Volume 1: A Synthesis of the Science. Washington State Department of Ecology. Publication #05-06-006. Olympia, WA.

U.S. Census Bureau, 2007, State and County QuickFacts. Online. http://quickfacts.census.gov/qfd/index.html. Accessed 1 December 2008.

U.S. Forest Service and U.S. Geological Survey. 2008. LANDFIRE National Data Products. Online. http://www.landfire.gov/products_national.php. Accessed 1 December 2008.

U.S. Geological Survey. 2005. Water Resources Data. Online. http://pubs.usgs.gov/wdr/2005/wdr-id-05-1/pdf/ID05v114.pdf. Accessed 1 December 2008.

Wagner, Joel, Pete Biggam, Michael Martin, and Ben Bobowski. 2005. An Assessment of Riparian and Upland Conditions on Grazing Allotments at Lake Roosevelt National Recreation Area, Washington. Natural Resource General Technical Report NPS/NRWRD/NRTR-2005/329. National Park Service. 50 pp.

Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. Science, 313, 940-943.

Western Regional Climate Center. 2003. Washington Climate Summaries. Desert Research Institute, Reno, Nevada. Online, http://www.wrcc.dri.edu/summary/climsmwa.html. Accessed 1 December 2008.

Williams, Clinton K., Brian F. Kelley, Bradley G. Smith, and Terry Lillybridge. 1996. Forested Plant Associations of the Colville National Forest. General Technical Report PNW-GTR-360. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 405 p.

Wissmar, Robert C.; Smith, Jeanette E.; McIntosh, Bruce A.; Li, Hiram W.; Reeves, Gordon H.; Sedell, James R. 1994. Ecological health of river basins in forested regions of eastern Washington and Oregon. Gen. Tech. Rep. PNW-GTR-326. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p. (Everett, Richard L., assessment team leader; Eastside forest ecosystem health

assessment; Hessburg, Paul F., science team leader and tech. ed., Volume III: assessment.)

Wright, Gerald. 2004. Final Report: Initial Noxious Weed Surveys at LARO. University of Idaho Cooperative Fish and Wildlife Research Unit. 4 pp.

Appendix A – List of NRCA Geodatabase Data by Theme

Theme	Layer Name
Air Resources	
Animal	
Bull Trout Distribution	laro_sp1498_BullTrout_lcc
Geography	
Grazing Areas 2003	Grazing_03_proposed_all
Basins (6th HUC)	laro_basins
Cities	laro_cities
Counties	laro_basins
Highways	laro_highway
Roads	LARO_Transportation
Project Boundary	laro_nrca_proj
Park Boundary	laro_parkbndy
Sections	laro_PLSS
Lake Roosevelt Mile Markers	usgsmile
Lake Roosevelt 5-mile Marker	usgsmile_5
Geology	
Soils-County Surveys	Soils_colville_rez
	Soils_douglas_co
	Soils_grant_co
	Soils_lincoln_co
	Soils_n_ferry_co
	Soils_stevens_co
Geology	laro_geology_MUID
Slope failure/potential areas	slides2
Land Slides	lsi
Liquifaction Susceptibility	laro_Liquefaction
Hazard Zones	laro_Haz_Zone
Land_Process	
Landuse	
Beach Cleanup Sites 2008	Beach_Cleanup
Vacation Cabin Sites	Vacation Cabin Sites

Theme	Layer Name
Stressors	
Past fires	Past_Fires
DNR Fires 1970-2007	wa_fstats
Weed points 03	laro_weeds03.pts
Weed Point 04	laro_weeds04.pts
Weed lines 04	laro_weeds04.lin
weed polygons 03	laro_weeds03_poly
Water Resources	
NRCA Aquatic Sample Sites	sites_of_spokane_arm
Original Columbia River Channel	origriv
Riverine Areas	Riverine_Areas
Bathymetric Data, Lake Roosevelt	fdr1290
Streams	Water_Course
Lakes	Water_Bodies
Water (303d listed)	Water_303d_2004_polys
Precipitation	precipitation
Raster Data	
Fire Regime Condition Class Departure	laro_frcc_dep
Existing Vegetation	laro_evt

Appendix B – List of Indicators Analyzed to Calculate Landscape Attribute Values.

Plot No.	Allotment	Ecological Reference Code	Soil Name	1. Rills	2. Waterflow	3. Pedestal	4. Bare	5. Gullies	6. Wind	7. Litter	8. Soil Surface	9. Soil Degredation
1	Rosenberg W.	R008XY102WA	49-Nespelem silt loam	N-S	M	M	M	N-S	N-S	S-M	M	S-M
2	Rosenberg W.	R008XY102WA	48-Nespelem	N-S	M	S-M	S-M	N-S	N-S	S-M	M	S-M
3	Rosenberg W.	R008XY102WA	48-Nespelem	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S
4	Rosenberg W.	R008XY501WA	37-Ewall	N-S	S-M	S-M	S-M	N-S	N-S	S-M	M	M
5	Rosenberg E.	R008XY501WA	37-Ewall	N-S	S-M	N-S	M	N-S	N-S	S-M	S-M	S-M
6	Rosenberg E.	R008XY102WA	48-Nespelem	N-S	S-M	N-S	S-M	N-S	N-S	N-S	S-M	S-M
7	Rosenberg E.	R008XY102WA	48-Nespelem	N-S	S-M	N-S	M	N-S	N-S	M	M	M
8	Rosenberg E.	R009XY401WA	53-Pedigo	N-S	S-M	N-S	S-M	N-S	N-S	N-S	S-M	N-S
9	Rosenberg E.	R008XY501WA	27-Conconully	N-S	S-M	N-S	S-M	N-S	N-S	S-M	S-M	S-M
10	Green	R008XY501WA	27-Conconully	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S
11	Green	R008XY501WA	36-Ewall	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S
12	Green	R008XY501WA	36-Ewall	N-S	S-M	N-S	N-S	N-S	N-S	N-S	S-M	S-M
13	Coffman	R008XY501WA	36-Ewall	N-S	M	S-M	S-M	N-S	N-S	S-M	M	S-M
14	Coffman	R008XY501WA	36-Ewall	N-S	M	N-S	S-M	N-S	N-S	S-M	M	S-M
15	Fort Spokane	R008XY803WA	73-Springdale gravelly sandy loam	N-S	N-S	N-S	N-S	N-S	N-S	N-S	S-M	S-M
16	Gifford		46-Cedonia silt loam	N-S	M	N-S	M	N-S	N-S	S-M	M-E	M
17	Gifford		46-Cedonia silt loam 5-15	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S
18	Matney	R044XY601WA	172-Peone	N-S	M	N-S	M-E	N-S	N-S	S-M	M-E	M-E
19	Matney		49-Cedonia silt loam 30-65	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S
20	Matney		30-Bisbee loamy fine sand 0-15	N-S	S-M	N-S	S-M	N-S	N-S	N-S	M	S-M
21	Matney		225-Springdale sandy loam 0-15	N-S	N-S	N-S	N-S	N-S	N-S	N-S	N-S	S-M
22	Hensley		30-Bisbee loamy fine sand 0-15	N-S	M	N-S	M	N-S	N-S	S-M	M	M

