CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter links the discussions of Chapters 2 and 3. It describes the impacts that the alternatives (see Chapter 2) would have on the affected environment (see Chapter 3).

Watershed management actions and even restoration activities can affect the human environment (Bisson et al. 1992, Stanford and Ward 1992). The primary objective of the Watershed Management Program is to increase and sustain anadromous and resident fish populations by increasing the amount of high-quality habitat available to these populations. The techniques employed under any of the alternatives, when implemented properly and in conjunction with other techniques, would improve water quality and generally increase fish habitat. The result would be a net benefit to fisheries. Various, undefined improvements to soils (including agricultural and forest soil productivity) and vegetation (including riparian areas and wetlands) would be coincidental benefits. Other resources, such as land and shoreline use, cultural and historic resources, economics, recreation, and air quality, might benefit, be adversely affected, or remain essentially unchanged, depending on the circumstances of each management technique.

The following sections outline possible environmental consequences associated with the alternatives and the impacts of the various management techniques that might be employed under some or all of the alternatives. Impacts are discussed by resource area, such as Soils or Recreation. Four major headings highlight discussion under each resource topic:

- *Context:* Identifies applicable laws, standards, and policies to provide the legal and political framework for managing the specific resources; it also lists potential impacts to be avoided as project managers work to establish a desired future condition.

- *Impacts of Alternatives:* Discloses and compares the anticipated impacts of each alternative on the specific resources.

- *Impacts of Techniques:* Discloses the anticipated impact of the site-specific management techniques that may be used under any of the alternatives presented in Chapter 2.

- *Potential Program-Wide Mitigation Measures:* Identifies ways to avoid, minimize, reduce, or rectify the potential environmental impacts of the watershed management techniques.

4.1 SOILS

4.1.1 Context

- **Legal.** Most states and counties have regulations to protect soils. Soil regulations may be tied to water resource protection (see Section 4.2, Water Resources and Quality). Under state regulations, mitigation plans may be needed to develop specific erosion and sediment control plans that specify BMPs to reduce soil loss.

- **Desired Condition.** Project managers will seek to establish a desired future condition of stability and soil conservation without incurring the following impacts: disturbing soils on unstable slopes; disturbing the upper soil horizons or accelerating erosion well beyond that occurring under natural processes; compacting of soil such that plant growth is prevented or severely restricted or runoff is increased; or allowing excess deposition of salts or other materials into soils such that vegetation growth is inhibited.

4.1.2 Impacts of Alternatives: Potential Effects on Soils

Alternative 1: No Action

Under No Action, Watershed Management Program mitigation and restoration projects would continue to be developed on a case-by-case basis. Experience with recently completed projects suggests that minor soil disturbances would occur during project implementation, followed by increased soil stability over time.

Alternative 2: Base Response (Common to All Alternatives)

Soil conditions would generally improve under Alternative 2 because the adopted planning process would help assure the identification, protection, and mitigation of problem soil areas. Soil would be temporarily eroded, compacted, or displaced whenever the ground is disturbed during habitat improvement and watershed restoration activities; however, in the long term the soil would rebound and be better than ever.

Alternative 3: Aquatic Habitat Objectives Emphasis

Under Alternative 3, short-term soil erosion and compaction would be expected as each new project is implemented. Because Alternative 3 emphasizes in-channel and riparian projects, construction disturbance of soils in streambanks and on floodplains and terraces might be high: heavy equipment can disturb soils and remove vegetation, making soils vulnerable to water erosion during storm rains and associated overbank flows. Heavy equipment can also compact soils and reduce infiltration capacity, resulting in heavier and more intense runoff to streams.

Alternative 3 would likely generate the most in-stream structures. When structures are placed properly, they create an acceptable scour that in turn creates pools, clean spawning gravel, bank cover, and other habitat features. The worst long-term impacts would result in improper or inadvertent in-stream placement of grade control structures, large woody debris, or culverts because they erode riparian soils by directing water scour into stream banks.

Plant propagation efforts would be intensified in riparian areas under Alternative 3. All methods (see Appendix A) are considered. Some soils and sites would require much scarification or planting disturbance; these activities would be carried out with soil erosion protection, in order to regenerate riparian vegetation.

Road management techniques might be used more often under Alternative 3, because many roads directly influence streams at road crossings. For example, ditches and culverts might have to be cleaned to assure adequate road drainage and prevent repeated road failures. Some soils would consequently be disturbed and remain exposed until revegetation.

Other techniques, for agricultural, forested, and urban uplands, would be used less often under Alternative 3 than under other alternatives. Negative soil-disturbance impacts are expected to be minor and short-term.

Over the long term, soil conditions would greatly improve under Alternative 3. Long-term soil stability and productivity would be promoted by establishing vegetation on stream banks, decommissioning or closing roads, and making improvements in forest, agriculture, and other land-use practices. No significant long-term adverse impacts on soils are expected.

Alternative 4: Cost and Administrative Efficiency Emphasis

Under Alternative 4, short-term impacts on soils would be minor, because a variety of smaller and less aggressive projects would be funded in a variety of locations throughout the watershed. Focus on cost and administrative efficiency would give agricultural, forest, and urban non-point source pollution on upland areas as much or more attention than in-stream habitat restoration. Natural regeneration of vegetation would be preferred to active restoration of soil cover.

Moderate-to-frequent use of techniques involving chemical applications (herbicides, pesticides, fertilizers) may occur under Alternative 4, where large areas may be more efficiently treated compared to other techniques. Chemical residues in soil may persist and/or degrade groundwater quality.

No significant long-term adverse impacts on soils are expected through the implementation of Alternative 4. Soil conditions would be slow to improve over the long term.

Alternative 5: General Environmental Protection

Because Alternative 5 would include an emphasis on providing coincidental benefits to all resources (fish, water quality, wildlife, recreation, local economic productivity, etc.), soil protection measures would be a high priority. Major soil-disturbing activities would also be minimized: for instance, in-stream structures would involve smaller-scale designs and more manual work. Impacts on soils, therefore, would be minor. Application of program-wide mitigation measures, as appropriate, would further minimize impacts on soils (see Section 4.1.4). No significant long-term adverse impacts on soils are expected through the implementation of Alternative 5.

Alternative 6: Balanced Action

Under BPA's preferred alternative, moderate short-term soil erosion would occur as new projects were begun. Techniques that disturb soils (e.g., in-stream structures, road management techniques) would be carried out completely. However, soil disturbance would be less than under Alternative 3. As with Alternatives 4 and 5, projects would be distributed throughout the watershed. Program-wide mitigation measures would be applied, as appropriate, to minimize erosion.

