Pack River
Watershed Management Plan
and
TMDL Implementation Plan

July, 2006
Bonner County, Idaho

Prepared in Cooperation with:
Bonner Soil and Water Conservation District
Pack River Technical Advisory Committee
Pack River Watershed Council

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

The Pack River is the second largest tributary to Lake Pend Oreille and is located in Bonner and Boundary counties of northern Idaho. The Pack River watershed encompasses approximately 185,433 acres. The Pack River watershed is a significant watershed for bull trout, westslope cutthroat trout, and many other wildlife species. Bull trout are listed as threatened under the Endangered Species Act.

The Pack River is currently included on the State of Idaho's list of water quality impaired water bodies. Section 303(d) of the Clean Water Act requires states to develop a Total Maximum Daily Load (TMDL) for water bodies that are water-quality limited. Water bodies are determined to be water-quality limited if they do not support the beneficial uses designated to that water body. Designated beneficial uses of the Pack River include agricultural water supply, domestic water supply, primary contact recreation, cold-water biota, and salmonid spawning. Currently, cold-water biota, salmonid spawning, and primary and secondary contact recreation are impaired or not fully supported in the Pack River watershed due to excess sediments and nutrients.

A TMDL is an assessment of the amount of a specified pollutant that a water body can carry without violating state water quality standards. State water quality standards are set at a level that has been determined to provide full support of beneficial uses. Following U. S. Environmental Protection Agency (EPA) approval of a TMDL, the state is committed to completing TMDL implementation plans which specify actions that will be taken by various entities to reach the goal of improving water quality to the level that designated beneficial uses are fully supported.

The Idaho Department of Environmental Quality (IDEQ) completed nutrient and sediment TMDLs for the Lower Pack River in 2001. The sediment TMDL has been approved by EPA. The nutrient TMDL will be revised by IDEQ in 2007, based on additional nutrient monitoring being conducted in 2006. A temperature TMDL is also planned for completion in 2007.

Simultaneous to IDEQ's work on the Pack River TMDLs, the Pack River Watershed Council (PRWC) formed in response to the ESA listing of the bull trout and concerns about water quality impairments and observed bank erosion. The PRWC is comprised of concerned citizens, many of whom live within the Pack River watershed boundaries. The mission of the PRWC is to "improve water quality and riparian habitat in the Pack River for people, fish and wildlife through education, collaboration, and cooperative/coordinated projects."

The PRWC formed a collaborative partnership with the Tri-State Water Quality Council, the Bonner Soil and Water Conservation District, and the Natural Resources Conservation Service to recruit a Technical Advisory Committee (TAC) to help create a Watershed Management Plan that would protect the natural resources of the Pack River and its tributaries. The TAC formed in August 2001, and began developing the watershed management plan. TAC members included representatives from agencies and organizations with expertise in hydrology, biology, forestry, cultural resources, watershed education, conservation planning, and urban development.

This document, therefore, serves two purposes: as a Watershed Management Plan, it addresses the concerns of the PRWC—watershed residents as well as the team of technical advisors—by providing strategies for protecting and improving water quality; and as a TMDL Implementation Plan, it fulfills the state's requirements by including recommendations for practices and restoration efforts that will reduce sediment and nutrient loads to the extent that full support of beneficial uses is restored.

Because Idaho's Water Quality Standard for sediment is narrative (not numeric) and not based upon something directly measurable in the water column, an integrated management approach is needed to achieve satisfactory water quality results. Over 120 recommended actions presented in this plan fall into two program areas: education projects and on-the-ground implementation projects. Through education, informed watershed residents and river users will be more conscious of how their activities affect the river, and thus may be more willing to modify those activities to meet water quality goals that they understand. In conjunction with education, on-the-ground pollution control measures are essential for achieving the goals of the TMDL, because these actions can directly prevent or reduce the amount of sediment or nutrient loading into the river.

Categories for the on-the-ground actions include: development/waterfront property, stormwater, transportation/roads, forestry/agriculture, riparian/buffer zone protection and rehabilitation, tributaries, and stream channels. Action items are also included for program coordination and water quality monitoring and data management. The recommended actions include a spectrum of activities that ranges from protecting and maintaining natural vegetation along the river, developing land disturbance and grading permit requirements, investigating increased setbacks for new waterfront lots, identifying and implementing road improvement projects in water quality problem areas, encouraging landowner participation in federal and state forestry and agriculture cost share programs, and evaluating areas for placement of large woody debris. For each recommended action, the plan identifies lead agencies, estimated costs and anticipated implementation dates.

In accordance with Idaho Code, the plan is based on commitment from the designated management agencies (IDEQ, Idaho Department of Lands, Idaho Transportation Department and the Soil Conservation Commission) to devote the necessary resources to meet the targets of the TMDL. IDEQ will meet with the designated lead agencies and other resource managers and stakeholder groups to review TMDL projects on a five-year cycle. This review will ensure that projects are being implemented and monitored and that all agencies are held accountable for their respective projects. Additionally, the PRWC will remain involved to provide updates to the public and seek local community input on the on-going efforts of this Watershed Management / TMDL Implementation Plan.

2.0 INTRODUCTION

2.1 Purpose of Effort

In the summer of 2000, about 40 landowners who live within the Pack River watershed boundaries joined to create the Pack River Watershed Council (PRWC) to address concerns about water quality and stream habitat in the Pack River and its tributaries. Soon after its formation, the PRWC entered into a collaborative partnership with the Tri-State Water Quality Council (TSWQC), the Bonner Soil and Water Conservation District (BSWCD), and the Natural Resources Conservation Service (NRCS) to recruit a Technical Advisory Committee (TAC). TAC members were recruited from several agencies and organizations to create a team with expertise in hydrology, biology, forestry, cultural resources, watershed education, conservation planning, and urban development to assist with preparation of a comprehensive Watershed Management Plan that would protect and improve the natural resources of the Pack River and its tributaries. In August 2001, the TAC began meeting to develop the plan.

In 2002, Avista Utilities provided the PRWC and TAC with funding to conduct a characterization of fish habitat, geomorphic features and riparian habitat along 40 miles of the Pack River. The characterization work was conducted by Golder Associates (Golder) and the resultant Stream Channel Assessment Final Report was completed in October 2003. Information from the report, as well as other sources, was used by the TAC to develop the *Pack River Watershed Management Plan Technical Guidance* document. The Technical Guidance document (available separately) provides the foundation for the recommended management strategies and priority actions presented in this Watershed Management/TMDL Implementation plan.

The primary resource concerns and goals of the PRWC and the Watershed Management Plan are as follows:

- Meet water quality standards in order to return the river to full support of beneficial uses.
- Reduce bank erosion to prevent land loss and sediment loading.
- Use consistent standards for assessing river dynamics when planning and implementing restoration projects to ensure long-term effectiveness.
- Ensure that the river's ability to access its floodplain is not reduced.
- Maintain existing wetlands and increase riparian trees and vegetation.
- Reduce pollution and impacts—logging, agricultural, septic systems, and urban and industrial development—caused by private landowners.
- Improve river conditions and habitat for the migration and spawning of bull trout and other native fish species.
- Encourage more specific zoning regulations and improved enforcement of existing regulations with regard to development in the floodplain and along the riparian corridor.
- Maintain and improve wildlife habitat and wildlife corridors.
- Increase citizen membership and involvement within the PRWC.
- Develop a cohesive strategy for long-term monitoring and protection of the Pack River.

Members of the TAC who assisted in the development of this Watershed Management Plan are as follows:

Juliet Barenti, U. S. Fish and Wildlife Service
Chris Downs and Ray Hennekey, Idaho Department of Fish and Game
Bob Dunnagan, Trout Unlimited
Bob Flagor and Mark Hogen, Soil Conservation Commission
Steve Gill, Terra Graphics
Tom Johnson, Bill Love, and Scott Marshall, Idaho Department of Lands
Chris Savage and Kevin Davis, U.S. Forest Service
Suzanne Sawyer, Herman Collins and Linda O'Hare, BSWCD
Scott Soults, Kootenai Tribe
Ray Entz and Michele Wingert, Kalispel Tribe
Jenna Borovansky, IDEQ
Dave Stasney, Darren Brandt, and Dave Mosier, formerly of IDEQ
Jeff Stewart, Natural Resources Conservation Service
Diane Williams, Tri-State Water Quality Council
Jamie Davis, Idaho Association of Soil Conservation Districts
Jean Gerth, Marie Meshke, Lang Baker, and Kevin Davis, PRWC

As a Watershed Management Plan, this document addresses the resource concerns and objectives of the PRWC. The document also serves as a TMDL Implementation Plan for the Pack River, which is currently listed under the Clean Water Act for impairments to beneficial uses.

2.2 Overview of the Pack River TMDL

The Clean Water Act requires states to compile a list of waters that either do not meet water quality criteria or support their beneficial uses. This list is updated every two years. When a water body is included on the list of impaired waters (i.e., does not support the beneficial uses designated to that water body), a Total Maximum Daily Load (TMDL) must be completed for the pollutants causing impairment. A TMDL identifies pollutants of concern in impaired waters and recommends how much those pollutant loads should be reduced to return the water body to full support of beneficial uses. Within 18 months of U. S. Environmental Protection Agency (EPA) approval of a TMDL, the state must complete an implementation plan, detailing how the reductions in pollutants are to occur to restore beneficial uses. In Idaho, designated management agencies are responsible for assisting with the preparation of the implementation plan for areas where they have regulatory authority or programmatic responsibilities. Idaho's designated state management agencies are specified in Idaho Code 39-3601 *et seq*., as follows:

- Idaho Department of Lands for timber harvests and mining activities,
- Idaho Soil Conservation Commission for grazing and agricultural activities,
- Idaho Transportation Department for design and construction of public roads,
- Idaho Department of Agriculture for aquaculture,
- Idaho Department of Environmental Quality for all other activities.

The Pack River is currently included on the State of Idaho's list of water quality impaired water bodies. Initially, the Pack River was included on Idaho's court-imposed list in 1994 for nutrients, sediment, dissolved oxygen, habitat alterations, pathogens, and pesticide pollution. A problem assessment conducted by IDEQ in 1999 (and revised in 2001) concluded that the Pack River is water quality limited due to excess sediment and nutrients. IDEQ has documented impairment of beneficial uses due to excess sediment and nutrients in the lower two-thirds of the basin, stretching from Highway 95 to Lake Pend Oreille (IDEQ 2001).

Through its Beneficial Use Reconnaissance Program (BURP) IDEQ has assessed tributaries to the Pack River and found temperature and "biological impairment" problems in a number of segments of the river. As a result, temperature was added as a limiting pollutant on the state's list of impaired waterbodies in 2002. In-stream temperature recorders show that temperatures frequently exceed temperature criteria in the Pack River and its tributaries during the summer, and during critical spring and fall trout spawning periods[1]. Following additional monitoring in 2006, a TMDL for temperature will be completed by the end of 2007. If additional pollutants are identified as causing the "biological impairment" in the upper Pack River and its tributaries, TMDLs will be completed for these pollutants in 2007 as well.

As designated in Idaho's Water Quality Standards (IDAPA 58.01.02), beneficial uses of the Pack River include cold-water biota support, salmonid spawning, domestic and agricultural water supplies, and primary and secondary contact recreation. Currently, cold-water biota and salmonid spawning, and primary and secondary contact recreation are impaired or not fully supported due to excess sediments and nutrients.

Nutrients

The Pack River has been found to contribute the highest ratio of nutrients per land area of any watershed in the Pend Oreille basin. This is likely a result of the high ratio of sediment that is produced within the watershed due to the geology of the watershed and the heavy land use in the lower reaches of the Pack River (Hoelscher, et al. 1993). The river is also the second greatest source of nutrients to Lake Pend Oreille. The water quality standards under IDAPA 58.01.02.200.06 state: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." Identifying and controlling nutrient sources in the Pack River watershed has also been proposed as a management alternative for reducing near-shore eutrophication in Lake Pend Oreille (Hoelscher, et al. 1993).