Appendix B (continued). List of Indicators Analyzed to Calculate Landscape Attribute Metrics.

Plot No.	Allotment	Ecological Reference Code	Soil Name	10. Plant Canopy Cover	11. Compaction	12. Function Structure	13. Plant Mortality	14. Litter Amount	15. Annual Pro-duction	16. Invasive Species	17. Repro-duction
1	Rosenberg W.	R008XY102WA	49-Nespelem silt loam	S-M	N-S	M	E-T	M	M	S-M	M
2	Rosenberg W.	R008XY102WA	48-Nespelem	S-M	N-S	N-S	M	S-M	S-M	S-M	S-M
3	Rosenberg W.	R008XY102WA	48-Nespelem	N-S	N-S	N-S	S-M	N-S	N-S	S-M	N-S
4	Rosenberg W.	R008XY501WA	37-Ewall	S-M	N-S	M	M-E	M	M	M	M
5	Rosenberg E.	R008XY501WA	37-Ewall	S-M	N-S	M	S-M	S-M	M	M	M
6	Rosenberg E.	R008XY102WA	48-Nespelem	S-M	N-S	S-M	S-M	S-M	S-M	M	S-M
7	Rosenberg E.	R008XY102WA	48-Nespelem	S-M	N-S	M	M-E	M	M-E	M	M
8	Rosenberg E.	R009XY401WA	53-Pedigo	S-M	S-M	M-E	M	S-M	M	M-E	M-E
9	Rosenberg E.	R008XY501WA	27-Conconully	M	N-S	S-M	M	S-M	M	M	M
10	Green	R008XY501WA	27-Conconully	N-S	N-S	N-S	S-M	N-S	N-S	S-M	N-S
11	Green	R008XY501WA	36-Ewall	N-S	S-M	N-S	N-S	N-S	N-S	M	M
12	Green	R008XY501WA	36-Ewall	N-S	N-S	S-M	M	N-S	S-M	S-M	S-M
13	Coffman	R008XY501WA	36-Ewall	M	N-S	M-E	S-M	M	M-E	M-E	M
14	Coffman	R008XY501WA	36-Ewall	M	N-S	M-E	S-M	M	M	M-E	M-E
15	Fort Spokane	R008XY803WA	73-Springdale gravelly sandy loam	S-M	N-S	M-E	N-S	S-M	S-M	M	S-M
16	Gifford		46-Cedonia silt loam	M	N-S	M-E	N-S	M	M	M-E	M
17	Gifford		46-Cedonia silt loam 5-15	S-M	N-S	N-S	S-M	S-M	S-M	S-M	S-M
18	Matney	R044XY601WA	172-Peone	M	N-S	M-E	N-S	M-E	M-E	M-E	M-E
19	Matney		49-Cedonia silt loam 30-65	N-S	N-S	N-S	S-M	N-S	N-S	N-S	N-S
20	Matney		30-Bisbee loamy fine sand 0-15	M	N-S	M	S-M	S-M	M	M-E	M
21	Matney		225-Springdale sandy loam 0-15	N-S	N-S	M	N-S	S-M	M	M	M
22	Hensley		30-Bisbee loamy fine sand 0-15	M-E	N-S	M-E	N-S	M-E	M-E	M-E	M-E

Appendix C List of Plant Species at NRCA Upland Assessment Points

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 1	2	3	4	5	6	7	8	9	10	11
Betula occidentalis	tree													
Pinus ponderosa	tree												2	
Pseudotsuga menziesii	tree													
Pyrus communis	tree	X						1						
Pyrus malus	tree	X									2			
Thuja plicata	tree													
Acer glabrum	shrub							5						
Alnus incana	shrub													
Amelanchier alnifolia	shrub							2				1	10	
Artemisia tridentata ssp. trider	shrub			15	15	10	15	1	15					1
Artemisia tripartita	shrub					5						5	5	
Chrysothamnus nauseosus	shrub			15	5		5		20	5			2	
Chrysothamnus viscidiflorus	shrub			5	1	2				10			2	
Crataegus columbiana	shrub							60						
Holodiscus discolor	shrub													
Leptodactylon pungens	shrub				1				5				2	
Mahonia aquifolium	shrub										5			
Philadelphus lewisii	shrub							2						
Prunus virginiana	shrub							2					1	
Purshia tridentata	shrub			25	10		25			25		35	20	
Ribes cereum	shrub													1
Rosa canina	shrub													
Rosa woodsii	shrub							2			20			10
Salvia dorrii	shrub				10		5							
Symphoricarpos albus	shrub							5						1
Tetradymia canescens	shrub				1	2								
Agropyron cristatum	grass	X												
Agropyron spicatum	grass				10	10							30	
Agrostis stolonifera	grass	X												20
Aira caryophyllea	grass	X												2
Aristida longiseta	grass									1				
Bromus inermis	grass													
Bromus japonicus	grass	X				20		50	30		5	20	2	10
Bromus mollis	grass	X												
Bromus tectorum	grass	X		5	10	5	30	15	10	40		20	10	10
Carex praegracilis	grass													5
Carex sp.	grass													5