No significant long-term adverse impacts on soils are expected from Alternative 6. This alternative would generally benefit soil productivity and stability.

4.1.3 Impacts of Techniques: Potential Effects on Soils

In-channel Modifications and Habitat Improvement

The erosion potential of streamside soils can generally be reduced by using in-channel modifications intended for habitat improvement, particularly those that strengthen channel-defining stream banks through the use of plant roots and/or engineered structures (Saskatchewan Environment and Resource Management 1995a). Some exceptions might result in short-term erosion and soil loss.

Streambank protection via planting/encouragement of vegetation helps to stabilize soils on stream margins. However, in areas or conditions where vegetation is slower to establish itself, high streamflow may impair or eliminate riparian functions and high-value property through accelerated soil erosion.

Streambank protection via bioengineering and structural techniques disturbs soil during construction. Heavy equipment use both in the stream and along stream banks is often required. Incidental disturbance of riparian vegetation, removal of debris barriers, and the removal or replacement of culverts and bridges loosens riparian soils that may then be transported to streams.

Heavy equipment can compact soils, reduce infiltration capacity, and otherwise degrade soil structure. Increased surface runoff can erode soil particles and transport them off-site. The loss of nutrients and presence of pesticides in the sediment reduces productivity of the remaining soil.

Careless placement of in-stream structures (grade control structures, large woody debris) can erode riparian soil over the long-term by directing hydraulic forces into stream banks. Accelerated bank erosion can cause acres of productive soils to be lost. However, limited scour can improve fish habitat by providing cutbanks for cover and feeding.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Erosion potential can eventually be reduced and soil quality maintained by any of the special vegetation treatment techniques, because all can be used to stabilize stream banks, riparian areas, bare soils, and other areas vulnerable to water and wind erosion.

Initially, planting disturbs the soil. Hand-transplanting affects relatively small areas. Mechanical transplanting and seeding and seedbed preparation can temporarily destabilize soils and increase susceptibility to erosion (Chutter 1969).

Adding nitrogen fertilizers can change the natural nitrogen cycle, reducing free ammonia (a necessary cycle component) and increasing soil acidity. Consequently, heavy nitrate fertilization can actually increase losses of nitrogen from the soil (Brady 1984). Fertilizers can also build up as salt layers in soil.

Herbicides used to control weeds that compete with desirable, beneficial vegetation generally decompose in the soil (USEPA 1980). Mechanical vegetation removal can disturb soils and make them vulnerable to erosion. Biological (e.g., use of insects) and hand-pulling methods of vegetative control have little direct effect on soils.

Prescribed fires for vegetation control add ash and associated nutrients to soils and protect them from unmanaged wildfire. However, prescribed burning can damage soils if the fire burns too hot: the water-holding properties of soils can be changed, so that they repel water rather than hold it. Erosion potential and water runoff can then increase, and productivity can decrease until vegetation recovers. This risk is much less than that associated with high-intensity wildfires.

Water level can be manipulated to control vegetation. However, such manipulation can add to soil erosion and transport. During drawdowns of reservoirs, exposed fine sediments can be vulnerable to wind or water erosion. During flooding, rising waters may destabilize and erode banks, and deposit loosely consolidated soils that may be further eroded.

Site conditions, seed selection, weather conditions, and time of year influence the rate of vegetation establishment on a site. Untimely or otherwise unsuccessful revegetation efforts may cause continued, untreated soil erosion.

Agricultural Management Techniques—Crops and General

Agricultural non-point source pollution stems from large-scale landscape disturbances: removing and controlling vegetation, tilling soil, and applying fertilizers and herbicides. Properly used, most agricultural management techniques would protect soils by reducing erosion rates and maintaining nutrient and chemical cycling in the soil and crops.

Some techniques have to disturb soil. Constructing terraces or diversion ditches to control overland flow, for example, may decrease slope length and gradient, but would make newly re-contoured areas more susceptible to sheet and rill erosion.

Techniques that increase on-site and perimeter vegetation, decrease erodible slope length, and decrease runoff velocity tend to increase the depth and volume of water infiltration into the soil. However, the risk of groundwater contamination by fertilizers, pesticides, and other soluble substances is increased. Where nutrients and chemicals are deposited near frequent wetting fronts and soils with reduced conductivity, nutrients/salts can concentrate in zones, a detriment to groundwater quality and vegetation.

Agricultural Management Techniques—Irrigation

Irrigation can lead to sheet, rill, and gully erosion, although soil condition (including vegetative cover, slope, and drainage pattern) is usually the underlying cause of erosion associated with irrigation (Brady 1984). Many of the techniques considered reduce the risk of soil erosion by reducing the amount of water applied to soil (irrigation water management, water measuring devices, soil and crop water-use data, avoiding excess flows); by the rate or method of water application (drip irrigation, surface irrigation); and the method of water conveyance (lined ditches, pipeline) (Saskatchewan Environment and Resource Management 1995b).

Irrigation can concentrate salts by leaching them from the top layers of soils or by depositing salts from the irrigation water itself. Excess salts are often removed through flushing, which involves temporary heavy irrigation to leach salts from the crop rooting zone.

Agricultural Management Techniques—Animal Facilities

Agricultural operations that concentrate animals (e.g., holding, feeding, watering, servicing areas) can disturb soils as vegetation is removed, soil compacted, and soil structure and drainage patterns destroyed. Techniques for animal facilities considered in this assessment protect soils by establishing vegetative cover, surfacing facilities with resistant materials, and installing drainage and access structures. Initial construction might cause some short-term erosion and sedimentation.

When wastes are applied to cropland and wetlands constructed for waste treatment, the structure and composition of soils at those sites can be changed. Crop applications typically incorporate wastes into the soil by tilling (soil disturbance). Similar soil disturbance occurs when wastes are buried in area landfills.

Agricultural Management Techniques—Grazing

Planned grazing systems, including deferred grazing for some lands, allow ground cover to increase, ground disturbance to decrease, soil bulk density to improve, and infiltration to increase. As a result, soil erosion can decline.

Where lands are placed in "deferred grazing" status, and where critical erosion and heavy use areas are not monitored periodically, maintenance and restoration needs may go unnoticed and unmet. Chronic erosion areas may develop.

Planting, seeding, and brush and weed management to stabilize rangeland and pasture can reduce soil erosion. Some short-term erosion might occur if ground is scarified before it is seeded.

Soluble substances (including fertilizer used in seeding and planting) and concentrated animal wastes may leach deeper into soils and reach groundwater where infiltration rates are increased.