Because nutrients are often bonded to sediment, excess sediment is often the source of nutrient pollution. This is probably true for nutrient sources in the forested portions of the Pack River

[1] The bull trout was listed as a threatened species in 1995, under the Endangered Species Act. The *Lake Pend Oreille Key Watershed Bull Trout Problem Assessment* of 1998 designates the mainstem Pack River as a key migratory corridor for bull trout between Lake Pend Oreille and spawning tributaries of the upper watershed. The mainstem of Grouse Creek is identified as a migratory corridor to spawning and rearing habitat in the upper Grouse Creek watershed as well. The mainstem Pack River and Grouse Creek are both designated high priority in the Bull Trout problem assessment (PBTAT 1998).

watershed; thus, a TMDL for sediment may be sufficient for both pollutants. However, due to mixed land uses and other potential sources of nutrients in the lower portion of the watershed, it would be conservative to assume that not all nutrients are coming from sediment. A separate assessment for nutrient pollution will be completed to ensure that other causes are not missed as potential sources for reduction. IDEQ prepared a nutrient TMDL in 2001 that was not approved by EPA because more quantification of nutrient loads from tributaries was needed. Additional monitoring is taking place during 2006 and this information will provide the basis for a revised nutrient assessment and TMDL, if needed, to be completed in 2007. It is anticipated that the nutrient TMDL will include load limits for phosphorus as well as nitrogen.

Sediment

It is important to make a distinction between the amount of erosion and the amount of sediment yielded. Sources of great erosion may not yield the most sediment. It is roughly estimated that 61,100 tons of silt and clay are eroded in the Pack River basin annually (IDEQ 2001). Sources of erosion include roads, sheet and rill erosion, and mass wasting/landslides. The sediment can be deposited in numerous places en route to the river, including the uplands and floodplain.

In 1999, the IDEQ completed TMDL pollutant targets for sediment. **The target load for sediment is 15,635 tons/year—a reduction of 45,465.6 tons/year, or 74% of the existing sediment load.** The EPA approved the sediment TMDL for the lower Pack River in April 2001. IDEQ calculations for the sediment TMDL are as follows:

	Acres	**Yield Co-efficient** (tons/acre/year)	**Background Load** (tons/year)
Total watershed	293,047		
Presently forested	239,047		
Estimated historically forested	290,487	0.038	11,038.5
Estimated historically pasture	2,560	0.14	358.4
Natural mass failure (tons/year)			4,238.3
Target (background) load			**15,635.2**
Existing Load			**61,100.8**
Load Reduction (74% of existing load)			**45,465.6**

The Idaho Water Quality Standards narrative criteria (IDAPA 58.01.02.200) states that sediment shall not exceed, in the absence of specific numeric criteria, quantities that impair designated beneficial uses. Such impairment is determined through water quality monitoring. Fine sediment, lack of large woody debris to create pools and cover, and elevated temperatures are also believed to be significant limiting factors of bull trout production in the Pack River.

While the Pack River sediment TMDL establishes a target load only for the lower main stem of the river, the implementation plan considers all sources. Problems and activities occurring in the watershed, including roads, wildfires, agricultural activities, grazing, timber harvest, mass wasting, and residential development can all contribute to an increase in total sediment to the river.

Because Idaho's Water Quality Standard for sediment is narrative and not based upon something directly measurable in the water column, an integrated management approach is needed to achieve a satisfactory implementation plan. TMDLs use a very conservative approach, in that the sediment target is limited to natural background amounts. However, beneficial uses may be fully supported at some point before the target is achieved, or the target could be achieved without restoring full support of beneficial uses. Therefore, a measure of sediment reduction cannot be used *exclusively* to determine a return to full support. Rather, an *integrated* approach that combines several different management strategies for reducing sediment loads will need to be implemented. In addition, erosion prevention, landowner education, restoration and revegetation efforts, better forestry practices, and other improvements such as new zoning regulations will be needed for long-term success.

3.0 OVERVIEW OF THE PACK RIVER WATERSHED ASSESSMENT

The following information is a synopsis of data compiled and presented in a separate document prepared by the Pack River TAC entitled *Pack River Watershed Management Plan Technical Guidance*. The Technical Guidance document provides the foundation for the recommended management strategies and priority actions presented in this plan.

3.1 Watershed Description

Encompassing approximately 185,433 acres, the Pack River watershed is located in the northern portion of the Lake Pend Oreille basin in the panhandle of Idaho. (See Figure 1.) From its headwaters at Harrison Lake the river flows approximately 45 miles through forested land to Lake Pend Oreille. Pack River is the second largest tributary to the lake and is fed by a number of significant tributary watersheds, including Grouse and Rapid Lightning Creeks. The Pack River provides important spawning and rearing habitat and a migration corridor for adfluvial bull trout (*Salvelinus confluentus*), Westslope cutthroat trout (*Oncorhynchus clarki lewisi*), kokanee, (*Oncorhynchus merka*), and Gerrard rainbow trout (a race of *Oncorhynchus mykiss*). Bull trout are listed and threatened under the Endangered Species Act (ESA) and Westslope cutthroat trout are a State of Idaho species of concern.

The watershed supports diverse land uses such as agriculture, timber harvest, residential development and recreation. As a result, road development in the upper watershed and loss of riparian vegetation and associated root masses due to fire, salvage, timber harvesting, livestock grazing, and/or clearing, may cause delivery of fine sediment to the stream channel. Present and historic land uses and the Sundance Fire of 1967 have impacted habitat conditions for bull trout and other fish species in the Pack River. The current overall habitat condition of the Pack River watershed has been rated as low.

Historically, the Pack River experienced natural disturbances such as fire, rain-on-snow events, large-scale rainstorms, and associated flooding. These events are distinct in time and space and can occur anywhere on the landscape. Random sediment inputs to stream channels occur as a complex series of pulses that are delivered and stored within high-gradient stream channels (Benda and Dunne 1997b). Sediment accumulates within these channels before debris flows or other intense erosional processes transport it downstream. Following an erosional event, large volumes of sediment are concentrated in different sections of the stream channel, mainly near tributary junctions along the larger order, lower gradient sections. The stream channel transports bedload (sediment that moves near the streambed) downstream from these storage sites at different rates. The bed material travels slowly, creating temporary patterns of sediment transport, sediment storage, and channel structure throughout the stream channel (Benda and Dunne 1997a).

The upper drainages within the Pack River and their dependent resources have evolved under this “pulse” disturbance regime so that they can effectively respond to those disturbances over time while sustaining their long-term functions, processes, and conditions. Under natural

conditions, riparian vegetation and in-stream structures, such as large woody debris and beaver dams, help to dissipate energy and maintain a level of channel stability.

Development of the land and resources in the watershed has affected this natural regime. The pattern of many of the human-caused disturbances has tended to be a more sustained or "press" disturbance regime (i.e. tending to mimic historic "natural" processes, but with greatly amplified frequency and intensity). In some cases, the watershed systems have begun to radically adjust to those press disturbances, or have become altered by them, resulting in severe stresses in their capability to support dependent resources.

Historic Land Use

For tens of thousands of years, the Kalispel Tribe and the Kootenai Tribe of Idaho, along with the larger Kootenai Nation (Ktunaxa Nation) and other tribes, traditionally depended on the vast aquatic and terrestrial resources of the Pack River watershed and other basins (i.e., Flathead, Clark Fork, Pend Oreille, and the upper main stems of the Columbia and Kootenai Rivers).

Small numbers of Europeans traveled through the area throughout the mid-1800s, trading goods, compiling maps, and performing surveys. The discovery of gold in British Columbia at Rock Creek, Kettle River, and on the Wild Horse River near Cranbrook in the 1860s drew a large number of prospectors and miners through north Idaho. Construction of the Northern Pacific Railroad in the early 1880s opened up settlement in northern Idaho and created rapid changes to the traditional way of life for Native American tribes.

Around the beginning of the 20th century, the influx of human populations began in the inland northwest, along with the development of the land and resources to support those populations. Although the sediment yield is naturally high in the Pack River system, it is important to note that human activity can accelerate or reduce erosion. Increased pressure from human settlement in the Pack River watershed has altered the hydrology, increased peak flows and associated erosion, decreased riparian vegetation and sources of in-stream structures, and reduced the quality and availability of aquatic and terrestrial habitat.

Human-caused changes in the hydrology of the Pack River watershed are largely responsible for the accelerated streambank erosion and slumping that is occurring today. Human disturbances in the Pack River watershed include hydroelectric development on the Pend Oreille River, historic post-fire salvage logging and road construction in the upper headwaters, historic riparian logging and other riparian disturbances, channel modifications for log drives down the Pack River from Hellroaring Creek south, conversion of forest to agricultural production, implementing surface drainage systems for agriculture and roads, timber harvest, residential development, and road and railroad construction. These activities have increased total runoff volumes and the rates (i.e., peak flows) at which runoff leaves the watershed.

Current and Projected Land Use

The U.S. Forest Service (USFS) manages about 55% of the Pack River watershed, primarily in the headwaters and upper reaches, while approximately 36% of the watershed is privately owned

and concentrated in the lower two-thirds of the Pack River drainage. Currently, approximately 75% of the watershed is in forested acres, with the remaining portion of the watershed in agricultural, rural residential, or open undeveloped acres. The close proximity of the Pack River watershed to the largest city in the county (Sandpoint) and to many recreational attractions make it a prime location for continued growth and development.

- Development

The majority of urban development in the Pack River watershed is residential, with limited commercial development in the lower reaches. Virtually all land in the lower reaches of the Pack River is zoned agricultural, and land in the upper reaches of the main-stem Pack River and most of the eastern tributaries is zoned rural. The construction and improvement of roads within the watershed, and specifically roads adjacent to the mainstem of the Pack River, will continue to allow for easier access to areas once considered difficult to reach, and traffic volumes within the watershed will increase. Impacts from urban development that are of particular concern in the Pack River watershed include floodplain development, loss of aquatic habitat and riparian vegetation, increased stormwater runoff, and bank erosion**.**

- Timber Harvest

Many of the negative impacts to the Pack River watershed from timber harvest activities have occurred in the past, but legacy effects from these activities are still evident. Prior to the establishment of regulatory protection in the last 30 years, streams and riparian areas received little protection from harvesting, skidding, and processing activities. Clearcutting, road construction, and channel modifications for log drives altered the hydrology and increased erosion. The legacy of these activities still affects fish and wildlife habitat in some areas of the watershed.

Forest management activities currently occur on National Forest, Bureau of Land Management (BLM), State of Idaho, and private lands. Private landowners and the State of Idaho tend to be the most active in timber harvest activities, while the USFS is least active. Forest managers recognize the potential impacts of forest management and design practices to reduce impacts resulting from new operations (Bisson et al. 1992). However, impacts from previous forest activities (legacy effects) may limit current management options. The principal concerns with current forest management activities are sediment from roads, road failures, concentration of flow on roads, and retaining riparian shade.

- Agriculture

Conversion of forested land to permanent agriculture played a significant role in altering the hydrology of the basin. Establishment of permanent agriculture reduced infiltration in the watershed, increasing the amount of surface runoff. In addition, when forestland was originally converted to agriculture, surface drainage was required to move water off the fields in some locations. On land that once had a high proportion of small, land-locked depressions, these drainage systems now contribute more surface runoff to the tributaries of the Pack River.

Of the 5% of the watershed currently devoted to agricultural land, most farm types are still hay and livestock oriented. The majority of agricultural land is located in the lower portion of the watershed. Cattle grazing is primarily seasonal, beginning in the spring and ending in the fall. Land use in the area is changing rapidly as pasture and hayland areas are being subdivided and developed. New homebuilders are acquiring larger lots on which they can keep a small number of animals. This transition is expected to continue. Primary agricultural concerns include nutrient increases from feedlot runoff into watercourses, overgrazing of pastures and associated soil compaction, and uncontrolled access to sensitive riparian areas and unstable streambank.