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 12	13	14	15	16	17	18	19	20	21	22
Betula occidentalis	tree										40			
Pinus ponderosa	tree						1		60			60	10	1
Pseudotsuga menziesii	tree										10	10		
Pyrus communis	tree	X												
Pyrus malus	tree	X							2					
Thuja plicata	tree										20			
Acer glabrum	shrub										10			
Alnus incana	shrub										10			
Amelanchier alnifolia	shrub								1		5			
Artemisia tridentata ssp. tride	shrub													
Artemisia tripartita	shrub			10										
Chrysothamnus nauseosus	shrub			15	50									
Chrysothamnus viscidiflorus	shrub			5	1									
Crataegus columbiana	shrub								1					
Holodiscus discolor	shrub			1							10			
Leptodactylon pungens	shrub			2										
Mahonia aquifolium	shrub										20		5	
Philadelphus lewisii	shrub													
Prunus virginiana	shrub													
Purshia tridentata	shrub			25	1									
Ribes cereum	shrub													
Rosa canina	shrub								1					
Rosa woodsii	shrub			1		2								
Salvia dorrii	shrub													
Symphoricarpos albus	shrub							1	5	1	30	10	2	
Tetradymia canescens	shrub													
Agropyron cristatum	grass	X			15	15	10							
Agropyron spicatum	grass													
Agrostis stolonifera	grass	X								10				
Aira caryophyllea	grass	X												
Aristida longiseta	grass				2									
Bromus inermis	grass				2			5						
Bromus japonicus	grass	X		20			1	10		5		2		5
Bromus mollis	grass	X						2						
Bromus tectorum	grass	X		30	30	30	1	2		10		1		5
Carex praegracilis	grass													
Carex sp.	grass													

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 1	2	3	4	5	6	7	8	9	10	11
Dactylis glomerata	grass	X												
Elymus canadensis	grass													
Elymus repens	grass	X												2
Festuca idahoensis	grass			3	3	30			10				5	
Hordeum jubatum	grass										10			2
Juncus balticus	grass													2
Juncus orthophyllus	grass													2
Koeleria macrantha	grass					1								
Leymus cinereus	grass							1						5
Panicum scribnerianum	grass													
Phleum pratense	grass	X												
Poa bulbosa	grass	X							5			20		1
Poa pratensis	grass	X									20			20
Poa secunda	grass			2	2	5	10	4	5			10	10	
Poa sp.	grass													
Secale cereale	grass	X												
Spartina gracilis	grass										40			
Sporobolus cryptandrus	grass										1			20
Stipa comata	grass			5	10	10			30	5		5	2	
Stipa occidentalis	grass													
Conyza canadensis	forb													
Achillea millefolium	forb			0.5	1				2			2	5	1
Adenocaulon bicolor	forb													
Amsinckia lycopsoides	forb													
Arctium minus	forb	X						1						
Artemisia dracunculus	forb			2										
Astragalus purshii	forb								5					
Balsamorhiza sagittata	forb			1	1	1	1							
Brodiaea douglasii	forb					1							1	
Cardaria draba	forb	X	X											
Centaurea diffusa	forb	X	X										2	2
Chenopodium album	forb	X									2			
Chondrilla juncea	forb	X	X											
Cirsium arvense	forb	X	X								2			1
Cirsium edule	forb	X												
Cirsium undulatum	forb							1						
Cirsium vulgare	forb	X	X								2			
Clematis ligusticifolia	forb							15			5			
Convuvulus arvensis	forb	X	X								2			

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 12	13	14	15	16	17	18	19	20	21	22
Dactylis glomerata	grass	X							2	5	1	1		
Elymus canadensis	grass										1	1		
Elymus repens	grass	X				10	5	25	10	30			10	20
Festuca idahoensis	grass						1							
Hordeum jubatum	grass													
Juncus balticus	grass													
Juncus orthophyllus	grass													
Koeleria macrantha	grass													
Leymus cinereus	grass													
Panicum scribnerianum	grass												5	3
Phleum pratense	grass	X						5						
Poa bulbosa	grass	X		5	10	15		10	5				30	5
Poa pratensis	grass	X						2		30		10		10
Poa secunda	grass			10			70							
Poa sp.	grass						5							
Secale cereale	grass	X					5							
Spartina gracilis	grass													
Sporobolus cryptandrus	grass			2	20	1							2	
Stipa comata	grass			30										
Stipa occidentalis	grass								2			10	20	
Conyza canadensis	forb 1									3				3
Achillea millefolium	forb			2	1			1	1	3		2	2	
Adenocaulon bicolor	forb										2			
Amsinckia lycopsoides	forb					1								
Arctium minus	forb	X												
Artemisia dracunculus	forb													
Astragalus purshii	forb													
Balsamorhiza sagittata	forb													
Brodiaea douglasii	forb													
Cardaria draba	forb	X	X							3		2		
Centaurea diffusa	forb	X	X	1	2	3				2				5
Chenopodium album	forb	X												
Chondrilla juncea	forb	X	X		1									
Cirsium arvense	forb	X	X							3				
Cirsium edule	forb	X								2				
Cirsium undulatum	forb													
Cirsium vulgare	forb	X	X							3				
Clematis ligusticifolia	forb													
Convuvulus arvensis	forb	X	X											