Construction of water supply projects, especially linear pipelines and larger-scale impoundments, may require large-area soil disturbance and attendant soil erosion risk.

Where streams are forded, streambanks and adjacent soils may be trampled.

Fencing to manage livestock access can reduce soil disturbance in sensitive areas. However, livestock tend to walk along fences, creating soil-worn paths. Fences may concentrate animals by placing many livestock in a smaller area, creating erosion and livestock waste problems.

Road Management Techniques

Road management techniques addressed here focus on forest, agricultural, and other rural roads subject to private and some public maintenance. Road construction and road maintenance increase natural erosion processes through excavation, oversteepening some slopes with uphill cut-slopes, loading slopes subject to mass wasting, and maintaining bared soil surfaces.

Many techniques considered here reduce the risk of soil erosion from slopes and road prisms by selecting preferred road locations, recognizing seasonal and weather-based construction windows, controlling water flow on roads and in ditches, maintaining roads, controlling access of soil-disturbing vehicles, and closing/restoring roads (Saskatchewan Environment and Resource Management 1995a).

While these principles are used to reduce overall sediment generation from roads, many techniques initially disturb soils. For example, roads must be graded to maintain the crown or outslope to assure drainage and prevent rilling down the running surface. Some soil from grading might inadvertently be pushed off the road, perhaps into a ditch where it could be transported toward a stream.

Unmonitored, closed roads may remain chronic erosion sites for long periods of time. Water bars, intended to improve drainage from the road prism, might accelerate water and start rilling or gullying if improperly constructed.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to address NEPA and other regulatory requirements to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances including fire and mass wasting, and human-caused influences (Megahan et al. 1992).

Tree removal and yarding can disturb soils if any part of the log is pulled along the ground. Where brush and organic matter are removed from the soil surface, mineral soil can be eroded by water.

Dry conditions, warm temperatures, excess fuels, and equipment that may generate sparks combine to increase the risk of wildfire during forest operations. The extreme heat of high-intensity wildfires can damage soils severely, changing the properties of soils so that they repel water rather than hold it. Erosion potential and water runoff can be increased, and soil productivity decreased during reclamation.

Prescribed burns carry the same risks, but generally have much lower intensity and diminished effects. They also augment soils with ash and associated nutrients and protect soils from the potentially adverse effects of unmanaged wildfire.

Thinning can improve the vigor and productivity of forest stands and tree roots that increase slope stability. It also allows light to penetrate closed canopies, encouraging the growth of herbaceous ground flora on the forest floor. Pre-commercial thinning may generate excess fuels and increase the risk of wildfire. Commercial thinning may actually decrease forest fuels.

Tree planting, both by hand and machine, would disturb soils. Hand planting affects a much smaller area.

The study, development, and implementation of a reward/penalty system for conscientious forest work may decrease overall soil disturbance. Implementation and effective monitoring of such a system might be difficult to complete.

Revegetation and interim stabilization techniques, such as planting sprigs, cordons, or wattles in rows on slope contours, disturb surface soils. On steep slopes, these soils may fall downslope. They are also subject to raindrop splash and sheet and rill erosion.

Seasonal livestock grazing to control fire fuels may disturb soils by removing vegetation, compacting soils, and eroding surfaces.

Urban Area Techniques

Constructing infiltration basins, trenches, and other runoff facilities would disturb soils near a project. Similarly, wastewater system improvements (septic or sewer) could extensively disturb and displace soil via trenching and placement of vaults and pipes.

Even building and implementing erosion and sediment control structures would incidentally disturb soils. Erosion and sediment control plans prepared for any construction project would address soil types, site grading details, structural controls, and stabilization measures, and could reduce soil disturbance to less than significant levels.

Land-use practices that reduce human-caused sedimentation may avoid the need for expensive treatment of domestic water supplies.

Recreation Management Techniques

Relocation and redesign of recreational facilities such as campgrounds and trails can reduce soil erosion by concentrating users in less sensitive areas, dispersing users over a wider area, and controlling access. Construction impacts on soils associated with relocation are mitigated with other techniques considered in this EIS.

Mining and Mine Reclamation Techniques

Mine reclamation efforts would generally lead to the stabilization of severely disturbed, bare soils through revegetation and the implementation of erosion control measures.

4.1.4 Potential Program-Wide Mitigation Measures - Soils

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Monitor newly disturbed soils for evidence of erosion, and implement active controls, such as plowing and seeding of new gullies (or temporary stabilization for later seeding during dry season).

- Where soil-disturbing activities are being considered, survey soil conditions to find and map potentially fragile soil types (such as shallow "scablands") and allow only those activities that would not disturb soils in these areas.
- Develop and implement project erosion control plans that select and apply several complementary techniques to address all erosion and sedimentation processes. For example, seeding a disturbed area encourages vegetative soil stabilization. Mulching the site not only holds seed in place, but also provides interim soil protection against raindrop splash and sheet and rill erosion.
- Assure quality control of project plans through technical reviews by qualified peers and appropriate agency personnel.
- For projects involving prescribed burns, conduct a pre-burn inventory to identify areas to avoid, including areas that may be vulnerable to increased erosion. Develop an approach to avoid these areas.

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4.2 FISH AND WATER RESOURCES/QUALITY

4.2.1 Context

- **Legal—Water.** Department of Energy requires an assessment of impacts on floodplains and wetlands (10 CFR 1022.12). The NRCS regulates wetlands on agricultural lands. The Corps regulates discharge of dredge and fill material in waters of the United States, including wetlands under Section 404 of the Clean Water Act. In addition, state and county regulations may be more restrictive, and may restrict certain activities that would otherwise be authorized under a Federal permit.

  Several state agencies also have regulatory authority over protection, use, and management of water resources. Projects would need to comply with state-specific regulations, as well as with any county, district, or other local regulations. The state agencies that may be involved in regulating water use and management on mitigation lands include the following:

  1. **Washington State Department of Ecology:** regulates pollutant discharge to waters of the United States, which include lakes, rivers, streams, wetlands, natural ponds, and tributaries; regulatory authority also includes flood control, dam safety and inspection, water right permitting, and well construction.

  2. **Oregon Water Resources Department:** responsible for overseeing state regulations to protect water resources, permit and license procedures for water rights, well construction, and stream-channel alterations.

  3. **Oregon Department of Environmental Quality:** regulates all pollution control programs in the state. Has jurisdiction over water quality.

  4. **Oregon Department of Agriculture:** responsible for non-point source water quality programs dealing with agricultural lands. Also manages the state's field-burning weather monitoring program, and the native plant species conservation program.