Biological Communities

The Pack River watershed is important habitat for a number of aquatic and terrestrial species, as well as significant native plant species. The bull trout was listed as an endangered species in 1995 under the ESA. The *Lake Pend Oreille Key Watershed Bull Trout Problem Assessment* designates the main-stem Pack River as a key migratory corridor for bull trout between Lake Pend Oreille and spawning tributaries of the upper watershed (PBTAT 1998). Westslope cutthroat trout, a species of special concern in Idaho, rely on the watershed for habitat. Other aquatic species that depend on the watershed include mountain whitefish, brook trout, brown trout, kokanee salmon, and rainbow trout.

Some terrestrial species supported by the Pack River watershed are also listed under the ESA, including woodland caribou, which is listed as endangered, and grizzly bear, gray wolf, Canada lynx, and bald eagle, which are listed as threatened. Idaho wildlife species of special concern supported by the Pack River watershed include the wolverine, fisher, northern goshawk, and the white-winged crossbill. Other wildlife that rely on the watershed include white-tailed deer, mule deer, moose, elk, black bear, mountain lion, mountain goat, river otter, mink, muskrat, beaver, osprey, peregrine falcon, a variety of hawks and owls, migratory songbirds and waterfowl, several species of game birds, and many other wetland species.

The vegetation in the Pack River watershed includes conifer forest habitat types consisting of mixed species, typified by stands of western red cedar/western hemlock; stands of codominant Douglas fir and ponderosa pine; stands of Douglas fir; and western larch, lodgepole pine, and western white pine. Dense stands of Douglas fir, larch, and lodgepole are characteristic of slopes with northern and eastern aspects. Relatively open stands of Douglas fir and ponderosa pine are typical on the warmer, dryer southern and western aspects. Based on surveys conducted in 2002, dominant riparian vegetation found along the river and streambanks includes willow, western red cedar, and Sitka alder types (Golder 2003).

3.2 Current Conditions and Reference Reaches

Stream channels within the upper Pack River watershed have the potential to efficiently transport water and sediment. Within the upper tributaries, sediment transport is very efficient with a small amount of sediment storage within debris jams, beaver ponds, and step pool habitats. However, lower in the watershed, different channel types are less efficient at sediment transport. This is evident along the lower gradient reaches of Pack River below Hellroaring Creek.

Fine sediment is moved from the upper watershed and deposited in the lower portions of the watershed. The majority of the riparian vegetation in the watershed is in disturbance stage. Pool habitat is limited, with most of the pools occurring in the upper reaches. Large woody debris is generally lacking in the river, which decreases complexity and availability of aquatic habitat.

Stability in the upper watershed is generally a result of large boulders and bedrock forming the channels as well as thick riparian vegetation. The middle reaches of the watershed have some stable and unstable areas. Most of these reaches are lacking large woody debris and pools. The transition between the stable upper reaches and unstable lower reaches occurs in Golder Reaches C and D, located between Hellroaring Creek and Highway 95. For the most part, the lower reaches of the watershed are unstable (Golder 2003).

The lower reaches of the watershed have high eroding banks, fast lateral movement of the channel, and are characterized by relatively wide, shallow channels. Much of the lower watershed has experienced reduced riparian vegetation and buffers and an increase in the presence of invasive plant species (Golder 2003). The low soil moisture resulting from the high eroding banks make riparian vegetation difficult to establish in these areas.

Golder Associates conducted a stream channel assessment in the Pack River watershed in 2002 that allows a view of the current channel conditions and identified reference sub-reaches for each reach assessed in the watershed (Golder 2003). A reference reach is a segment of stream or river channel that is similar in character to degraded stream segments except for the fact that it is not degraded and is relatively stable. Landowners and land management agencies use reference reaches as goals in watershed improvement, comparing degraded reaches to determine improvement actions and monitor progress toward ultimate health of the degraded segments.

All reference reaches for the Pack River were identified as those with the highest relative stability within its section, based on the characteristics of each given section. A reference reach was not identified for the mouth section of the Pack River, as it has more wetland-like characteristics due to the fluctuating lake levels associated with Albeni Falls Dam (Golder 2003).

3.3 Synthesis and Interpretation

Upper Pack River

The upper Pack River (Golder Reaches A and B, Figure 1), from the headwaters downstream to Hellroaring Creek, is categorized as a step-pool system. Step-pool systems are transport type channels with gradients that range from 3–8% and dissipate energy via vertical plunges. The geomorphology of the upper Pack River is characteristic of glaciated watersheds with granitic parent geology (Golder 2003). Within this reach, high volumes of sediment are input into the system due to the highly erosive nature of exposed granite and unconsolidated glacial deposits. The high channel gradient and discharge transports much of the sediment downstream to lower reaches. Because the upper Pack River is a transport reach, it is not as reactive as lower gradient reaches found further downstream. It exhibits the greater characteristics of a system that has evolved to accommodate high sediment production and transport.

Changes to the system from human and natural perturbations are not as pronounced as in lower portions of the watershed, but past human disturbances have altered the hydrology nonetheless. Logging operations and road building since the early 1900s, the Sundance Fire of 1967, post-fire salvage logging, and removal of large woody debris from the channel and floodplain have altered and increased the process of erosion and changed the vegetation in the upper Pack River watershed.

Increased rates of surface erosion and landsliding, changes in peak flow timing and magnitude, and attendant impacts on stream sedimentation and channel morphology are all results of changes to the system. Accelerated bank erosion led to widening and straightening of the stream channel and channel gradient increased slightly. Multiple channels developed in lower gradient reaches with wide floodplains, and downcutting occurred where lateral migration of the channel was restricted. Removing large woody debris from the system resulted in more sediment transport.

In the upper Pack River, the hydrologic trend is a moderating hydrograph with decreasing discharge volumes at peak flows and a later occurrence for peak flows during spring runoff. This is due to re-vegetation in the upper watershed where the Sundance Fire eliminated much of the canopy and also the re-vegetating and decommissioning of roads. Erosion rates in the upper Pack River are declining, due largely to natural regeneration of shrubs and conifers in riparian and forest areas. However, erosion rates in the upper watershed are most likely at an elevated state on a scale of natural variability within the watershed. Some recruitment of large woody debris has occurred in the decades since the fire, providing some grade control for the channel, but large woody debris will continue to be lacking in the upper Pack River for decades until a mature forest is established.

Currently, the natural frequency of stand-replacing fires and the extent of roads with problems in the upper watershed limit the recovery of historic hydrologic conditions. Constraints on declining erosion rates in the upper Pack River lie mainly with the duration of time for natural recovery of vegetation and the removal of problem roads.

The trend of the vegetative community in the upper Pack River is toward recovery. In the riparian zone, the shrub community is well established and will provide microsites for mid-seral tree species to colonize, stabilizing the stream channel. Pockets of remaining mature forest will continue to provide a seed source for late and climax tree species and benefit aquatic and terrestrial inhabitants. Current constraints on the recovery of pre-fire riparian and forest communities exist with the duration of time required for them to reestablish and the natural frequency of stand-replacing fires.

Fish habitat in the upper Pack River changed, as well as concurrent changes in species population and distribution. Stream channel changes that most directly affected fish were reduction of pool habitat and residual pool volume as well as reduction in thermal cover, large woody debris, lateral rearing habitat, and overhanging banks. Loss of some or all of these critical characteristics has led to patchy or incomplete availability of the necessary habitat

components. Thus, species distribution and spawning habitat within the upper watershed has become fragmented.

Trends in fish habitat will be equally slow to recover. As vegetation reestablishes in the upper Pack River, the trend in increasing quality fish habitat will continue to improve. Revegetation will continue to reduce natural erosion rates. This in turn will improve the quality of spawning gravels in documented critical habitat. Stream bank integrity will improve with a healthy riparian zone and overhanging banks will benefit fish cover. Improving vegetation communities in the riparian zone will improve thermal cover and provide a moderating influence to stream temperatures as well as provide a source for future large woody debris recruitment.

Lower-Upper Pack River

The lower-upper Pack River (Golder Reaches C and D, Figure 1), from Hellroaring Creek to Highway 95, is a response type reach that is reactive to water quantity and sediment inputs from the upper reaches and tributaries. Erosion processes in Reaches C and D have fluctuated through a natural range of variability due to fire, unstable landforms, and upstream and tributary influences. The channel is continually adjusting to input from tributaries and the main channel upstream.

Human influences have exacerbated the natural influences and trended more toward a press disturbance regime, in turn affecting a larger scale. Riparian logging in Reaches C and D has accelerated bank erosion rates and erosion of the floodplain during overbank flows and is responsible for the lack of mature forest in the valley bottom areas as well. Log drives and associated channel alterations for increased log transport efficiency greatly increased bank erosion and channel migration.

In the 1940s and 50s, larger scale logging operations began to access timber at higher elevations. Road construction was extensive, especially in the tributary watersheds. Sedimentation rates entering the watershed increased due to roads and, to a lesser extent, the common practice of clear-cut logging.

More recently, clearing of the land for home site development has become a significant impact in Reaches C and D. Development within the riparian zone and floodplain is influencing increased upland surface runoff and transport of contaminants, increased streambank erosion, unstable stream channels, and impaired habitat (Stream Corridor Restoration, 1998).

Hydrologic variables and the resulting influences mentioned for Reaches A and B are largely the same for Reaches C and D. Discharge volumes will obviously be higher in downstream reaches, but, as a result, channel capacity is greater to accommodate higher flows. Flood related landforms such as floodplains and oxbows are frequently inundated, which serves to reduce stream power in the main channel.

Reaches C and D receive rain-on-snow events that have a similar effect as would an annual spring runoff flood event. Floodplain features have been constricted somewhat by road construction in the valley. The effect has been reduced residence time of floodwater and slightly

higher discharge volumes and stream power. Historically, some tributaries within the lower-upper reach may have been flashier due to more open forest stands, which resulted from more frequent fires. This scenario may be more consistent with the historical range of variability in Reaches C and D.

Present forest management will influence a trend toward a moderating hydrograph with decreasing discharge volumes at peak flows and a later occurrence for peak flows during spring runoff. This is slightly offset by development in this reach of the river. Increased roads and development on private land will continue to force an opposing trend by decreasing runoff time to the watershed and reducing residence time of floodwaters by limiting access to the floodplain.

Over the decades, fire suppression influenced the return of seral forest species to the hillsides, and riparian plants such as willow, dogwood, and cottonwood returned to the valley bottoms in Reach C. The dominance of willow in Reach C indicates an even earlier level of succession than that of the alder-dominated areas in Reach B, partly due to naturally frequent changes in channel morphology (Golder 2003). Reach D exhibits a varied forest and riparian component in 1934 photos and represents an improvement in the vegetative condition over Reach C.

One change in vegetation that becomes increasingly apparent in 1968 and subsequent photos is the conversion of forested areas into pasture. The lowering of the base level of the Pack River, especially in Reach D, encouraged the growth of drier site shrubs and invasive weed species as riparian vegetation on high banks had difficulty reaching the water table. Areas that have been converted from their natural vegetative community will experience greater channel adjustments, especially through Rosgen C type channels. Where riparian zones remain intact, forested areas will continue to provide streambank protection, thermal regulation, and a seed source for mid-seral tree species. Current constraints on recovery of riparian communities exist with the duration of time required for them to reestablish, the natural frequency of stand-replacing fires, and the press of future development.

Currently erosion rates in Reaches C and D due to logging and road construction have leveled out as natural forest regeneration ensues and the benefits of a more mature forest canopy are realized. Old roads are also revegetating and lessening inputs of sediment to streams. Recognition and removal of problem roads will continue to reduce sediment input. Homesite development and associated land clearing will continue to exacerbate streambank and surface erosion until setbacks or zoning regulations are established and enforced to protect the riparian areas along the river and tributaries.

The current trend in Reaches C and D is toward continued elevated rates of bank erosion and channel migration. Areas where riparian vegetation and large woody debris are lacking will continue to experience accelerated rates of erosion, particularly lateral migration. Tributaries to these reaches will also experience similar channel adjustments.