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 1	2	3	4	5	6	7	8	9	10	11
Cynoglossum officinale	forb	X	X											
Disporum trachycarpum	forb													
Equisetum hyemale	forb							2			2			15
Erigeron sp.	forb			2			1		1					
Eriogonum compositum	forb				5									
Eriogonum niveum	forb			2	1		20			15		5	1	
Eriogonum sphaerocephalum	forb				5	2			2				5	
Erodium cicutarium	forb	X												
Helianthus annuus	forb										1			
Heuchera cylindrica	forb				2								1	
Hypericum perforatum	forb	X	X											
Kochia scoparia	forb	X	X											1
Lactuca serriola	forb	X						1				1		2
Lepidium perfoliatum	forb	X									2			2
Linaria dalmatica	forb	X	X		2								1	
Lomatium triternatum	forb											5		
Lupinus leucophyllus	forb												5	1
Lupinus sericeus	forb			0.5		2			1					
Lupinus sp.	forb											2		
Melilotus alba	forb	X									5			
Melilotus officinalis	forb	X												
Oenothera strigosa	forb										1			
Opuntia polyacantha	forb			2						5				
Osmorhiza berteroi	forb													
Phacelia sp.	forb													
Plantago lanceolata	forb	X									1			
Plantago patagonica	forb													
Polygonum aviculare	forb	X												
Polygonum douglasii	forb													
Potentilla recta	forb	X	X											
Pteridium aquilinum	forb													
Rumex crispus	forb	X									1			1
Salsola kali	forb	X									6			
Sisymbrium altissimum	forb	X						2				2		
Smilacina racemosa	forb													
Solidago sp.	forb													1
Taraxacum officinale	forb	X												
Tragopogon dubius	forb	X										1		1
Trifolium dubium	forb	X												
Trifolium repens	forb	X												1

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 12	13	14	15	16	17	18	19	20	21	22
Cynoglossum officinale	forb	X	X							3	2			
Disporum trachycarpum	forb										1			
Equisetum hyemale	forb					50								
Erigeron sp.	forb			1			1							
Eriogonum compositum	forb													
Eriogonum niveum	forb			2										
Eriogonum sphaerocephalum	forb													
Erodium cicutarium	forb	X					1	1		1				1
Helianthus annuus	forb													
Heuchera cylindrica	forb													
Hypericum perforatum	forb	X	X					1		3		10	3	15
Kochia scoparia	forb	X	X	1				2						
Lactuca serriola	forb	X			1	2	2	2		1		1		1
Lepidium perfoliatum	forb	X												
Linaria dalmatica	forb	X	X	5										
Lomatium triternatum	forb													
Lupinus leucophyllus	forb			2										
Lupinus sericeus	forb												5	
Lupinus sp.	forb											2		
Melilotus alba	forb	X												
Melilotus officinalis	forb	X						1		1				
Oenothera strigosa	forb													
Opuntia polyacantha	forb				1									
Osmorhiza berteroi	forb										1			
Phacelia sp.	forb						1							2
Plantago lanceolata	forb	X												
Plantago patagonica	forb												1	10
Polygonum aviculare	forb	X												1
Polygonum douglasii	forb									1		2	1	
Potentilla recta	forb	X	X					20	2					2
Pteridium aquilinum	forb										1			
Rumex crispus	forb	X				1								
Salsola kali	forb	X			2	5								
Sisymbrium altissimum	forb	X		1		1		5		3			2	5
Smilacina racemosa	forb										2			
Solidago sp.	forb													
Taraxacum officinale	forb	X								3				
Tragopogon dubius	forb	X			1	1	1	2				1	1	1
Trifolium dubium	forb	X								3				
Trifolium repens	forb	X								1				

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 1	2	3	4	5	6	7	8	9	10	11
Urtica dioica	forb										1			
Verbascum thapsus	forb	X	X		3						2			2
Verbena bracteata	forb													
Vicia americana	forb													

List of Plant Species at NRCA Upland Assessment Points (continued).

Species Name	Growth Form	Non-Native	Noxious	Aerial Cover by Plot 12	13	14	15	16	17	18	19	20	21	22
Urtica dioica	forb													
Verbascum thapsus	forb	X	X			5				3		2		
Verbena bracteata	forb							3						
Vicia americana	forb					10	1			5		10	30	

Appendix D – Aquatic Site Properly Functioning Condition Checklists

Lentic Standard Checklist – LARO Beach 1

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _7/31/2008_Segment/Reach ID: LARO Beach 1_____Acres: _____

ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
4. Roads above banks
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
9. Little diversity of vegetation, site dominated by reed canarygrass
10. It is difficult to determine due to the dominate presence of reed canarygrass and other fac-wet species. Obligate species do not dominate, this is why we indicated a no for this question.
17. Frequent lowering of the water table and water level does not keep the soils saturated for long periods of time

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____	Upward _____
Functional – At Risk __X__ Downward	__X___
Nonfunctional _____ Not	Apparent ___
Unknown _____	

Additional notes:

1. Little large woody debris, However upland may be a source

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _X_ Watershed condition
___ Dredging _X __ Road encroachment _X_ Land ownership
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 2

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/31/2008_Segment/Reach ID: LARO Beach 2_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
4. Roads above banks, development, boat moorage, nearby stream tributary upstream from site brings an influx of sediment and nutrients
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
9. Little diversity of vegetation, site dominated by reed canarygrass
10. It is difficult to determine due to the dominate presence of reed canarygrass and other fac-wet species. Obligate species do not dominate, this is why we indicated a no for this question.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____	Upward _____
Functional – At Risk __X__ Downward	__X__
Nonfunctional _____ Not	Apparent ___
Unknown _____	

Additional notes:

2. Little large woody debris, However upland may be a source
3. Good rocky shoreline, well drained
4. No vegetation diversity – reed canarygrass dominates

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _X_ Watershed condition
___ Dredging _X __ Road encroachment _X_ Land ownership
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 3

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/31/2008_Segment/Reach ID: LARO Beach 3_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to areas devoid of vegetation
4. Roads above banks, development, boat moorage, nearby stream tributary upstream from site brings an influx of sediment and nutrients
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
8. Diverse age class distribution of vegetation not apparent
9. Little diversity of vegetation, site dominated by reed canarygrass
10. It is difficult to determine due to the dominate presence of reed canarygrass and other fac-wet species. Obligate species do not dominate, this is why we indicated a no for this question.
12. Vegetation not showing high vigor likely due to fluctuation of water table, malnourishment
13. Vegetation is patchy, shoreline is mostly bare.
17. Soil saturation, i.e. ponding, is not sufficient to maintain hydric soils likely due to the frequent water level fluctuation and water table is too low for long periods of time have soil saturation
19. Site appears to have more sediment supplied to the site at a faster rate than the riparian area can expand and be in balance with its surroundings

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent __ _ __

Unknown _____

Additional notes:

5. Good supply of large woody debris further up shoreline; upland may be a source
6. Good rocky shoreline, well drained
7. Road encroachment and access a major factor; road very close to riparian shoreline