  5. **Idaho Department of Water Resources:** responsible for permit and license procedures for water rights, well construction, and stream-channel alterations.

  6. **Montana Department of Natural Resources and Conservation:** plans, regulates, and coordinates the development and use of water, land, and energy resources; water-right adjudication; floodplain management.

7. **Nevada Department of Conservation and Natural Resources, Division of Water Resources:** responsible for permit and license procedures for water rights, well construction, and stream-channel alterations.

8. **Utah State Department of Natural Resources, Division of Water Rights and Division of Water Resources**: responsible for permit and license procedures for water rights, well construction, and stream-channel alterations.

9. **Wyoming Environmental Quality Department**: regulates water quality and use.

- **Legal—Fish.** As described under **Section 4.3.1**, Section 7 of the ESA requires Federal agencies to ensure that their actions do not jeopardize the continued existence of any threatened or endangered species. Officially designated critical habitat for listed species cannot be adversely modified without a permit from the NMFS or USFWS.

  The USFS and BLM have developed guidelines for management activities that may affect fish on Federal lands. These guidelines are identified in the Decision Notice/ Decision Record for Interim Strategies for Managing Anadromous Fish-Producing Watersheds on Federal Lands in Eastern Oregon and Washington, Idaho and Portions of California (PACFISH, USFS and USBLM 1995a, 1995b, and 1995c), and the Decision Notice for the Inland Native Fish Strategy (INFISH, USFS 1995). In general, these guidelines identify riparian management objectives, standards and guidelines, and monitoring requirements for USFS and BLM activities. These guide- lines may apply to mitigation actions taking place on Federal lands.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following water resources impacts: violating water quality standards; placing dredge or fill materials into wetlands under the jurisdiction of the Corps and not covered under a nationwide permit, as defined under Section 404 of the Clean Water Act; reducing in-stream flows to the extent that riparian vegetation is likely to be permanently reduced or eliminated; or injuring existing, priority water rights. They will further seek to establish that condition without the following impacts on fish: adversely affecting a fish species listed or proposed for ESA listing; adversely modifying designated critical habitat for listed fish species; adversely affecting fish species listed by state fish and wildlife or tribal agencies as species of special concern (such as endangered, threatened, sensitive, etc.); removing habitat that has been identified by state or tribal agencies as unique, rare, or important to fish distribution; directly killing fish or fish eggs; permanently removing or degrading spawning habitat; temporarily reducing habitat that in turn may result in increased fish mortality or lowered reproductive success; or avoidance by fish of biologically important habitat for substantial periods (e.g., blockages of upstream passage), possibly resulting in increased mortality or lower reproductive success.

4.2.2 Impacts of Alternatives: Potential Effects on Fish and Water Resources/Quality

Alternative 1: No Action

Under No Action, individual projects would continue without a standardized program; impacts on fish and water resources could occur, for example, where extreme climatic events coincide with soil disturbance during project implementation. However, the nature of the mitigation and restoration projects are such that fish and water resources/quality would benefit overall. State water regulations would be followed under all alternatives, so no significant impacts are expected.

Alternative 2: Base Response (Common to All Alternatives)

Under Alternative 2, the risk of short-term water quality and fish habitat degradation would be decreased, relative to the No Action Alternative. A consistent planning approach would help recognize areas of high-value habitat and water quality and the processes that influence them. Fish and water quality would benefit in both the near and long term.

State water regulations would be followed, including regulations for activities in or near wetlands and floodplains. No significant or long-term impacts are expected.

Alternative 3: Aquatic Habitat Objectives Emphasis

Water quality may be impaired as many mitigation or improvement projects are built and implemented, particularly those involving in-channel modifications, such as culvert replacements. Therefore, Alternative 3 would generate more applications for temporary variances from state water quality standards. However, in most instances, water quality would remain impaired in only a short reach of the stream, and usually only for time intervals ranging from hours to a few days. Habitat improvement and other benefits to fish generated by these projects would often be immediate and sustained in their effect.

Alternative 3 would likely generate the most in-stream habitat improvement structures. However, improper placement of grade control structures, large woody debris, or culverts could actually result in a net loss of habitat: for example, local channel gradient could be altered or hydraulic forces directed into stream banks. A result could be wider, shallower streams with a loss of habitats formerly afforded by deep pools and undercut stream banks. Monitoring and mitigation required under the planning process would work to correct such errors in a timely manner.

Most frequently used irrigation techniques (e.g., tailwater recovery, filter strips, and diversion screens) under Alternative 3 could improve water quality and fisheries: water control structures, subsurface drains, and ditches would generally reduce surface runoff. When runoff from fields does occur, water quality could decrease as soluble substances increase in the runoff.

Except for the temporary water-quality impairments during project construction, water quality and fish habitat would improve more under Alternative 3 than under other alternatives. The direct benefit of in-stream habitat improvement, the establishment of riparian habitat and other vegetation communities, the acquisition of sensitive riparian habitats through easements and leases, and the closure of roads and improvement of upland land practices would all support these increases in habitat. No significant or long-term impacts are expected.

Alternative 4: Cost and Administrative Efficiency Emphasis

Short-term impacts on fish and/or water resources/quality would generally be minor under Alternative 4 because in-stream mitigation and improvement projects would be fewer, smaller, and/or less aggressive in their disturbance of the environment. For example, funding that went primarily to in-channel modifications under Alternative 3 would be more likely to be split between in-stream work and public education in Alternative 4. In this example, Alternative 4 recognizes the value of an educated public in reducing water quality degradation, and deems the relative low cost and administrative ease equal in benefit to one or more in-stream structures.

Moderate-to-frequent use of techniques involving chemical applications (herbicides, pesticides, fertilizers) may occur under Alternative 4 where large areas are more efficiently treated, compared to other techniques. Chemical residues may degrade surface and groundwater quality and may be toxic to fish and wildlife.

No significant long-term adverse impacts on water resources/quality or fish habitat are expected. Both immediate and long-term habitat and water quality improvements under Alternative 4 would occur more gradually relative to Alternatives 3 and 6, and the same as or more quickly than under Alternative 5.

Alternative 5: General Environmental Protection

Alternative 5 would require Project Management Plans to provide coincidental benefits to other resources. This alternative treads the most lightly on the land. Projects would be smaller in size and scope, and would generate smaller benefits to fish habitat. Consequently, fish habitat would increase in step with other ecological improvements under this alternative, but at a much reduced rate relative to the other alternatives.

Water quality would improve or remain unchanged. Herbicide application as a special vegetative treatment, and pesticide use on cropland, would be used only when necessary to meet mitigation objectives on critical lands. Fertilizers would be used moderately in upland agricultural areas. Application of program-wide mitigation measures, as appropriate, would minimize impacts on fish and water resources/quality.