Current constraints to the equilibration process lie mainly with continued development activities within and adjacent to the floodplain and within the stream channel. Hard engineering for streambank erosion protection can be particularly damaging in this reach. Miller (1999) notes that non-deformable, or hard-engineered streambank protection projects can function, in effect,

contrary to the goal of establishing fluvial processes desirable for "true" restoration. Hardened banks will often accelerate water velocity, due to low tractive forces along smooth structures, and increase erosion activity to areas downstream. Because the lower-upper reach of the Pack River is a response reach directly downstream from a higher energy transport reach, it is particularly vulnerable to any changes that occur in the watershed.

Effects of disturbance on aquatic life and the projected trend in the lower-upper Pack River are discussed collectively with the lower Pack River below.

Lower Pack River

The Lower Pack River (Golder Reach E, Figure 1) is characterized by low gradient, moderate to high sinuosity, moderate entrenchment, high width/depth ratio, and fine substrate. These primary characteristics are typical of a pool-riffle or regime channel. Both of these channel types are particularly sensitive to changes in sediment supply and discharge as well as changes in large woody debris. This is because of their relatively low sediment transport capacities.

"C" type channels naturally undergo higher relative rates of lateral adjustment. Meander cutoffs are a natural progression of the channel continuum process. Oxbow lakes are a testament to this process. Some natural events that would have changed the rates of natural adjustment within Reach E are mass wasting, rain-on-snow, fire, and beaver activity. These perturbations resulted in changes that occurred within an historic range of variability. Integrity of the riverine system was such that catastrophic events, such as rain-on-snow, could be easily accommodated due to the morphology of the channel and valley basin. Human disturbances presented changes to the system that moved outside the natural range of variability and changed the physical processes and morphologic characteristics of Reach E.

Logging operations and log drives in Reach E focused on riparian species such as cedar and white pine and relied on small watercraft to transport logs to the lake. Disturbance of the riparian zone would have increased the susceptibility of the channel to accelerated lateral erosion. Channel straightening by mechanically forcing meander cutoffs influenced further channel adjustments. Cutover land was sold to settlers who further cleared the land. Conversion of riparian vegetation to crops or grass accelerated vertical and horizontal adjustments of the channel. Concomitantly, sections lowering in base level would experience a dropping water table and a gradual change in vegetation to more pioneering and dry site species. Over time this process leads to increased bank erosion and lateral migration.

The Humbird Company logged much of the Pack River valley and selected mostly cedar and white pine. Historic photos show that much of the area that was logged was heavily impacted. Thus, much of the climax riparian and upland forests in the valley were lost. This likely had profound impacts on channel stability, thermal regulation, and erosional processes. Riparian forests of cedar are very effective at reducing shear stress on banks and provide diverse habitat and sediment storage once decadent trees are incorporated into the channel. Many areas that were initially cleared of forest have remained cleared for decades.

By the 1950s cumulative watershed impacts in the upper Pack River and associated tributaries disrupted the sediment-discharge balance and further channel adjustments are documented. In the decades to follow development in Reach E increased, which resulted in more compacted soils, road construction, cleared land, and drainage diversion. This all has the net effect of decreasing residence time of storm water, increasing the potential for sediment delivery to the watershed, and increasing stream power.

The current trend in erosional processes in Reach E is toward continued elevated rates of erosion above pre-settlement levels. Significant floodplain development, increased urban and sub-urban runoff, stream riparian zone clearing, and stream channel alterations are all contributing factors (PBTAT 1998).

The trend in vegetation in Reach E is toward continued alterations in forest and riparian communities due to construction and development. The presence of upland vegetation types in the riparian area is increasing. Invasive species, like tansy, knapweed, and Canada thistle are becoming more common. In some sub-reaches that have become seriously downcut, even native riparian species cannot perform vital stabilizing functions and will eventually become reduced. Some cleared areas have been reclaimed by forest and early seral stages of forest are revegetating more of the valley bottom. Where late-seral vegetation is more prevalent, bank stability ratings are consequently higher.

The development of the floodplain and clearing of land for housing construction will continue to alter riparian plant communities. Large wood will continue to be lacking from the system as a result. A healthy riparian zone as well as an abundant source of large wood to the system is an integral part in maintaining the channel dimensions.

Present forest management will influence a trend toward a moderating hydrograph with decreasing discharge volumes at peak flows and a later occurrence for peak flows during spring runoff. This is slightly offset by development in this reach of the river. Increased roads and development on private land will continue to force an opposing trend by decreasing runoff time to the watershed and reducing residence time of floodwaters by limiting access to the floodplain.

The current trend in Reach E of the Pack River is for continued accelerated channel adjustments. Lateral adjustments will be most pronounced in areas lacking sufficient native riparian vegetation. The stream will not return to equilibrium until it has moved enough sediment to create a new floodplain at the new lower base elevation (Golder 2003). This will entail lateral and vertical adjustments over time.

In the lower portions of Reach E the river is influenced by the backwater effect produced from the raising of the summer levels of Lake Pend Oreille to approximately 2,066 feet. This is resulting in an increased tendency of the river to deposit bedload and is influencing accelerated lateral migration. Lack of native riparian vegetation through sub-reaches has contributed to extensive channel adjustments. Large sediment additions from Grouse Creek are exacerbating these channel adjustments. Similar channel adjustments will occur in respective tributaries such as Sand, Gold, Grouse, and Rapid Lightning Creeks.

Sediment additions from upstream sources on the Pack River will likely continue and add to instability in Reach E. Development within the riparian zone and floodplain is influencing increased upland surface runoff and transport of contaminants, increased stream bank erosion, unstable stream channels, and impaired habitat (Stream Corridor Restoration, 1998). Channel adjustments in well-vegetated areas will occur at a rate more consistent with historical channel continuum processes. Channel features such as pools and riffles are trending toward a more natural ratio in these sub-reaches.

As with Reaches A and B, channel adjustments in the main Pack River in Reaches C through E were significant enough to influence resultant changes in the tributaries, which effectively reduced spawning habitat components. Removal of large woody debris from Reach A and B, riparian logging in Reach B and C, and roads in numerous tributaries and the main Pack River valley all influenced increased sediment transport and essentially cut off the supply of wood moving through the system. As a result, downstream reaches could not effectively handle the increased supply of sediment being transported. Formative features for development of pool habitat, such as boulder scour areas or large woody debris, were generally not present in Reach C (Golder 2003).

As in the upper reach, the stream channel changes that occurred and most directly affected fish were reduction of pool habitat, reduction of residual pool volume, reduction in thermal cover, reduction in large woody debris, reduction in lateral rearing habitat, and reduction in overhanging banks. Since Reaches C through E are response driven, input of sediment had an impact on fish populations by reducing pool volume, and lateral rearing habitat. Available habitat in the tributaries would have been similarly affected.

Changes in the physical characteristics of the migratory corridor affect fish populations as well. In recent years, development in the riparian zones endangers fish habitat by maintaining accelerated sediment transport, directly reducing cover habitat, influencing increasing stream temperatures, and reducing habitat diversity and complexity.

As watershed conditions in the respective tributary headwaters improve, the potential for fish habitat components to attain higher diversity and complexity will increase. The limiting factor for an improving trend in fish habitat and populations is development in the riparian zone and floodplain in spawning tributaries and along the main Pack River migration corridor.

Pack River Delta

The delta of the Pack River (Golder Reach F, Figure 1) has undergone significant changes since the completion of Albeni Falls dam in 1955. Higher summer levels of Lake Pend Oreille resulted in the lower five miles of the Pack River being inundated for a period of about six months, from May to November. The resulting raised water table in the lower Pack River produces an altered hydrology, which created an area with a more still-water character (Golder 2003). The river historically possessed consistent morphological characteristics through Reach E and F all the way to the confluence with the lake. The river was predominantly a Rosgen C type channel that was slightly entrenched, sand and gravel dominated, low gradient, and highly

sinuous and meandering throughout a broad floodplain. Well-developed point bars indicate that sediment deposition was a driving process.

Riparian vegetation becomes less prevalent closer to the lake due to inundation but also because the flats adjacent to the river were developed into pasture in the late 1800's. Conversion to pasture in the lowest reaches of the river most likely increased bank erosion and accelerated lateral migration of the channel. Therefore, a disruption of the sediment discharge balance probably existed prior to the construction of the dam. When lake level fluctuation began it changed the channel morphology, and it changed riverine habitat to a more palustrine or wetland-like environment.

Much of Reach F has changed to multiple interconnecting channels that exist across the floodplain due to the heightened water table. The channel in Reach F is more prone to excessive channel alterations during winter rain-on-snow events when water tables are low. Channel banks are poorly protected at low water periods due to the altered growing environment and channel aggradation will tend to accelerate lateral migration.

In some areas more palustrine-associated plant communities are growing where cottonwood and cedars were common. These plant communities do not exhibit the rooting strength that once existed with forested riparian zones. This is also influencing accelerated bank erosion.

The trend in channel dynamics in Reach F will be toward increased morphological adjustments, particularly lateral migration due to excessive aggradation from inundation during a portion of the spring runoff period.

4.0 RESPONSIBLE PARTIES

Idaho Code §39-3601 specifies certain entities as the designated agencies for various land use activities. These include the Idaho Department of Lands (IDL) for timber harvest and mining activities, the Idaho Soil Conservation Commission (SCC) for grazing and agricultural activities through local conservation districts, the Idaho Transportation Department (ITD) for public road construction, the Department of Agriculture for aquaculture (not relevant to the Pack River TMDL), and the IDEQ for all other activities. Designated agencies are expected to take the lead in identifying and selecting proven management practices that can be used to reduce nonpoint source pollution, and facilitate implementation for their respective activities.

4.1 Idaho Department of Lands

Idaho's water pollution administrative rules governing non-point source activities (IDAPA 58.01.02.001.350) recognize Best Management Practices (BMPs) as the most appropriate method to handle these types of sources, and section .03.a. recognizes the Idaho Forest Practices Act (FPA) as administered by the IDL as an approved BMP for silviculture and forestry. The IDL is the designated agency in Idaho for administering the Idaho FPA on state, private and federal forestlands. Rules developed under the Act provide BMPs for forestry activities.

Under the FPA, the party responsible for conducting any forest practice activity must meet rules and BMPs. In addition to the regular FPA inspection program conducted by the IDL, the Forest Practices Water Quality Management Plan calls for statewide audits of the application effectiveness of forest practices rules. In 1991, the Cumulative Watershed Effects (CWE) analysis process was added to the IDL tool chest. This process includes assessments of erosion hazards, canopy closure, stream temperature, hydrology, sediment delivery, channel stability, beneficial uses and nutrients. The CWE process provides a broad scale watershed assessment that determines if water quality problems exist and what should be done to mitigate those problems. This process can be initiated by the IDL or by a watershed advisory group or by IDEQ at any time that it appears beneficial and when funding is available.

4.2 Idaho Transportation Department

The ITD is designated as a lead agency responsible TMDL implementation actions related to public roadways. ITD coordinates these efforts with local roadway jurisdictions such as highway districts, counties and municipalities.

ITD's principle operations are dominated by the need to maintain and improve the state highway system; however ITD also provides local transportation agencies with planning support and contract administration services for federally funded activities associated with local roads. The effects of state and local roadway infrastructure on environmental quality is principally dictated by past roadway corridor development. For the most part, highway corridors are well established and will continue to influence environmental baseline conditions, particularly with respect to stream morphology and hydrology in lower stream reaches. Maintenance activities and roadway improvement projects on existing routes, however, do pose some risk of additional adverse

impact to these highly altered systems, primarily from short-term construction related sediment discharge.

In some cases, adverse environmental impacts resulting from previous construction of transportation systems near water bodies may be correctable through beneficial stream channel and floodway alterations and/or reclamation actions. These may include but are not limited to the use of biological and physical stabilization techniques, as well as realignment and subsequent removal of original roadway fill material.