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X __ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _X_ Watershed condition

___ Dredging _X ___ Road encroachment _X_ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 4

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 4_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas
4. Roads above banks, development, boat moorage, nearby stream tributary upstream from site brings an influx of sediment and nutrients
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
8. Diverse age class distribution of vegetation not apparent, reed canarygrass dominates
9. Site dominated in central area of the site by reed canarygrass, outskirts show other invasive species however distributed across the site
10. It is difficult to determine due to the dominate presence of reed canarygrass and other fac-wet species. Obligate species do not dominate, this is why we indicated a no for this question.
13. Vegetation is patchy, shoreline is mostly bare.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent __ _ __

Unknown _____

Additional notes:

1. Site experiences heavy wave action, water at shoreline suspended sediment
2. Bluff upstream from site is undercut from wave action
3. Tributary upstream shows excessive erosion at mouth and may highly contribute to sediment loading of the site

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X _ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _ __ Watershed condition

___ Dredging __ _ _ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 5

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 5_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
	X		1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
	X		11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
	X		18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas
4. Roads above banks, development, boat moorage, nearby stream tributary upstream from site brings an influx of sediment and nutrients. Slopes above site show excessive erosion
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
9. Site dominated by horsetail. Little diversity across the site.
10. With the vegetation dominated by horsetail, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
13. Vegetation is patchy, shoreline is mostly bare.
17. No hydric soils at the site
18. Site appears to be deeply free draining, water table fluctuates easily with fluctuation of lake level
19. Site appears to have more sediment supplied to the site at a faster rate than the riparian area can expand and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent __ _ __

Unknown _____

Additional notes:

4. Site experiences heavy wave action, water at shoreline suspended sediment
5. Bluff above site from show signs of ongoing erosion

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X _ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _ __ Watershed condition

___ Dredging __ _ _ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 6

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 6_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
	X		18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas and along shoreline
4. Roads above banks, development, boat moorage. Slopes above site show excessive erosion
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
9. Site dominated by reed canarygrass, little to no diversity across the site.
10. With the vegetation dominated by reed canarygrass and other fac-wet invasive species, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
13. Vegetation is patchy, shoreline is mostly bare. This large spacing allows for shoreline erosion.
17. No ponding at the site due to the relatively free draining soils at the site. The water table drops sufficiently when the reservoir water level is lowered seasonally.
18. Site appears to be free draining, water table fluctuates easily with fluctuation of lake level
19. Site appears to have more sediment removed/eroded from the site at a faster rate than the riparian area can expand and protect the shoreline, and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent __ _ __

Unknown _____

Additional notes:

6. Site experiences heavy wave action
7. Slopes above site from show signs of ongoing erosion

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X _ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _ __ Watershed condition

___ Dredging __ _ _ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 7

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 7_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas and along shoreline, the slope of the shoreline prevents wetland vegetation from expanding to these steeper areas
4. Slopes, Roads above banks, development, boat moorage. Slopes above site show excessive erosion
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
8. Little age-class distribution across the site vegetation dominated by reed canarygrass
9. Site dominated by reed canarygrass, little to no diversity across the site.
10. With the vegetation dominated by reed canarygrass and other fac-wet invasive species, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
13. Vegetation is patchy, shoreline is mostly bare. This large spacing allows for shoreline erosion.
19. Site appears to have more sediment removed/eroded from the site at a faster rate than the riparian area can expand and protect the shoreline, and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent __ _ __

Unknown _____

Additional notes:

8. Site experiences heavy wave action
9. Slopes along shoreline at the site show signs of ongoing erosion
10. The site is underlain by hardpan/clay which maintains soils moisture characteristics

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X __ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _ __ Watershed condition

___ Dredging __ _ _ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 8

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 8_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
	X		5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
		X	18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas and along shoreline, the slope of the shoreline prevents wetland vegetation from expanding to these steeper areas
4. Slopes, Roads above banks, boat moorage. Slopes above site show excessive erosion with minor erosion on-site with gullies from storm runoff
5. The site is in a natural bay which is stagnant water
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
8. Little age-class distribution across the site vegetation dominated by reed canarygrass
9. Site dominated by reed canarygrass, little to no diversity across the site.
10. With the vegetation dominated by reed canarygrass and other fac-wet invasive species, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
12. Vegetation in water are wilting showing low vigor
13. Vegetation is patchy, shoreline is mostly bare. This large spacing allows for shoreline erosion.
17. Soil appears relatively free draining, no evidence of ponding after flooding. Frequent rising and lowering of water table causes little maintenance of hydric soils
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk ____ Downward _____

Nonfunctional __X__ Not Apparent ____

Unknown _____

Additional notes:

11. Slopes along shoreline at the site show signs of ongoing erosion
12. The site is underlain by relatively free draining soils which doesn't allow ponding for additional habitat for a quiet water environment

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities ___ Watershed condition

___ Dredging __ __ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 9

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 9_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
X			2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
10. With the vegetation dominated by reed canarygrass and other fac-wet invasive species, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
12. Willows have extensive dead material (low water table) and grasses are short and stumpy
17. Soil appears relatively free draining, no evidence of ponding after flooding. Frequent rising and lowering of water table causes little maintenance of hydric soils

Summary Determination

Functional Rating:	Tr	end for Functional – At Risk:
Proper Functioning Condition _____		Upward _____
Functional – At Risk __X__	Downward	_X__
Nonfunctional ___	Not	Apparent ___
Unknown _____		

Additional notes:

13. Slopes along shoreline at the site show signs of ongoing erosion
14. The site is underlain by relatively free draining soils which doesn't allow ponding for additional habitat for a quiet water environment
15. Downward trend due to lack of vigor, high fluctuation of water table

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes __X ___
No _____

If yes, what are those factors?