No significant long-term adverse impacts on water resources/quality or fish habitat are expected.

Alternative 6: Balanced Action

Under BPA's preferred alternative, project managers would have a wide range of techniques available that could potentially affect fish and/or water resources/quality. Negative effects are almost entirely associated with soil disturbance during project implementation. However, program-wide measures would be applied, as appropriate, to minimize or avoid such impacts. Fish habitat and water quality at new mitigation sites would increase over the long term as the diversity of in-stream habitats increased and as riparian habitat was established and expanded.

No significant long-term adverse impacts are expected on water resources/quality or fish habitat.

4.2.3 Impacts of Techniques: Potential Effects on Fish and Water Resources/Quality

In-channel Modifications and Habitat Improvement

Stream-channel morphology reflects the combined influence of landform, climate, hydrology, vegetation, and land use in the watershed draining into the channel. Channel forms and controls are generally described as colluvial, bedrock, and alluvial. The form of an alluvial channel, for instance, is determined by the interaction of eight physical variables: 1) width, 2) depth, 3) slope, 4) velocity, 5) discharge, 6) sediment size, 7) sediment concentration, and 8) channel roughness. Changing one variable causes compensating changes in one or more of the other variables. These geomorphic factors, the quality of the streamflow, and the riparian vegetation combine to determine the quantity and quality of fish habitat in a stream.

Channels formed in bedrock and colluvial material respond to the same factors, but are restrained by the landform.

In-channel modifications and habitat restoration projects affect habitat by changing the variables listed above. Under-designed projects can degrade habitat conditions because the interaction of these variables was not considered. Using hydraulic models for channel design can ensure that all variables are adequately addressed.

Using concrete, riprap, and other semi-permanent structures to stabilize stream banks imposes increasing constraints on some channels. Restricting one or more of a channel's geomorphic characteristics hinders its ability to reach equilibrium. Long-term degradation of channel condition and related habitat may result.

Placement of in-stream structures (e.g., large woody debris or large boulders or engineered structures) can improve habitat by increasing channel complexity (channel roughness, local scour pools, self-cleaning spawning gravel, etc.). Grade control structures can control streamflows, stabilize sediments, and improve fish habitat. Installing and replacing culverts and bridges can alleviate chronic road erosion, reduce stream bed scour and deposition, and improve fish passage (Saskatchewan Environment and Resource Management 1995a).

Improper placement of any in-stream structures may affect channel condition, degrade water quality, and decrease fish habitat, as geomorphic factors interact to influence the channel.

Nearly all in-stream work requires the use of heavy equipmenteither on the banks or the bed of the channel. Disturbance within the channel can increase turbidity of the streamflow (which in turn affects all aquatic life), increase fine sediment on the streanbed, fill or destroy pools used by fish, fill or destroy spawning gravels with fine sediment, crush fish eggs in the stream bed, and crush or deter both juvenile and adult fish in the vicinity of construction.

The use of hardened (paved or reinforced) fords, although protecting the channel bed, may encourage animal/equipment contact directly with streamflow. Water quality can be reduced.

Watershed treatments that facilitate natural hydrology may result in available water for other uses.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Any treatments that increase the cover and vigor of vegetation in a watershed, especially in riparian areas, improve the water quality of streams draining that watershed. Vegetation holds soil in place, reducing erosion; organic rich soils develop and retain nutrients in the soil profile, preventing eutrophication of lakes and glide areas; trees (and especially shrubs and herbaceous cover) on floodplains reduce flood flow velocities and encourage deposition of sediments, maintaining spawning gravels and pool habitat downstream; and shading of streams by riparian vegetation maintains water temperatures within a range favorable to fisheries.

Large trees in riparian areas, particularly conifers, serve as a source of large woody debris for the channel. Large woody debris increases the complexity and stability of most channels, and is key to many habitat features they contain. Attempts to accelerate large woody debris recruitment should not negatively affect habitat or channel conditions provided it is done on a select, individual tree basis. (See Appendix A, section 2.15, for a discussion of the uses of large woody debris.)

Where constructed wetlands are used as water treatment systems, contaminated storm flows may be discharged from under-designed wetlands before pollutants are stabilized. Downstream water quality would be degraded.

Herbicides used for vegetation control can affect water quality, and are a substantial risk to environmental and human health. Waters contaminated by herbicides can be toxic to fish.

The acquisition of sensitive riparian areas through easements and leases would provide for uses such as short-term grazing that would enhance habitat and water quality, particularly in floodplains and side channels.

Prescribed fires for vegetation control augment soils with ash and associated nutrients. However, where vegetation is lost, soil may erode. Eroded soils and nutrients often reach streams, and may degrade water quality and increase fine sediment on the streambed. Available spawning area may decrease; increases in turbidity may affect many fish functions.

If allowed to invade riparian areas, prescribed burning can remove streamside shade. Water temperatures consequently increase, thus harming aquatic organisms, including fish.

Water level manipulation to control vegetation can affect stormwater storage during rain and groundwater contributions to base (low) stream flows. Where groundwater is increased, less storm flow can be stored in the soil and slowly released as the flood crest passes. Lower groundwater levels during low flow periods (e.g., late summer) decrease the amount of water available to sustain stream flows, maintain water quality, and permit fish passage through channels. During flooding, rising waters may destabilize banks, causing erosion, and deposit loosely consolidated soils that may be further eroded. During reservoir drawdowns, exposed fine sediments can be vulnerable to wind or water erosion.

Agricultural Management Techniques—Crops and General

Agricultural non-point source pollution stems from large-scale landscape disturbances: removing and controlling vegetation, tilling soil, and applying fertilizers and herbicides. Properly applied, most agricultural crop management techniques will protect water quality and fish habitat by reducing erosion and sedimentation rates and maintaining nutrient and chemical cycling in the soil and crops.

Techniques that disturb soils may temporarily increase suspended sediment and turbidity, and increase sediment deposition in pools and spawning gravels for the longer term. Examples include the construction of terraces, diversion ditches, grassed waterways, and sediment basins to control overland flow and sediment runoff. Of course, any cropping practice that tills the soil holds some risk of increased sediment yields in nearby streams.

The common practice of applying fertilizers, herbicides, other pesticides, and other soluble substances to cropland increases the risk of both surface-water and groundwater degradation. All techniques considered here would decrease this risk, and improve water quality for fish and other aquatic life.