4.3 Idaho Soil Conservation Commission

The SCC is the designated management agency in Idaho for managing agricultural nonpoint source pollution. Although the SCC does not have regulatory or licensing authority over water quality or pollution control, the mission of the SCC is to provide support to Idaho's Soil and Water Conservation Districts for wise use and improvement of natural resources. The SCC works with BSWCD, the Idaho Association of Soil Conservation Districts (IASCD), and the NRCS in a *conservation partnership* to reach common goals and successfully deliver conservation programs in Bonner County.

The effects of agricultural practices on water quality vary depending on the management practices and location of particular operations in relation to surface and ground water. The conservation partnership assists landowners in implementing BMPs that minimize negative impacts to water quality. The partnership is committed to targeting watersheds listed as water quality limited, and program delivery efforts prioritize projects occurring in degraded watersheds.

4.4 Idaho Department of Environmental Quality

With the responsibility for lead agency coordination, the IDEQ will provide forums for the exchange of scientific information between lead agencies and other interested parties throughout the implementation of this plan. The designated lead agencies are responsible under Idaho Code §39-3601 for complying with the provisions and agreements set forth within this implementation plan. While the IDEQ is responsible for overseeing the development of this plan and monitoring progress over time, the success of this plan is directly dependant upon the commitment and involvement of lead agencies and stakeholders within the watershed and their ability to implement the necessary changes outlined in this plan to restore beneficial uses.

4.5 Other Participants

As described above, the lead agencies under this TMDL implementation plan are IDEQ, IDL, ITD, and SCC with involvement from the NRCS and the BSWCD. Federal agencies working in cooperation with IDL on forestry issues include the USFS, and BLM. The Bonner County Public Works road department will work in cooperation with ITD to address water quality impacts from county roads within the watershed. The IDEQ recognizes that involvement from the Idaho Department of Fish and Game (IDFG) as well as the Bonner County Planning Department may have significant impacts on designated beneficial uses in the Pack River

watershed and will make a genuine effort to include them in all aspects of TMDL implementation and planning.

While IDEQ is responsible for overseeing and monitoring the progress of the TMDL Implementation Plan over time, the success of the plan is directly dependent upon the commitment and involvement of lead agencies and various stakeholders within the watershed and their ability to implement the necessary improvements to restore beneficial uses. It is therefore critical in order for this implementation plan to succeed to have participation from citizens, business, industry, government, tribes and organizations within the watershed. The PRWC will encourage such participation through public meetings to provide interested parties with an opportunity to stay involved and interested in implementation of this plan.

5.0 RECOMMENDATIONS FOR IMPROVING AND PROTECTING THE PACK RIVER

Education, on-the-ground actions, preventative maintenance and program coordination will all play a role in protecting and improving the Pack River and restoring its beneficial uses.

Education is one of the most effective methods for meeting the goals of the TMDL Implementation Plan. Through education, informed watershed residents and river users will be more conscious of how their activities affect the river that they depend on and value, and thus may be more willing to modify those activities to meet water quality goals that they understand.

On-the-ground application of effective BMPs is also crucial to achieving the attainment of beneficial uses. BMPs are a practice or combination of practices determined to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. BMPs can be different from restoration projects although many components of restoration projects do incorporate BMPs. All lead agencies and agencies under their purview have a list of standard BMPs that are used by that agency. Any business, industry, or citizen conducting a project within the watershed should utilize the most appropriate BMPs as needed to ensure compliance with the TMDL.

5.1 General Management Strategies

Hydrologic processes requiring restoration include decreased runoff volumes and peak discharges through increased infiltration, "de-channelizing" runoff paths from uplands to main channels, re-establishing healthy riparian corridors, and maintaining diverse land cover conditions. Mitigation for loss of large woody debris in the system would be beneficial in most areas. Land management activities should be planned so as to encourage recovery from legacy wildfire effects (PBTAT 1998).

5.1.1 Management Units

The upland areas of the Pack River watershed should be managed by small hydrologic units (subwatersheds). The extent of these units will need to be determined through input from the Pack River TAC, the PRWC, local zoning boards, and land resource managers. Management of the entire Pack River watershed through management of its parts will prevent localized resource problems on the subwatershed level and at the same time provide for spatial balance of diversified land use throughout the whole watershed. A good example of this idea is the recommendation to have no more than 40 percent (or other appropriate percentage) of a hydrologic unit in open and young forest. Managing on this smaller level also may make landowners feel more a part of any implementation effort. Landowners will likely identify more with the immediate area in which they live rather than the Pack River watershed as a whole. Organization of volunteers for stream sampling or educational activities could also be successful at this level. Riparian zones should be managed by Golder's stream channel reaches A through F.

5.1.2 Streambank, Riparian, and In-stream Improvements

Although structural practices such as large rip-rap and reservoirs can certainly help reduce sediment yield from the treated location itself, they are not emphasized in this Watershed Plan as a streambank erosion treatment due to the potential disruption of the natural processes of the river. These applications should only be considered in situations where high loss potential exists, such as threats to highways or railroad embankments, homes, or buildings. Use of soil bioengineering is a possible alternative to hard engineering in the treatment of excessive streambank erosion. The applicability of soil bioengineering should be evaluated on an individual basis. A brief description of soil bioengineering is included below.

Erosion Control with Soil Bioengineering/Geotechnical Construction Techniques

Soil bioengineering/geotechnical construction techniques combine mechanical, biological and ecological concepts and treatments to reduce slope failures and erosion (NRCS Engineering Field Handbook, Chapter 18). Two approaches to soil bioengineering are woody vegetative systems and woody vegetative systems combined with simple structures. Nonliving approaches use rigid constructions, such as surface armoring, gravity retaining walls and rock buttresses. The type of system used must fit the site. Treatment sites should be carefully selected. Woody vegetation may not solve a stability problem caused by geologic parameters.

Soil bioengineering/geotechnical construction offers a promising alternative to traditional riparian engineering techniques for the Pack River watershed. Most traditional engineering practices used to control erosion along streams require good access to the site, and a great deal of earth moving on site to install the practices. In contrast, soil bioengineering can often be done by hand, with minimal disturbance to the site. Some common soil bioengineering techniques are fascines (bundles of small diameter live brush tied together), brush mattresses (many long branches criss-crossed and fastened to the ground with dead stakes), live stakes (insertion of medium diameter live vegetative cuttings into the ground), and root wads (part of the trunk and roots of dead, uprooted trees).

The Pack River watershed has many remote areas with poor road access. These areas are valued by the public as high quality aesthetic resources. To reduce erosion damage in the riparian corridor and still maintain high aesthetic values, these labor intensive but simple bioengineering practices seem to offer the best solution.

Where possible soil bioengineering/geotechnical construction should be used to incorporate large woody debris, such as root wads and tree revetment, into streams. It is highly recommended that people with considerable experience in soil bioengineering techniques be consulted prior to planning these systems. Soil bioengineering/geotechnical construction is a developing science that requires a good interdisciplinary understanding of the problem. Each site should be custom designed with someone knowledgeable in soil bioengineering/geotechnical construction techniques, and the evolution of stream systems. All practices done to improve stream channel condition should be done with an understanding of channel morphology and classification. Rosgen's stream classification, or a similar system, should be used.

Research done for similar river systems and "opportunities" in the discussion section of the Pack River Stream Channel Assessment (Golder 2003) has led to the following recommendations: (1) where possible, woody species should be phased into the herbaceous cover; (2) among woody species, more advanced successional species are preferred, largely due to their greater root strength; (3) along streambanks and the associated drainage area, soil stability equations should be employed to demarcate the "safe zone" (i.e. a 100 ft. wide strip adjacent to each streambank). Within this zone, all human activity that arrests or reverts the successional process should be discouraged. This includes logging and building construction unless these activities are consistent with forest management practices that promote advanced successional stands; (4) in critical erosion sites, the establishment of advanced successional woody vegetation should be actively promoted by acceptable methods of forest management including planting of seedlings, selective cutting; and (5) on construction sites, vegetation should be established at the earliest opportunity. Critical area planting could be used to stabilize some slopes and eroding areas. It is preferable to use native plant species since exotic species often compete with native species, leading to their decline.

Riparian Zone Management

The Pack River TAC should meet with the PRWC initially and on a yearly basis to discuss riparian zone management recommendations. Activities that promote healthy, diverse riparian areas should be encouraged. A no commercial harvest cut zone recommendation could exceed the forest practices act requirements.

Financial incentives, educational opportunities, and technical assistance should be provided to landowners to enable them to manage their riparian zones for stream ecosystem improvement. Landowner implementation of riparian zone recommendations is on a voluntary basis. Therefore, a coordinated effort to inform and assist them is needed to implement recommendations. Riparian zones in agricultural and urban areas should be established or managed to have a buffer between cultivated fields, pastures, and street and lawn runoff.

In-Stream Fish Habitat Improvement

Trout spawning beds can be improved by creating areas of constricted flow where the sediment is removed from the gravel by increased water flow. Instream areas suitable for fish spawning should be inventoried and mapped. These areas should be prioritized for preservation and enhancement. This process would consider water temperature, substrate embeddedness, forage base, pollution sources, conditions of stream crossings and access points, etc. Introduction of suitable large woody debris into stream channels should be encouraged through appropriate silvicultural management of riparian areas. Instream improvements should be site-specific and planned with technical assistance from hydrologists, fisheries biologists, and engineers.

5.1.3 Wetlands

It is difficult to determine how many of the original wetlands in the Pack River watershed have been drained or filled. There have been and still are wetland manipulations for agricultural,

urban and road building purposes. Although agriculture in the area is declining, much of the drainage remains today. Urban development and road building have also contributed to wetland loss to a lesser degree.

Wetland enhancement and creation can improve water quantity, water quality, and wildlife conditions within a watershed. Water quantity benefits include reduction of peak flows by virtue of the storage properties of the wetland and maintaining base flows by acting as groundwater recharge areas. Water quality benefits include sediment filtering and nutrient uptake by wetland plants. Wildlife benefits include providing habitat for diverse species and a food and water source for land animals. Wetlands can also benefit urban or residential areas. Incorporating wetlands in roadway designs can offset increased peaks associated with surface ditching and wetlands can maintain flows and sediment loadings at pre-development levels for residential or commercial areas.

The restoration of altered wetlands is more effective than the creation of wetlands because the hydrology, soils, and seed bank are usually still present on the site. In addition, restored wetlands have a higher functional value than created wetlands. Created wetlands do not support the diversity of plant and wildlife species that are found in natural or restored wetlands.

Bonner County has prioritized wetland areas in its Comprehensive County Local Land Use Plan. Certain categories of wetlands will be targeted for high protection levels possibly including financial assistance. The U. S. Army Corps of Engineers (COE) has some wetland manipulation regulatory authority through the Clean Water Act Section 404 permits. The NRCS has some disincentives for USDA program participants for draining, filling or altering of wetlands for the purpose of crop production.

The existing wetlands within the Pack River watershed should be maintained through current local, state, and federal laws. Although the current level of wetland area within the Pack River watershed is high, the distribution and function of wetlands could be improved. Thus, wetland restoration, enhancement, and creation in the Pack River watershed should be encouraged.

Priority should be given to those sites having one or more of the following characteristics:

- within or near the riparian zone except in cases where water from the wetland can exit at seeps in bluffs and having a direct connection to zones of bluff slumping
- within an area having a high concentration of artificial surface drainage
- the site has potential for being an open water wetland
- the site is within an area having urban development pressures

Emphasis should be placed on restoring drained wetlands rather than creating wetlands. Some specific design considerations include the following:

- Where a wetland is being created or restored for mitigation purposes, its location should be within the same hydrologic management unit as the wetland that is being altered.
- For open water wetlands, the potential safety hazards should be considered.

- Care should be taken to locate sites so that unique or valuable upland habitats are not destroyed in the process of creating or restoring a wetland.
- Ensure that any wetland restoration or creation does not restrict the movements of migratory fish.
- Design of a wetland should be such that water bird nest predation is minimized.