___ De-watering	___ Mining activities	___ Watershed condition
___ Dredging __	_ Road encroachment	_X_ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – LARO Beach 10

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/29/2008_Segment/Reach ID: LARO Beach 10_____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
X			2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. 5-6 foot green belt maintains groundwater level fluctuations at the site and do not appear to affect the longevity of this area during Lake Roosevelt Reservoir drawdown
3. Riparian areas potential is limited by nearby slope
4. Near by tributary upstream of site is feeding sediment and nutrients to site.
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
19. Site appears to have more sediment being supplied from the site at a faster rate than the riparian area can expand and protect the shoreline, and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____	Upward _____
Functional – At Risk __X__	Downward _X__
Nonfunctional ___	Not Apparent ____
Unknown _____	

Additional notes:

16. Slopes along shoreline at the site limit the expansion of the riparian area
17. Nearby tributary supplying excess sediment to site

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering	___ Mining activities	_X_ Watershed condition
___ Dredging __	_ Road encroachment	_X_ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – Spokane Lentic 2
Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/30/2008_Segment/Reach ID: _Spokane Lentic 2____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, and boats
13. There is not adequate vegetative cover along the shoreline to dissipate energy during high wind and wave events, much of the beaches are bare
17. Difficult to determine, however it seems like the vegetation is dominated by hydric soil conditions
20. No adequate large woody debris present to dissipate wind and wave event energies.

Summary Determination
Functional Rating: Tr end for Functional – At Risk:
Proper Functioning Condition _____ Upward _____
Functional – At Risk __X__ Downward _____
Nonfunctional _____ Not Apparent _X___
Unknown _____

Additional notes:
1. It is difficult to determine if cattails are spreading to upland areas or if upland vegetation are encroaching on the riparian habitat

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes __X __
No _____

If yes, what are those factors?
___ De-watering ___ Mining activities ___ Watershed condition
___ Dredging ___ Road encroachment _X_ Land ownership
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – Spokane Lentic 3

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _7/30/2008_Segment/Reach ID: _Spokane Lentic 3____Acres: _____

ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, and boats
10. Cattails present which indicate maintenance of soil moisture characteristics.
13. There is not adequate vegetative cover along the shoreline to dissipate energy during high wind and wave events, large spaces between vegetation groupings, portions of site good but may not handle high flow events if the rest of the site disappears
20. No adequate large woody debris present to dissipate wind and wave event energies.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __X__ Downward _____

Nonfunctional _____ Not Apparent _X___

Unknown _____

Additional notes:

1. It is difficult to determine if cattails are spreading to upland areas or if upland vegetation are encroaching on the riparian habitat
2. Subsurface soil consists of silt and clay

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities ___ Watershed condition

___ Dredging ___ Road encroachment __ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – Spokane Lentic 4

Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _7/30/2008_Segment/Reach ID: _Spokane Lentic 4____Acres: _____
ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive due to Lake Roosevelt Reservoir controlled levels and outflow.
3. Riparian area has room for expansion
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, and boats
7. Though not impacting safe passage of flows, the bay appears to be head-cutting
9. There is little diversity of riparian vegetation. The dominant species is reed canarygrass
10. Reed canarygrass does not indicate maintenance of soil moisture characteristics.
13. There is not adequate vegetative cover along the shoreline to dissipate energy during high wind and wave events, much of the shoreline beaches are bare
20. No adequate large woody debris present to dissipate wind and wave event energies.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk ___ Downward _____

Nonfunctional __X_ Not Apparent ___

Unknown _____

Additional notes:

3. Stagnant water in bay, poor visibility
4. Room for improvement with high potential to add species diversity

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities ___ Watershed condition

___ Dredging ___ Road encroachment ___ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lotic Standard Checklist – Columbia Lotic

Name of Riparian/wetland Area: LARO National Recreation Area

Date: 8/12/2008 Segment/Reach ID: Columbia Lotic Acres: _____

ID Team Observers: Ladd, Neumiller

Yes	No	N/A	HYDROLOGY
		X	1) Floodplain above bankfull is inundated in "relatively frequent" events
		X	2) Where beaver dams are present they are active and stable
X			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
X			4) Riparian/wetland area is widening or has achieved potential extent
X			5) Upland watershed is not contributing to riparian/wetland degradation
Yes	No	N/A	VEGETATION
X			6) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			7) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		8) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
	X		10) Riparian/wetland plants exhibit high vigor
	X		11) Adequate riparian/wetland vegetative cover is present to protect banks and dissipate energy during high flows
	X		12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)
Yes	No	N/A	EROSION/DEPOSITION
X			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
	X		14) Point bars are revegetating with riparian/wetland vegetation
X			15) Lateral stream movement is associated with natural sinuosity
X			16) System is vertically stable
X			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks (numbers correspond to checklist items)

1. No indication of floodplain connection due to bedrock and cobble banks.
8. Vegetation is absent in places due to cobbles and mostly dominated by upland species. This is due to bedrock and cobble-boulder lined banks.
10. Many plants rooted in very rocky substrate and do not appear vigorous.
11. Vegetation sparse along stream banks, protective cover not adequate to dissipate high energy events.
12. No large woody debris present on banks. Upland woody debris potential source but up slope from riparian area.
14. Point bars are unstable and highly erosive with minimal vegetation coverage. Vegetation present will not withstand high flow events therefore revegetation is not occurring.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition ____ Upward _____

Functional – At Risk _____ Downward _____

Nonfunctional __X__ Not Apparent _____

Unknown _____

Additional notes:

1. Limiting factors outside of management control have altered this system (i.e., railroad) and there are no options available to management to improve this system.
2. Steep bedrock site.
3. Railroad and road encroachment limits riparian potential.

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X __

No _____

If yes, what are those factors?