Water impounded annually or seasonally for agricultural uses may, collectively and at the watershed scale, affect the water quantity available in streams for necessary fish passage and the natural cleaning of spawning gravel and other habitat features. Wholesale reversal of current impoundment practices can have variable and unpredictable effects on basin hydrology, ranging from no effect to the benefit of improved spawning success to the loss of off-channel stormwater storage and habitat to the loss of eggs and of fine sediment to excessive peak flows.

Agricultural Management Techniques—Irrigation

Irrigation runoff can transport soil, agricultural chemicals, salts, and naturally occurring inorganics leached from soils. Many of these chemicals can be toxic to aquatic organisms (Ohlendorf and Killness 1988, Dwyer and Burch 1992, Ingersoll and Dwyer 1992). Many of the techniques considered reduce the risk of such degradation by reducing soil erosion (minimizing water volume and velocity flowing across soils) and intercepting eroded sediments in surface runoff (subsurface drainage collection, tailwater recovery, filter strips) (Saskatchewan Environment and Resource Management 1995b).

Irrigation can concentrate salts by leaching them from the top layers of soils or by depositing salts from the irrigation water itself. Excess salts are often removed through flushing, which involves temporary heavy irrigation to leach salts from the crop rooting zone.

Water quantity/water rights conflicts can arise where irrigators and other water users vie for limited surface water supplies, particularly during summer low flows when irrigation is critical to crop success. Water supply techniques (water rights applications, limiting inter-watershed diversions, development of alternative sources) and water conservation techniques (water measuring devices, minimizing water loss through conveyance facilities) could reduce water quantity conflicts.

Screens on irrigation intake and return ports can prevent the intake of fish and other aquatic organisms of all lifestages. Fish mortality due to stranding and/or temperature and oxygen stress would be reduced.

Agricultural Management Techniques—Animal Facilities

Agricultural operations that concentrate animals (e.g., holding, feeding, watering, servicing areas) can disturb soils, create impervious areas, concentrate contaminants, and increase the risk of water quality degradation in vicinity surface waters. Runoff from these areas is rich in nutrients, chemicals, oils, bacteria, and organic matter. Techniques for animal facilities considered here would reduce this risk by managing runoff from these facilities, providing safe collection and treatment of wastes, and preventing the destruction and direct contamination of stream channels.

Land application, storage, or landfill burial of wastes may generate leachates (e.g., nitrates) that may percolate and contaminate groundwater. Land application of wastes during wet weather or when storms threaten may cause nutrients, bacteria, and organic matter to run off directly to surface waters.

Under-designed wetlands and other storage areas may contaminate storm flows and then discharge them before the pollutants are stabilized on site.

Agricultural Management Techniques—Grazing

Planned grazing systems, including deferred grazing for some lands, allow vegetative ground cover to increase, ground disturbance to decrease, soil bulk density to improve, and infiltration to increase. As a result, soil erosion and sediment yields to surface waters would decline.

Where lands are placed in "deferred grazing" status, and where critical erosion and heavy use areas are not monitored periodically, maintenance and restoration needs may go unnoticed and unmet. Chronic erosion areas may develop, increasing sediment yields over the long-term.

Planting vegetation, seeding, brush and weed management to stabilize rangeland and pasture would reduce soil erosion. Some short-term erosion might occur if ground is scarified before it is seeded. Whether this erosion affects surface water quality depends on distance and slope characteristics to adjacent water bodies.

Soluble substances (including fertilizer applied with seeding and planting) and concentrated animal wastes may leach deeper into soils and reach groundwater where infiltration rates are increased. During wet weather and on wet sites, nutrients may enrich overland flow and storm runoff. With time, receiving surface waters may become eutrophic systems, especially when surface waters consist primarily of groundwater contributions.

Water supply projects, especially linear pipelines and larger-scale impoundments, may require large-area soil disturbance to construct. The risk of soil erosion and sediment yields to adjacent surface waters during and immediately after construction would be increased.

Using fords at stream crossings may cause trampling of stream banks and adjacent soils. Direct contact of livestock with the stream can degrade water quality, disturb streambeds, and, if fish are present, injure and kill fish. Some fords may reduce spawning success. Frequent activity at fords during adult and juvenile migration may effectively be a barrier to fish passage.

Fences to manage livestock access can reduce soil disturbance in sensitive areas. Fencing is frequently credited as an effective riparian improvement technique. However, livestock tend to walk along fences, creating soil-worn paths. Fences may concentrate animals by placing many livestock in a smaller area, creating erosion and livestock waste problems.

Road Management Techniques

Road management techniques addressed here focus on forest, agricultural, and other rural roads subject to private and some public maintenance. Road construction and road maintenance worsen natural erosion processes through soil excavation, oversteepening some slopes with uphill cut slopes, loading slopes subject to mass wasting, and maintaining bared soil surfaces. Roads are a frequent, chronic source of fine sediment in streams.

Many techniques considered here reduce the risk of sediment yields to streams by selecting preferred road locations, recognizing seasonal and weather-based construction windows,

controlling water flow on roads and in ditches, maintaining roads, controlling access of soil-disturbing vehicles, and closing and restoring roads (Saskatchewan Environment and Resource Management 1995a).

While these principles are used to reduce overall sediment generation from roads, many techniques initially disturb the soil. For example, grading is required to maintain road crown or outslope to assure drainage and prevent rilling down the running surface. Some soil from the grading procedure might inadvertently be pushed off the road, perhaps into a ditch where it might be transported to a stream and degrade water quality. Fish are affected when spawning gravel is clogged with fine sediment, when pools used for resting and rearing fill up, and when water quality is reduced.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences (Megahan et al. 1992).

Any forest practice that disturbs soils increases the risk of increased sediment yields in streams and of decreased fish habitat. As discussed under Soils, forest management techniques considered here may disturb soils through log yarding, wildfires started by equipment, prescribed burns, stand thinning, planting of trees and other vegetation by hand and machine, other site stabilization methods, and livestock grazing.

Techniques involving streamside management areas (SMAs) are intended to preserve the integrity of the stream channel and banks, provide a recruitable source of large woody debris for channel structure and habitat diversity, provide the shade and microclimate needed for optimum thermal regulation of streams, improve water quality, and maintain slope stability adjacent to streams, whether the landform be a floodplain or oversteepened slope.

Trees and slash accidentally introduced to channels are removed on a case-by-case basis. Debris may be removed by the least disturbing method, or left in place if removal would worsen channel instability or interfere with SMA functions. Some incidental habitat disturbance might occur, regardless of the approach.