5.1.4 Development

Working with private landowners to increase awareness of watershed issues, make improvements near streams, and encourage conservation easements on sensitive areas, such as the floodplain and riparian zone, would help prevent further degradation of habitat. Education should be made available to landowners and residents on the importance of maintaining streambanks and riparian areas for native fish as well as permit requirements and processing time for activities occurring in stream channels, wetlands, and floodplains. Vehicle crossings over stream channels on private land should be assessed and upgraded where appropriate, with the cooperation of private landowners. The Idaho Department of Water Resources (IDWR) and the COE should be consulted on new crossings and improvements. Enforcement of IDWR and COE permit requirements should be increased. In addition, Bonner County should be "encouraged to adopt and enforce zoning regulations that will prevent or discourage floodplain development or damage," and to improve public use sites to minimize impacts to stream channels (PBTAT 1998).

Roads and Railroads

Roadside erosion contributes to total erosion and sedimentation in the Pack River basin. Difficulties with high water table soils, low strength soils, steep terrain and occasional sudden heavy rains, have caused many problems for road, railroad and structure maintenance. Although much of the erosion in the watershed comes from streambanks, many of these areas are inaccessible and therefore could not be treated. In contrast, all of the roadside erosion sites in the watershed are accessible.

Regular road maintenance would help to prevent mass failures due to roads. To date there has not been a roadside erosion inventory completed in the watershed. There are some privately maintained roads that service many residences. Some of these receive very minimal maintenance. A road condition assessment throughout the watershed would help identify where roads are currently impacting the watershed. Corrective actions could then be identified.

Coordination between public road maintenance employees, landowners, and land management agencies regarding road construction and repair could help reduce effects such as increased peak flows, sediment delivery to streams, fish barriers, and channel alterations. Avoiding road construction near streams and in unstable areas would help reduce the fine sediment problem in the Pack River watershed (PBTAT 1998).

Water Diversions

Screens should be installed on all existing and new water diversions to avoid damage to fish (PBTAT 1998).

5.1.5 Forestry

All forest management activities should be planned so as to avoid increasing peak flows. Growth of large trees near streams should be encouraged in order to provide future recruitment of large woody debris. Before major timber harvest operations, information from CWE analyses should be utilized to identify and prioritize legacy effects for treatment, where this information is available. A watershed analysis should be conducted where the information is not available to identify legacy effects. Site-specific BMPs that will protect or improve stream conditions should be developed for these areas. Watershed analyses should look at stream stability, habitat, shade, surface runoff characteristics, and potential erosion/mass failure sites, at a minimum. On smaller-scale timber harvest operations, sites should be inspected by a forester, fish biologist, and water quality/hydrology professional to identify BMPs (PBTAT 1998).

Coordinated Forestry Management

Forestry management is a critical element affecting the hydrologic system. This is due to the fact that the majority of the Pack River watershed is forested. There are several groups owning land in the watershed (federal 57%, private 36%, state lands 6.6%) and logging activities are seldom coordinated. Without coordination, cumulative effects of separate logging activities within the same area could have negative hydrologic impacts. Coordinated logging activities that would benefit the hydrology of the watershed include the following:

- Ensure that no more than 40 percent of a management unit is in open land and young forest,
- Develop a coordinated, watershed-wide logging transportation plan,
- Coordinate activities within a defined riparian zone to maintain and improve the physical continuity of that zone throughout a management unit or defined reach,
- Develop forest harvesting research proposals and seeking funding for those proposals as a unified group.

Forestry coordination in the watershed should be initiated. A committee should be comprised of representatives from county, state IDL, forest industries, private landowners, and federal agencies (USFS, BLM and NRCS). It could meet once or twice a year to coordinate harvesting on a subwatershed basis, to share data for input in a watershed-wide GIS database, and discuss opportunities for improving the forest resource base.

5.1.6 Agriculture

An inventory of livestock grazing would be useful in determining the extent of impacts to streambanks, riparian areas, and fish habitat. A high, medium or low hazard rating should be assigned for surface or groundwater pollution potential. The potential for stream and riparian

improvements on private agricultural land should be assessed in cooperation with livestock owners (PBTAT 1998). Landowners with agricultural and open land should consider opportunities to plant trees and manage for wildlife opportunities.

Some potential treatments for agricultural land in the Pack River watershed are Waste Management, Nutrient Management, and Livestock Management. Various combinations of BMPs may be applicable to individual areas. Site-specific treatments are determined on an individual basis considering inventory results and landowner objectives.

Agricultural Waste Management Systems

Agricultural waste management usually involves on-site animal waste storage or filtering. The NRCS has developed standards for a number of BMPs. Below is a brief description of a Waste Management System and associated practices. The numbers following the practices refer to the NRCS standard numbers. All practices below are further outlined in the standards described in the Idaho Field Office Technical Guide (FOTG), Section IV. The FOTG can be accessed at the Sandpoint NRCS Field Office or online at http://www.nrcs.usda.gov/technical/efotg/.

Waste Management Systems (312) include one or more of a series of related practices that can be used to improve the management (storage, handling and land application) of inorganic fertilizers and liquid or solid animal waste including runoff from concentrated waste areas. These other practices include the following:

- Waste storage facility (313)
- Waste treatment lagoon (359)
- Waste treatment strip (635)
- Dike (356)
- Diversion (362)
- Fence (382)
- Filter strip (393)
- Riparian forest buffer (391)
- Roof runoff structure (558)
- Streambank and shoreline protection (580)
- Subsurface drains (606)

Nutrient Management

The Nutrient Management practice (680) is aimed at reducing the potential for applied nutrients to pollute surface or groundwater by applying only the amount needed to produce a crop consistent with the land user's goals. It accomplishes this by managing the amount, form, placement and timing of plant nutrients. Planning is done to properly supply plant nutrients for optimum forage and crop yields, to minimize entry of nutrients to surface and groundwater, and to maintain or improve the chemical and biological condition of the soil.

Minimum requirements for the practice include, with technical assistance, the development of a nutrient management plan by the farmer. The nutrient management plan includes a nutrient

budget accounting for current nutrients in the soil, realistic yield goals, and nutrient credits or carryover. Nutrient management planning includes testing of soils, manure analysis, equipment calibration, and field-specific fertilizer and manure applications. The end result is improved crop production and less polluted runoff.

Livestock Management

Soil compaction and overgrazing should be reduced by using rotational or controlled grazing and other pasture management techniques. This will reduce compaction and produce healthier vegetation to reduce water yield from pastures. Livestock access to riparian zone and stream channels should be eliminated or controlled. This can be accomplished by providing offsite watering facilities or providing limited, controlled access to surface water. Where livestock need to cross stream channels, a designed hardened crossing (rock ford) an arched culvert, or an engineered bridge should be used.

5.1.7 Other

Actions not related to land use and land management were identified in the Bull Trout Problem Assessment as well. These include monitoring/managing brook trout and increasing protection of bull trout from poaching. Non-native brook trout compete with bull trout for habitat and may hybridize with the native bull trout. Monitoring populations of brook trout in the Pack River would help identify if a problem exists and, if so, how to reduce brook trout populations in the watershed. Increasing public education and outreach on the needs of bull trout and their threatened state of existence as well as increasing enforcement of poaching would also be beneficial for bull trout populations in the watershed (PBTAT 1998).

5.2 Priority Actions

The following tables provide a list of proposed management actions by category developed by the Pack River TAC. These actions were identified during the development of this plan as items that will enhance the quality of the Pack River watershed's natural resources, increase available habitat, and ensure the success of restoration efforts. **Table I** includes actions for education projects; **Table II** includes actions for coordination and on-the-ground restoration and implementation projects.

Table I. Pack River Watershed Education Projects

Agency / Organization[2]	Project Description	Anticipated Start-up Date	Estimated Start-up or Annual Cost
PRWC, BSWCD	Pursue and fund multi-dimensional approaches for educating and engaging general public, as well as targeted groups (contractors, realtors, etc.) Need on-going campaign that reaches all sectors of the community and influences value systems about the river (PRWC, flyers, brochures, web sites, workshops, public speakers, public watershed monitoring, etc.) Investigate utilizing a graduate student for some of this work.	2007-08	$20,000
TSWQC, BSWCD, PRWC	Coordinate educational efforts with the Lake Pend Oreille nearshore TMDL committee and the lake awareness campaign.	2007	$1,000
TSWQC	Coordinate with county waterways committee on education programs and funding programs.	2006	$1,000
BSWCD, PHD	Distribute Panhandle Health District brochures on septic tank and drain field maintenance and use, targeted to riverfront property owners. Include information on septics in other educational materials. (In 2006-07 information will be distributed through the Pend Oreille Lake*A*Syst program.)	2008	$2,000
BSWCD, NRCS, SCC, IASCD	Develop/distribute a brochure (and include in other educational materials) about fertilizer use and livestock watering/grazing and ways to reduce impacts on waterways. (In 2006-07 information will be distributed through the Pend Oreille Lake*A*Syst program.)	2008	$2,000
Bonner County, municipalities, EPA, IDEQ	Expand education programs to improve compliance with stormwater and construction ordinances.	2007	$10,000
TSWQC, BSWCD, Bonner County, municipalities, PHD	Develop/implement education programs and workshops for contractors, engineers, design professionals and excavators on construction site (and off-site) BMPs. Provide relevant Lake*A*Syst materials to all licensed contractors.	2006	$1,000
PRWC, BSWCD, Bonner County, municipalities, PHD	Develop educational materials about land disturbance activities that agencies can hand out with permits (including permits for buildings, and septic systems). (In 2006-07 information will be distributed through the Pend Oreille Lake*A*Syst program.)	2008	$2,000

[2] First entity shown is lead agency for project; other agencies/groups to assist.

IDFG, PRWC, BSWCD	Educate landowners regarding functions of beaver dams, where/how to remove or retain dams, and how to discourage beavers.	On-going	$1,500
PRWC, BSWCD, Bonner County	Develop/implement education programs on waterfront buffers and potential impacts from lawn fertilizers, oil, antifreeze, burning, removal of native vegetation. Work with county commissioners on waterfront protection (burning, buffers, fertilizer use, etc.). (In 2006-07 information will be distributed through the Pend Oreille Lake*A*Syst program.)	2008	$2,000
BSWCD, PRWC	Utilize Pend Oreille Lake*A*Syst materials to develop fact sheets specific to the Pack River watershed.	2007	$1,000
IDPR, PRWC, IDEQ, BCWC, IDFG, USFS	Develop and distribute educational materials about potential impacts from recreational activities. Distribute existing educational materials about potential impacts from motorized recreation in certain sensitive areas (off trail and off route impacts).	2007	$3,000
BSWCD, NRCS, SCC, IASCD, Extension	Educate agricultural landowners about the benefits of practices related to water quality, pasture/forest & nutrient management and available cost share programs.	On-going	$50,000/yr
BCWD	Coordinate with SCWMA on funding for weed management programs and education (noxious weeds)	On-going	Varies by project
PRWC	Distribute educational materials (including "The Pack River Watershed: A Resident's Guide for Water Quality") about water quality protection targeted to new residents (i.e., what they can do to help protect the river) and develop ways to reach new residents with this information.	2006	Volunteers, in-kind
NRCS	Educate and encourage landowners to preserve forested riparian zones, abandoned channels, oxbow lakes and vegetated banks.	On-going	N/A
NRCS, BSWCD	Develop/implement landowner education programs regarding streambank stabilization methods and required permits	2007	$500 + NRCS in-kind
IDFG, PRWC	Increase efforts to educate anglers and public about bull trout and their critical reliance on tributary streams; expand I&E programs regarding fragile nature of small bull trout population in Grouse Creek.	2006	$3,000
PRWC	When PRWC brochure is developed, include information to encourage planting of native riparian plants along streambanks.	2007-08	$200/mailing

Table II. Pack River Watershed Coordination and Implementation Projects

Agency / Organization[3]	Project Description	Anticipated Start-up Date	Estimated Start-up or Annual Cost
COORDINATION			
IDEQ	Recruit and coordinate with Pack River representatives to the Pend Oreille Watershed Advisory Group to ensure completion of the temperature TMDL for the upper Pack River tributaries.	2006-07	In-kind
IDEQ	If 2006 monitoring identifies nutrients or other pollutants in addition to sediment, complete TMDLs.	2007	In-kind
IDEQ	Review implementation projects on a 5-year cycle to determine progress toward TMDL targets and need for additional TMDLs.	2009, 2014, & every 5 years	In-kind
IDEQ	Work with federal and state agencies, county and cities to maintain or improve enforcement of existing regulations, especially IDWR and COE regarding in-stream work permits	On-going	In-kind
DMA partners, PRWC, BSWCD, USFS, USFWS, TSWQC	Seek funding for project implementation, monitoring and education projects.	On-going	In-kind
IDEQ, TSWQC, Bonner County	Coordinate with agencies regarding consistency of existing setback standards.	On-going	In-kind
IDL	Establish a committee of county, state & federal agencies, forest industries and private landowners to meet semi-annually to coordinate harvesting and logging transportation on a sub-watershed basis, share data for watershed-wide GIS database, research and recommend appropriate percentage for maximum open/young forest in sub-watersheds, and discuss opportunities for improving forest resource base. (Through implementation of CWE.)	2006	In-kind
IDFG +PRWC	Encourage coordination between county road department and land managers on issue of beaver dam removal and removal techniques.	On-going	$500
MONITORING/DATA MANAGEMENT			
IDEQ, EPA	Evaluate existing BURP monitoring data and secure resources for additional nutrient monitoring to investigate nutrient contributions of tributaries. Determine if nutrient or other TMDLs are necessary for Pack R watershed.	2006	$30,000

[3] First entity shown is lead agency for project; other agencies/groups to assist.