_X_Flow regulations ___ Mining activities _X_ Upstream channel conditions

_X_ Channelization _X_ Road encroachment ___ Oil field water discharge

___ Augmented flows _X__ Other (specify)_Agriculture, forestry (Logging), railroad

Lentic Standard Checklist – Columbia Lentic

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _8/12/2008_Segment/Reach ID: _Columbia Lentic____Acres: _____

ID Team Observers: _Ladd, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive due to Lake Roosevelt Reservoir controlled levels and outflow
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, development, and boats
8. Little age class distribution of vegetation, most very young likely due to the fluctuation of water level, underwater part of the year and exposed other part of the year. No signs of dying species, however dominated reed canarygrass
10. Obligate vegetation not present, likely indicating that the groundwater fluctuates and is too dry for soil moisture maintenance for part of the year
12. Small near-shore plants are dying, areas of shoreline brown, signs of fluctuating watertable
20. No adequate large woody debris present to dissipate wind and wave event energies.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __ _ __ Downward _____

Nonfunctional __X__ Not Apparent _ _ __

Unknown _____

Additional notes:

1. Site is near public boat launch which impacts sediment transport and activity at the site.
2. Site is dominated by reed canarygrass, little large woody debris
3. vegetation consists of small shrubs

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X _ __

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities ___ Watershed condition

___ Dredging _X __ Road encroachment _X_ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lotic Standard Checklist – Kettle Lotic

Name of Riparian/wetland Area: LARO National Recreation Area

Date: 8/13/2008 Segment/Reach ID: Kettle Lotic Acres: _____

ID Team Observers: Ladd, Neumiller

Yes	No	N/A	HYDROLOGY
X			1) Floodplain above bankfull is inundated in "relatively frequent" events
		X	2) Where beaver dams are present they are active and stable
X			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	X		4) Riparian/wetland area is widening or has achieved potential extent
	X		5) Upland watershed is not contributing to riparian/wetland degradation
Yes	No	N/A	VEGETATION
	X		6) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			7) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			8) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
X			10) Riparian/wetland plants exhibit high vigor
	X		11) Adequate riparian/wetland vegetative cover is present to protect banks and dissipate energy during high flows
	X		12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)
Yes	No	N/A	EROSION/DEPOSITION
X			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
X			14) Point bars are revegetating with riparian/wetland vegetation
X			15) Lateral stream movement is associated with natural sinuosity
X			16) System is vertically stable
X			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks (numbers correspond to checklist items)

4. Riparian area has not reached its potential extent, there are many bare areas and vegetation is young
5. A nearby tributary, flowing through a horse pasture, up stream is feeding sediment into the site.
6. Little age-class distribution on banks in riparian zone, very young.
11. Vegetative cover is patchy and clumped. Likely not enough to dissipate high flow events.
12. No large woody debris present on banks. Upland woody debris potential source but up slope from riparian area.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward __X___

Functional – At Risk __X__ Downward _____

Nonfunctional ____ Not Apparent _____

Unknown _____

Additional notes:

1. Areas of vegetation are patchy, clumping in groups. May have a chance to fill out, high flow events seem common.

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___

No _____

If yes, what are those factors?

___Flow regulations ___ Mining activities ___ Upstream channel conditions

__ Channelization _X_ Road encroachment ___ Oil field water discharge

___ Augmented flows _X__ Other (specify) Agriculture, forestry (Logging) railroad

Lentic Standard Checklist – Kettle Lentic

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _8/13/2008_Segment/Reach ID: _Kettle Lentic_____Acres: _____

ID Team Observers: _Ladd, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
X			4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
X			19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
X			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. The riparian area is enlarging because of the water level fluctuation, however it appears to have reached is potential extent because where the water level fluctuates there is brown vegetation which does not thrive under water for part of the year and comeback when the water level is lower.
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
9. There is little diversity of riparian vegetation. The dominant species is reed canarygrass
10. There is not a dominate presence of vegetation that indicates maintenance of riparian soil moisture characteristics.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____	Upward _____
Functional – At Risk __X__ Downward	__X_
Nonfunctional _____ Not	Apparent ___
Unknown _____	

Additional notes:

8. Little large woody debris, however upland is a potential source
9. Unable to determine whether riparian area is expanding or degrading due to the dominate vegetation consisting of reed canarygrass
10. Reed canarygrass is providing function but the riparian area will never function as it can unless vegetation diversity is increased at this site

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering	___ Mining activities	_ _ Watershed condition	
___ Dredging _X	__ Road encroachment	_X_ Land ownership	
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances			

Lotic Standard Checklist – Spokane Lotic
Name of Riparian/wetland Area: _LARO National Recreation Area_____
Date: _8/11/08_Segment/Reach ID: _Spokane Lotic_____Acres: _____
ID Team Observers: __Ladd, Neumiller_____

Yes	No	N/A	HYDROLOGY
	X		1) Floodplain above bankfull is inundated in "relatively frequent" events
		X	2) Where beaver dams are present they are active and stable
X			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
X			4) Riparian/wetland area is widening or has achieved potential extent
	X		5) Upland watershed is not contributing to riparian/wetland degradation
Yes	No	N/A	VEGETATION
	X		6) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		7) There is diverse composition of riparian/wetland vegetation for maintenance/recovery)
X			8) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
X			10) Riparian/wetland plants exhibit high vigor
	X		11) Adequate riparian/wetland vegetative cover is present to protect banks and dissipate energy during high flows
	X		12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)
Yes	No	N/A	EROSION/DEPOSITION
	X		13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
		X	14) Point bars are revegetating with riparian/wetland vegetation
X			15) Lateral stream movement is associated with natural sinuosity
X			16) System is vertically stable
X			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks (numbers correspond to checklist items)

1. Dam just upstream limits typical flow fluctuations
5. Roads and houses present as well as dam just upstream
6. Young willows and grasses present but not much mature vegetation
7. Limited vegetation diversity
11. Mostly young plants with many bare areas susceptible to high flows
12. Few mature woody vegetation capable of providing source of LWD
13. No floodplain present due to steep V channel; rip rap will help dissipate energy but is not adequate alone
15. Natural landform limits sinuosity

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk _____ Downward _____

Nonfunctional __X__ Not Apparent _____

Unknown _____

Additional notes:

1. Presence of dam just upstream alters typical flows and is outside of the managers control

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X____

No _____

If yes, what are those factors?

__X_Flow regulations ___ Mining activities _X_ Upstream channel conditions

__X_ Channelization __X_ Road encroachment ___ Oil field water discharge

___ Augmented flows _X__Other (specify)_rip-rap shoreline; human development

Lentic Standard Checklist – Spokane Lentic 1

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _7/30/2008_Segment/Reach ID: _Spokane Lentic 1____Acres: _____

ID Team Observers: _Hinson, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
X			3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
X			9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
X			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
X			12) Riparian/wetland plants exhibit high vigor
X			13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
	X		16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive due to Lake Roosevelt Reservoir controlled levels and outflow.
4. Near by tributary is transporting a log of fines and nutrients causing some algal mag development
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, development, and boats
16. There is apparent nutrient loading causing the increasing algae growth
19. Excessive deposition of sediment from the nearby tributary is occurring as well as excessive erosion due at mouth of tributary
20. No adequate large woody debris present to dissipate wind and wave event energies.