Managing forest stands to improve snowpack in a watershed is difficult due to multiple ownerships, the multitude of factors influencing snowpack development, and the variable successes of previous efforts. Successful management reduces peak flows and extends spring snowmelt later into the summer. Unsuccessful efforts may actually increase peak flows, exhaust the summer water supply in spring, and disturb both forest slopes and stream channels and fish habitat in the process.

Increasing peak flows is an even more untested attempt to provide gravel flushing where available streamflows are declining. The goal is the cleaning or winnowing of sand and fine sediment from the spaces between spawning gravel. Forest practices that increase peak flows during spring runoff may improve the "cleaning ability" of these discharges. Increasing peak flows, however, may erode upland and riparian areas, degrade channel conditions, increase instability, decrease base flows, and provide very short-term benefits to gravel flushing.

Stream-channel protection during forest operations, particularly through recognition and management of SMAs, would maintain and restore channel integrity, water quality, and fish habitat.

Wildfire contingency plans would minimize the intensity and duration of burning observed in aquatic and riparian environments after wildfires. This would minimize the loss of vegetative cover and woody debris, and support channel stability.

Watershed treatments that facilitate natural hydrology may result in available water for other uses.

Urban Area Techniques

By implementing and monitoring erosion and sediment control plans prepared for construction projects, sediment transport off-site would be minimized and sediment yields to urban area streams decreased.

Channelized stream systems are designed to facilitate the greater storm flows of increasingly impervious urban areas. Channel modifications often increase velocities and reduce or eliminate structural diversity, including a reduction in pools and flow diversity, and a loss of spawning gravel through transport or sedimentation. Protecting floodplains and maintaining natural channel processes can restore and maintain channel structure and fish habitat. For example, using bioengineering methods (e.g., vegetative plantings instead of riprap) for streambank protection and preserving floodplains maintains the water quality and fish habitat of both the naturally transitioning channel and overbank stream.

Public programs that encourage reduction in waste (recycling, litter control), non-point water pollution sources (lawn care, pet excrement control), water use (water conservation, landscaping), and other chemical use (use of biodegradable cleaners, avoiding chemical disposal in household drains) generally favor maintenance of water quality without negative impacts. Similarly, programs that increase public awareness of environmental resources and responsibility (public education programs, storm drain stenciling, adopt-a-stream programs) can lead to improvements in water quality and fish habitat in urban areas.

Community transportation and utility management can prevent water quality degradation by cleaning and maintaining parking lots and streets, improving impervious drainage patterns on bridges and culverts near streams, and managing winter road conditions (improved road salt

storage, using alternative de-icing materials, using environmentally preferred snow disposal areas).

Accumulated snow along roadsides and in urban areas is usually high in sand, salts, and other debris and pollutants. Depositing plowed snow next to streams can lead to fine sediment deposition in spawning gravels, reductions in water quality, and/or the increase in peak flow volumes and velocities of receiving streams, resulting in the scour of stream bed and banks. Salt storage piles can create saline conditions in shallow aquifers. Use of alternative de-icing or traction control materials on winter roads (e.g., sand or salt substitutes) can increase fine sediment yields in spring runoff.

Recreation Management Techniques

Relocating and redesigning recreational facilities will generally benefit stream systems and fish habitat by protecting stream channels and riparian areas and improving sanitation. Water quality improves through reductions in sediment yields when, for example, eroding streamside trails are rerouted and trampled stream banks are restored, and when dispersed camping areas reduce user traffic in vegetation-sparse areas.

Closure of seasonal sport fisheries and entire streams to fishing would limit recreational opportunities demanded by the public, and might concentrate anglers in other sensitive streams and reaches. Habitat could be further degraded. Providing alternative sport fishing locations and opportunities might relieve or distribute pressure on fish and fish habitat.

Mining and Mine Reclamation Techniques

Mine reclamation efforts would result in improved water quality and fish habitat as metals and compounds that might be toxic to fish are reduced. However, recovery is expected to be a gradual process, with small initial gains.

4.2.4 Potential Program-Wide Mitigation Measures - Fish and Water Resources/Quality

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Develop and implement project erosion control plans that select and apply several complementary techniques to address all erosion and sedimentation processes. For example, seeding a disturbed area encourages vegetative soil stabilization. Mulching the site not only holds seed in place, but also provides interim soil protection against raindrop splash and sheet and rill erosion.
- Assure quality control of project plans through technical reviews by qualified peers and appropriate agency personnel.

- Select, implement, and enforce BMPs based on site-specific conditions, technical and economic feasibility, and the water quality standards for those waters potentially affected.
- Isolate in-stream construction from flow, and remove fish above or below the construction site during construction. Coordinate in-channel projects with state, local, and tribal fisheries agencies and obtain permits as needed.
- Monitor water quality downstream from activities with potentially significant adverse effects on water quality, such as those land-disturbing activities occurring within 15 meters (m) (50 feet (ft.)) of the wetted perimeter of a stream or wetland. Take corrective actions for conditions approaching maximum allowable degradation under state regulation.
- Stop application of fertilizer if signs of eutrophication are detected.
- For projects involving wetland and/or island creation, construct wetlands and islands during the dry season.
- For projects involving wetland creation, ensure adequate strategy to control nutrients excreted by large concentrations of waterfowl.
- Monitor dissolved oxygen levels in water released from deep impoundments and take actions to eliminate low-oxygen discharges if found.
- Withdraw surface waters or groundwater only where such withdrawal is necessary for the use and management of the property and when such withdrawal is demonstrated not to cause significant adverse effects on aquatic life, riparian communities, or adjacent land use.
- Coordinate with state water resource and/or rights agencies to verify viability of new water sources, obtain water rights for withdrawal of water from the state where the project is being considered, and design and implement features necessary to protect aquatic systems and other water users.
- Develop water impoundments or diversions in consultation with state water agencies and state and tribal fish and wildlife agencies. Obtain Corps permits, where needed.
- For projects involving prescribed burns, conduct a pre-burn inventory to identify areas to avoid, including areas that may be vulnerable to increased erosion. Develop an approach to avoid these areas.
- Coordinate with adjacent landowners and management agencies to discuss and resolve potential problems.
- Monitor groundwater quality under managed lands and near project areas that may contribute to groundwater contamination by herbicides, nutrients, petroleum hydrocarbons, and other soluble substances. Take corrective actions for conditions found to exceed state groundwater quality standards.
- Use hydraulic models for design of in-stream structures to ensure that all stream-channel morphology variables are adequately addressed.
- Coordinate with state, local, and tribal water resources and water quality agencies or departments to share data collection efforts in project areas.