IDEQ	Utilize IDEQ's Large River monitoring protocol to assess status of lower Pack River.	Summer 2006 or 2007	In-kind
IDEQ, TSWQC	Secure funding for, and implement, annual river monitoring program. This would include project-related monitoring and overall TMDL compliance monitoring with data submitted to one centralized database. Coordinate with other groups/agencies already monitoring (such as IDFG.)	2007 or beyond	$2,000 annually
IDEQ, TSWQC	Investigate opportunities to expand citizen/student volunteer monitoring program as part of overall monitoring program.	2007 or beyond	In-kind
IDEQ, TSWQC	Utilize results of monitoring program to evaluate support of beneficial uses.	2006-2007	In-kind
IDEQ, TSWQC, DMA partners	Utilize results of monitoring program to identify and prioritize specific geographic areas to target for further investigation of septic systems, stormwater impacts, and sediment sources.	2007 and beyond	In-kind
IDEQ, TSWQC, DMA partners	Utilize results of monitoring program to identify geographic areas to target for implementation of sediment reduction measures and to prioritize types of projects for these areas.	On-going	In-kind
IDEQ	Require that on-the-ground TMDL implementation projects include a monitoring component to evaluate results.	On-going	In-kind
DMA partners	Ensure BMP effectiveness monitoring takes place by IDEQ and/or agencies implementing BMPs.	2006	Varies by project
IDEQ, IDFG, USFS, Avista, PRWC	Monitor water temperatures in the Pack River and key tributaries to identify steam channels, or segments of stream channels, limited in their ability to support salmonids due to high water temperatures.	2008	In-kind
DEVELOPMENT/WATERFRONT PROPERTY			
Bonner County	Examine county waterfront setbacks and determine whether increases are merited based on soils, shoreline stability, vegetation, habitat, etc.	2006	$1,500
Bonner County	Work to continue to resolve high rate of non-compliance for building location permits. (County notes that improvements are being made and that there were much fewer building violations in 2005 than 2004; also another compliance person has been added to staffing.)	On-going	$7,000
Bonner County	Investigate new regulations regarding buffers.	2006	$1,500
Bonner County, IDWR	Consider curtailing or limiting modifications to, or development in, the floodplain including levee or road fill across overflow channels or oxbow lakes.	2006-07	$2,000
Bonner County, IDL, COE	Investigate incentive program (tax break) for property owners who leave native riparian vegetation or re-plant native vegetation.	2006-07	$1,500
Bonner County	Investigate buffer protection as part of building location permits.	2006-07	$800

COE + IDWR, IDL, IDFG, SCC, BSWCD, NRCS, IASCD	Promote/encourage low impact methods of bank stabilization to reduce erosion (bioengineering) rather than hard armoring (rip-rap); provide information on alternative methods to landowners and consultants.	2007	$5,000
Bonner County	Increase enforcement of stormwater ordinance.	2006	$30,000
Bonner County	Pursue possible setback or protection zones for wetland areas.	2006/07	$2,000
Bonner County	Pursue possible land disturbance and/or grading permit requirements.	2006/07	$1,500
IDWR	Screen all water diversions to prevent loss of juvenile fish and work with users to install screens where they do not currently exist.	2007	In-kind
IDEQ	Work with IDWR and COE on in-stream work permitting and increased enforcement of regulations	On-going	In-kind
CFPOC	Actively pursue opportunities with private landowners to protect sensitive or critical areas through conservation easements or fee title acquisition.	On-going	Varies by project
STORMWATER			
IDEQ, EPA, Bonner County	Work with Bonner County on stormwater management and enforcement of regulations.	In-going	In-kind
IDEQ, TSWQC	Monitor stormwater discharges in areas of potential impact identified through monitoring program.	2009	Unknown
Bonner County, EPA, IDEQ	Implement a program to increase awareness of, and compliance with, federal stormwater regulations for 1-acre construction sites. (County notes that hand-outs are now available and every subdivision adjacent to a waterbody is now required to obtain a stormwater permit before plat is recorded; the county has increased its work with EPA and IDEQ to enforce compliance and seek fines and remedial actions of violators.)	On-going	$5,000
TRANSPORTATION/ROADS			
ITD	Administer roadway programs affecting water quality in watershed: State Highways, National Highway System; Bridges; Congestion Mitigation Air Quality; Idaho Forest Highway; Local Roads; Enhancement Program.	Ongoing	N/A
ITD, Bonner County, municipalities, highway agencies	Identify roadway projects with water quality benefits and/or water quality problem areas. Participate in transportation planning team meetings (Bonner County Area Transportation Team). Participate in local agency grant workshops.	Annual review	$10,000
Bonner County, ITD, municipalities, highway districts	Work on development and implementation of regulations/guidelines and BMPs for reducing impacts from roads (federal, state, county, cities and private) for construction, maintenance and operations near river, other waterways, and wetlands.	2006	$15,000

USFS	Conduct a road and trail inventory on federal land.	Within 5 years	$10,000/yr
IDL	Assess state and private forest roads through CWE process.	2007	Included in CWE costs
DMA partners	Conduct inventory of private non-forest roads. (Use LIDAR)	Unknown	Unknown
USFS	Perform a road and trail condition survey adjacent to Pack R. and particularly at large mass failure in SE1/4 of Section 14 in lower-upper reach (C&D) to see if they are routing water to the site.	Within 5 years	$10,000/yr
USFS	Obliterate known problem roads; prioritize those within 300 horizontal feet from stream. 2006: USFS will implement Upper Pack River Road Rehabilitation project to obliterate 1,800 feet of problem roads	USFS: 2006	$5,000
USFS	Identify corrective actions to reduce road impacts; improve drainage on system roads and trails with erosion problems. 2006: USFS will implement Upper Pack River Road project to replace 2 briges and decommission 2 miles of trail.	USFS: 2006	$150,000
Bonner County, DMA partners	Encourage location of roads outside of riparian areas and off unstable soils.	On-going	In-kind
BSWCD + TSWQC + PRWC	Identify funding sources (including IDEQ 319 program and private funding sources) to upgrade existing roads and road crossings.	2007	$500
COE	Discourage placement of levees or road fill across overflow channels or oxbow lakes.	On-going	In-kind
Bonner County, BCWC, private landowners	Maintain and/or improve public use sites to minimize impacts to stream channel.	2006	Varies by project
FORESTRY/AGRICULTURE			
IDL + Bonner County	Discourage clearcutting in sensitive areas of the watershed—such as in riparian areas—and in conjunction with residential forest land conversions.	On-going	In-kind
IDL	Increase IDL enforcement of FPA practices.	On-going	$100 per site visit
IDL	Conduct Cumulative Watershed Effects (CWE) Analysis on sub-watersheds in Pack River drainage to determine adverse conditions (including stream channel conditions). Coordinate with landowner committees to develop CWE Management Practices that address adverse conditions.	2007 or beyond	$6,500 per sub-watershed
PRWC	Work with the FPA Advisory Committee to add or improve rules to address timber harvest-related issues such as clearcutting on small acreages, pre-harvest watershed analysis, effects on stream temperature, and habitat protection. (If rule change efforts are not successful, then encourage land owners and land management agencies to undertake measures voluntarily.)	2006-07	$500

IDL, Bonner County, IDEQ	Develop guidelines/BMPs for non-commercial tree removal.	October 2006	$500
USFS	Conduct watershed analysis on federal lands (stream stability, habitat quality, shading, runoff characteristics, potential sediment delivery) prior to large-scale timber removal to identify BMPs and restoration action.	2007 or beyond	$6,500 per sub-watershed
IDL, USFS	Identify, evaluate and prioritize for treatment the legacy effects of past timber harvest activities on fish and wildlife habitat.	On-going	Varies depending on treatments
IDL, Bonner County	Develop and implement an interagency coordination policy between state and county agencies for land development practices near streams and lakes that involve timber harvesting.	December 2006	$500
USFS	Through USFS Soils Amendment program, improve soil infiltration through long-term application of BMPs that affect the forest floor.	On-going	$200/visit
IDL, BSWCD, NRCS	Increase amount of forestry technical assistance available to non-industrial private forest landowners.	2008	$10,000
IDL, USFS	Manage forested land for species diversity and land cover diversity.	On-going	In-kind
SCC, BSWCD, NRCS, IASCD, IDL, Extension	Encourage landowner participation in EQIP and other federal/state forestry and agriculture cost share programs.	On-going	In-kind
SCC, BSWCD, NRCS, IASCD	Encourage the development of conservation plans and implementation of BMPs to reduce impacts to surface water from agricultural activities.	On-going	In-kind
SCC, BSWCD, NRCS, IASCD	Survey feedlot sites or locations with livestock concentrations in conjunction with stream survey of livestock inventory for Lake Pend Oreille nearshore TMDL.	2006	$4,000
BSWCD, NRCS, IDL	Focus tree planting efforts in hydrologic units or reaches that contain more than 20% agricultural land.	On-going	N/A (prioritizing existing efforts)
SCC, BSWCD, NRCS, IASCD	Inventory tributaries in the Pack River watershed with adjacent agriculture land use.	2006	$18,000
SCC, BSWCD, NRCS, IASCD	Develop specific agriculture implementation plans based on above inventories.	2006-07	$6,000
SCC, BSWCD, NRCS, IASCD	Work with landowners to implement management practices to reduce impacts to watercourses from livestock (feedlot runoff, overgrazing, uncontrolled access to riparian areas).	2007 and on-going	Unknown (project specific)
NRCS, BSWCD	Place added emphasis on explaining technical and financial assistance available to landowners; solicit assistance applications specifically in the Pack River watershed and give them high-priority ranking.	2006 and on-going	N/A