Summary Determination

Functional Rating: Tr end for Functional – At Risk:

Proper Functioning Condition _____ Upward _____

Functional – At Risk __X__ Downward _____

Nonfunctional ___ Not Apparent __X__

Unknown _____

Additional notes:

5. This site is impacted greatly by the influx of sediment from the nearby tributary as well as by the increasing nearby development
6. May be signs of downward trend in the future

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___

No _____

If yes, what are those factors?

___ De-watering ___ Mining activities _X_ Watershed condition

___ Dredging _X __ Road encroachment _X_ Land ownership

_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – Ricky Point Lentic

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _8/14/2008_Segment/Reach ID: Ricky Point Lentic_____Acres: _____

ID Team Observers: _Ladd, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
	X		7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
X			8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
X			10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
	X		11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
	X		17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas and along shoreline, the slope and seawall prevents wetland vegetation from expanding to these steeper areas
4. Slopes, Roads above banks, development, boat moorage.
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
7. fluctuation of water level creates dam at spill way from historical dredged bay area. Also deposition of long shore drift and wave action on the point is blocking access of water into some riparian zones.
9. Site dominated by a small shrub species and reed canarygrass, little to no diversity across the site.
11) Vegetation along shoreline is sparse and does not include root masses capable of withstanding excessive wave action and overland flows.
12. Vegetation is sparse and not showing much life and expansion. Willows seem to show high vigor, however very sparse and clumped in communities
13. Vegetation is patchy, shoreline is mostly bare. This large spacing allows for shoreline erosion, approximately 15% coverage across shoreline.
17. Groundwater fluctuation appears to be consistent with the reservoir water fluctuations. Shoreline relatively free draining, no evidence of ponding even in man-made bay. However moisture characteristics appear to be maintained within the bay area.
19. Site appears to have more sediment being supplied from the site at a faster rate than the riparian area can expand and protect the shoreline, and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:
Proper Functioning Condition _____ Upward _____
Functional – At Risk ____ Downward ____
Nonfunctional __X__ Not Apparent _____
Unknown _____

Additional notes:

18. High amount of sediment supplied to the site by fluctuation of water level and wave action. Area in-land where the community had a man-made bay for boat moorage, not used since mid-1980's, had completely been filled with sediment. We were informed that the filling has been natural.

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering ___ Mining activities ___ Watershed condition
___ Dredging _X __ Road encroachment _X_ Land ownership
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

Lentic Standard Checklist – Sherman Creek Lentic

Name of Riparian/wetland Area: _LARO National Recreation Area_____

Date: _8/14/2008_Segment/Reach ID: _Sherman Creek Lentic_____Acres: _____

ID Team Observers: _Ladd, Neumiller_____

Yes	No	N/A	HYDROLOGY
X			1) Riparian/wetland area is saturated at or near the surface or inundated in "relatively frequent" events
	X		2) Fluctuation of water levels is not excessive
	X		3) Riparian/wetland area is enlarging or has achieved potential extent
	X		4) Upland watershed is not contributing to riparian/wetland degradation
X			5) Water quality is sufficient to support riparian/wetland plants
	X		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
X			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)
Yes	No	N/A	VEGETATION
	X		8) There is diverse age-class distribution of riparian/wetland vegetation (recruitment for maintenance/recovery)
	X		9) There is diverse composition of riparian/wetland vegetation (for maintenance/recovery)
	X		10) Species present indicate maintenance of riparian/wetland soil moisture characteristics
	X		11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
	X		12) Riparian/wetland plants exhibit high vigor
	X		13) Adequate riparian/wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
X			14) Frost or abnormal hydrologic heaving is not present
		X	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics
Yes	No	N/A	EROSION/DEPOSITION
X			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
X			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
X			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
	X		19) Riparian/wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
	X		20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

Remarks (numbers correspond to checklist items)
2. Water level fluctuation is excessive depending on Lake Roosevelt Reservoir levels
3. Riparian area has not reached potential extent due to bare areas and along shoreline, the slope of the shoreline prevents wetland vegetation from expanding to these steeper areas
4. Slopes, Roads above banks, development, boat moorage. Slopes above site show excessive erosion
6. The natural surface or subsurface flow patterns are potentially altered by hoof action, dams, roads, boats and beaches
8. Little age-class distribution across the site, young and small
9. Site dominated by a small shrub species and reed canarygrass, little to no diversity across the site.
10. With the vegetation dominated by reed canarygrass and other fac-wet invasive species, the soil moisture characteristics do not appear to be maintained. Obligate species do not dominate, this is why we indicated a no for this question.
11. Vegetation dominated by sparse communities of obligate and fac-wet species. Large amount of bare areas along shoreline.
12. Vegetation is sparse and not showing much life and expansion. Vegetation is small and in some areas wilting and brown.
13. Vegetation is patchy, shoreline is mostly bare. This large spacing allows for shoreline erosion, only covering approximately 35% of the site.
19. Site appears to have more sediment being supplied from the site at a faster rate than the riparian area can expand and protect the shoreline, and be in balance with its surroundings
20. Not enough rocks or large woody material to adequately dissipate wind and wave event energies

Summary Determination

Functional Rating: Tr end for Functional – At Risk:
Proper Functioning Condition _____ Upward _____
Functional – At Risk ___ Downward ____
Nonfunctional __X__ Not Apparent _____
Unknown _____

Additional notes:

19. Slopes along shoreline at the site limit the expansion of the riparian area
20. Nearby tributary supplying excess sediment to site

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes __X ___
No _____

If yes, what are those factors?

___ De-watering ___ Mining activities __ Watershed condition
___ Dredging _X __ Road encroachment _X_ Land ownership
_X_ Other (specify) Excessive fluctuation of water level, and human disturbances

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