RIPARIAN/BUFFER ZONE PROTECTION & REHABILITATION			
PRWC	Maintain & improve riparian areas to increase physical continuity, canopy cover and channel stability, and to recruit large woody debris	On-going	$1,000/yr
PRWC	Control invasive species to protect riparian vegetation in all reaches (knapweed, tansy, reed canary grass)	On-going	$1,000/yr
PRWC, Extension, BSWCD	Research alternatives to herbicide use to control noxious weeds, especially directly adjacent to stream channels	On-going	$1,000/yr
PRWC	Retain native riparian vegetation and canopy cover/shade	On-going	$1,000/yr
IDEQ, PRWC	Develop shade targets for the watershed (pending monitoring results)	2007	In-kind
BSWCD, NRCS, IDL, PRWC	Encourage increased riparian buffer widths	On-going	N/A
BSWCD, NRCS, IDL, PRWC	Encourage planting of native riparian plants along streambanks particularly in sub-reaches 46-49 of lower reach (E) and lower Grouse Creek.	On-going	N/A
BSWCD, NRCS, IDL, PRWC	Promote growth of large trees in riparian corridor for large woody debris recruitment for fish habitat and shade to decrease water temperatures, particularly in lower-upper reach (C&D)	On-going	N/A
BSWCD, NRCS, IDL, PRWC	Encourage, preserve & maintain Western Red Cedar habitat type; "No net loss of late seral vegetation"	On-going	N/A
PRWC, BSWCD, NRCS	Encourage landowners to plant more native vegetation (mesic forbs) to increase riparian species diversity in delta reach (F).	On-going	N/A
BSWCD, NRCS, IDL, PRWC	Emphasize retention of riparian vegetation and invasive species control (esp. reed canary grass) in lower reach (E) where mass bank failure has been accelerated and lateral migration, meander cut-off and deposition of finer sediment particles is in active process	On-going	N/A
PRWC, BSWCD, NRCS	Establish willow stooling beds for propagation of riparian planting stock; secure funding and location for proper facility	On-going	Unknown
BSWCD, NRCS, IDL, PRWC, IDFG	Encourage planting of upland shrubs (alder, snowberry, chokecherry, cottonwood, scouler willow) to slow mass erosion of banks and spread of noxious weeds.	On-going	N/A
TRIBUTARIES			
IDL	Perform a sediment survey of Caribou, Colburn, Sand & Grouse Creeks. (To be done in conjunction with CWE analysis.)	2007	Included in CWE cost

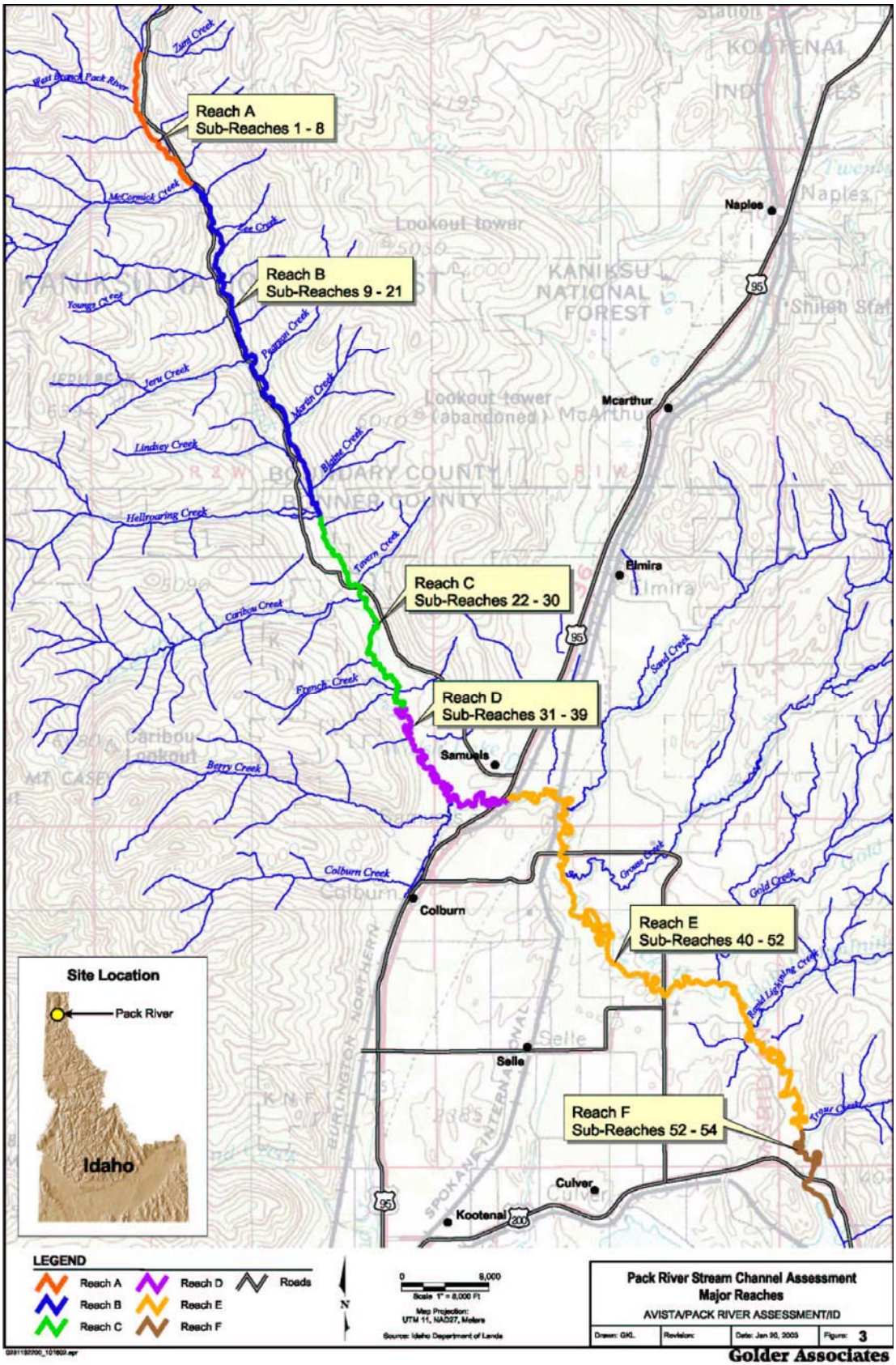
DMA partners, USFS	Explore ways to control sediment loads from Caribou & Colburn Creeks (lower-upper reach) and Grouse, Rapid Lightning, and Sand Creeks (lower reach) USFS: Grouse Creek; IDL, all but Grouse Creek.	2007	Varies by project
IDL	Assess risks and options for reducing potential impacts from high road densities near stream channel in Hellroaring and Berry Creeks.	2006: Berry Creek	$6,500
		2007-08: Hellroaring	$6,500
USFS, IDFG, Avista	Expand I & E programs regarding fragile nature of small bull trout population in Grouse Creek in conjunction with Grouse Creek watershed assessment.	Within 5 – 7 years	$50,000
USFS +IDL	Perform road and sediment source surveys along major tributaries and implement repairs as needed. Costs would be dependent on identification of data gaps in existing agency data.	2007 and beyond	Currently unknown
USFS, IDL	Perform watershed assessment/stream channel assessment in Grouse Creek.	Within 5 to 7 years	$50,000
USFS, IDL	Evaluate re-vegetation options for riparian zone along McCormick Creek to reduce stream temperature.	Within 3 years	$500
STREAM CHANNEL			
Refer to Golder Report for specific recommendations prior to conducting in-stream work or when working with private landowners on stream habitat improvements, including the following:			
USFS, IDFG, Avista	Rehabilitate sub-reaches that deviate from reference reach condition.	2007 or beyond	Varies by project
USFS, IDFG, Avista	Focus large woody debris placement in headwaters reach (A) on grade control, fish cover, and sediment & spawning gravel storage (bear in mind channel processes and only in areas that will accommodate such additions).	2007 or beyond	Varies by project
USFS, IDFG, Avista	Preserve sub-reaches 6 & 13 that are exhibiting properly functioning condition in headwaters/mid-upper reach (A&B).	On-going	N/A
USFS, IDFG, Avista	Add large woody debris where appropriate (areas with below reference amount of LWD), especially in reaches B through D, always considering stream channel process and condition.	2007 or beyond	Varies by project
PRWC, IDFG, USFS IDEQ, NRCS, Avista, BSWCD	Exert caution when implementing restoration projects in lower-upper reach (C&D) where there is active channel movement, recurring disturbance to riparian areas, and a new floodplain is being created.	2007 and beyond	Varies by project
PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Preserve sub-reaches 25 & 36 that are exhibiting properly functioning condition in lower-upper reach (C&D).	2007 and beyond	Varies by project

PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Focus large woody debris placement in lower-upper and lower reaches (C, D & E) on bank stabilization and creation of fish habitat.	2007 and beyond	Varies by project
PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Seek opportunities to restore sinuosity in lower-upper and lower reaches (C, D & E) by reconnecting old meanders, particularly sub-reaches 41, 43, 44, 48, and 49.	2007 and beyond	Varies by project
PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Evaluate on a sub-reach basis (22, 24, 38, 39 in lower-upper reach C&D; 41, 43 in lower reach E) whether F type channels can be converted to facilitate floodwater access by raising the base level of the channel through grade control (i.e. adding large woody debris) or excavating the floodplain to a lower level.	2007 and beyond	Varies by project
PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Evaluate and identify causes of river pattern problems leading to meander cutoffs and take actions to address cause of pattern adjustments where feasible. Preventing meander cutoffs in lower reach (E) should be evaluated in sub-reaches 44 and 45.	2007 and beyond	Varies by project
PRWC, IDFG, USFS, IDEQ, NRCS, Avista, BSWCD	Preserve sub-reaches 40-43 in lower reach (E) that are exhibiting properly functioning condition.	2007 and beyond	Varies by project

ABBREVIATIONS, LEAD AGENCIES AND ORGANIZATIONS

Avista	Avista Corporation
BCWC	Bonner County Waterways Committee
BCWD	Bonner County Weed Department
BSWCD	Bonner Soil & Water Conservation District
CFPOC	Clark Fork-Pend Oreille Conservancy
COE	U. S. Army Corps of Engineers
DMA	Designated Management Agencies (IDL, ITD and SCC)
EPA	U. S. Environmental Protection Agency
Extension	University of Idaho, Bonner County Extension Service
IASCD	Idaho Association of Soil Conservation Districts
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish & Game
IDL	Idaho Department of Lands
IDPR	Idaho Department of Parks and Recreation
IDWR	Idaho Department of Water Resources
ITD	Idaho Transportation Department
NRCS	U.S. Dept of Agriculture Natural Resources Conservation Service
PRWC	Pack River Watershed Council
PHD	Panhandle Health District
SCC	Idaho Soil Conservation Commission
SCWMA	Selkirk Cooperative Weed Management Area
TSWQC	Tri-State Water Quality Council
USFS	U. S. Forest Service

FIGURE 1. PACK RIVER WATERSHED MAP WITH REACH DELINEATIONS



LITERATURE CITED

Benda L., Dunne T. 1997a. Stochastic forcing of sediment supply to the channel network from landsliding and debris flow. Water Resources Research 33: 2849–2863.

———. 1997b. Stochastic forcing of sediment routing and storage in channel networks. Water Resources Research 33: 2865–2880.

Bisson, P.A., Quinn, T.P., Reeves, G.H., Gregory, S.V. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. In: Naiman, R.J., ed. Watershed management: balancing sustainability and environmental change. New York, NY: Springer-Verlag. 189-232.

Federal Interagency Stream Restoration Working Group. 1998. Stream corridor restoration: principles, processes, and practices.

Golder Associates, Inc. 2003. Pack River stream channel assessment. Final report to Avista Utilities and Pack River Technical Advisory Committee. Redmond, Washington.

Hoelscher, B., Skille J., and Rothrock, G. 1993. Phase I diagnostic and feasibility analysis: a strategy for managing the water quality of Pend Oreille Lake. Bonner and Kootenai Counties. Idaho Department of Health and Welfare Division of Environmental Quality. Boise, Idaho.

[IDAPA] Idaho Administrative Procedures Act.
http://adm.idaho.gov/adminrules/rules/idapa58/58index.htm

[IDEQ] Idaho Department of Environmental Quality. 2001. Pend Oreille sub-basin assessment and total maximum daily loads. Coeur d'Alene, Idaho.

Miller, Dale. E. 1999. Deformable stream banks: can we call it restoration without them? American Water Resources Association.

[PBTAT] Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille key watershed bull trout problem assessment. Prepared for the Lake Pend Oreille Watershed Advisory Group and the State of Idaho. Boise, Idaho.