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4.3 VEGETATION

4.3.1 Context

- **Legal.** As described under the Wildlife and Fish sections, Section 7 of the ESA requires Federal agencies to ensure that their actions do not jeopardize the continued existence of any threatened or endangered plant or animal species. Officially designated critical habitat for listed species cannot be adversely modified. Counties typically have jurisdiction over weed control. County Noxious Weed Control Boards may cooperate with project planners to ensure that watershed management activities do not promote or spread noxious weeds.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: adversely affecting a plant species listed or proposed for ESA listing; adversely modifying designated critical habitat for a listed plant species; adversely affecting plant species that are listed by state or tribal agencies as species of special concern (such as endangered, sensitive, monitor, etc.); removing or disturbing plant communities that have been identified by state or tribal agencies as unique or rare (such as late-successional forest or native shrub-steppe); or promoting or spreading noxious weeds.

4.3.2 Impacts of Alternatives: Potential Effects on Vegetation

Alternative 1: No Action

Under No Action, mitigation and improvement projects would continue to be developed without a standardized program to protect vegetation. Overall, however, native plant communities would continue to benefit (after some initial impacts) from Watershed Management Program activities, which promote the establishment of natural vegetation communities to secure soils, stabilize slopes, and provide a matrix for wildlife habitat and land use.

Alternative 2: Base Response (Common to All Alternatives)

Activities at or near mitigation and improvement sites under Alternative 2 would initially disturb vegetation as habitat improvements are implemented. Vegetation would be disturbed less than under the No Action Alternative, primarily because a consistent planning approach would help identify the best approaches to vegetation management. Vegetation communities, particularly those associated with riparian/riverine and wetlard environments, could increase. No significant or long-term impacts are expected.

Alternative 3: Aquatic Habitat Objectives Emphasis

Because intensive riparian management techniques (e.g., streambank bioengineering, large-scale planting operations) would be used often under this alternative, more land at new mitigation sites would be disturbed under Alternative 3 than under the other alternatives. This increased disturbance would increase the potential for (1) invasions of noxious weeds and other undesirable plants, and (2) direct loss of native plant communities and rare, threatened, or endangered plant species.

Alternative 3 would accelerate the development of riparian and some upland plant communities, including potential changes in existing composition and structure of these communities.

Alternative 4: Cost and Administrative Efficiency Emphasis

Compared to the other alternatives, Alternative 4 would disturb the least amount of vegetation at mitigation and improvement sites because projects would be distributed across the watershed. Less aggressive methods would be used to revegetate disturbed soils and restore riparian areas (e.g., natural revegetation would be preferred over planting). Also, many techniques would be implemented in developed or managed areas with little or no natural vegetation (urban areas, agricultural fields, roads).

Herbicide applications would be considered acceptable for unwanted-vegetation control under Alternative 4, especially where low costs are achieved when large areas need treatment. BMPs would be implemented as mitigation measures to reduce the risk of adverse effects on non-target vegetation, water quality, and so on.

Because native vegetation communities would not always regenerate promptly by themselves, some damaged communities could remain disturbed indefinitely, because cost would prohibit active efforts to restore them. In most cases, native vegetative conditions would improve naturally; however, results would generally take much longer to achieve than under the other alternatives.

Alternative 5: General Environmental Protection

Alternative 5 would include relatively little initial disturbance to vegetation because the more intensive habitat improvement techniques would be seldom used. Program-wide mitigation measures, applied as appropriate, would further minimize impacts. The multiple-use allowance of Alternative 5 would reduce the number of native plant communities protected at mitigation sites where developed recreation or local economic development opportunities exist. More vegetation might be trampled and more unwanted vegetation might be introduced under Alternative 5.

Alternative 6: Balanced Action

BPA's preferred alternative would include program-wide mitigation measures, as appropriate, to control the spread of weeds and to protect high-quality native plant communities and rare, threatened, and endangered plants. Projects might include a wide range of techniques that could disturb or alter vegetation (e.g., prescribed burn, clearing/seeding); however, the strong emphasis on revegetation with native species, particularly in riparian areas, would restore the composition and structure of natural plant communities.

4.3.3 Impacts of Techniques: Potential Effects on Vegetation

In-channel Modifications and Habitat Improvement

Riparian area vegetation would be incidentally destroyed during in-channel modifications and habitat improvement projects that require heavy equipment along channel margins. Where vegetation needed to be cleared on access roads, species and condition of post-project regrowth on the road might be altered.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Propagating plants changes vegetation patterns over time. In general, biological diversity would increase as multiple native species replace single-species crops or lands dominated by a few species of weeds.

Active propagation techniques (seeding, fertilizing, planting) speed development of desired plant communities compared to passive techniques or no action. In places where the land has been severely disturbed, native vegetation may not naturally regenerate, and habitats may remain disturbed if active efforts are not taken.

Propagation of native species may not work on soils that have been severely disturbed. Likewise, native plants from non-local stock may not adapt to site-specific conditions and may not survive. In addition, introduction of non-endemic stock (plants from different regions) may dilute the genetic composition of existing vegetation over time through cross-pollination.

Planting activities could remove threatened or endangered plant species directly.

Transplanting vegetation can be more successful than seeding. Use of this technique in problem areas could accelerate restoration or improvement of native vegetation.

Tilling (to prepare seedbeds) disturbs soils and can allow noxious and other weeds to establish themselves.

Creating or expanding wetlands reduces upland vegetation, which may include high-quality native habitats or habitat for rare, threatened, or endangered pant species.

Control of non-native plants would increase native plant communities. Non-native invasive plant species (e.g., reed canarygrass and Himalayan blackberry) would decrease in watersheds where vegetation control programs are implemented.

The acquisition of sensitive riparian areas through easements and leases would provide for possible uses such as short-term grazing that would enhance habitat and water quality, particularly in floodplains and side channels.

Attempts to accelerate in-stream large woody debris recruitment would result in the slow death of select individual trees.

Each of the techniques available to control vegetation carries some risk of adversely affecting vegetation. Herbicides can incidentally harm desirable plant species. Mechanical removal of vegetation is typically non-selective and is likely to remove desirable plants, possibly including threatened, endangered, or sensitive plant species. Biological control of vegetation can disrupt natural systems. Prescribed fire can reduce desirable species, increase invasive weeds, and reduce soil productivity. Water manipulation and mechanical control can slow natural vegetative succession. Hand-pulling carries the least risk of causing adverse affects.

Agricultural Management Techniques—Crops and General

Crop production would continue the ongoing effects of agriculture, which include maintenance of non-native annual crops, application of herbicides and pesticides, and ongoing soil disturbance.

Agricultural Management Techniques—Irrigation

Irrigation would support crop production and continues the annual cycles of soil disturbance and non-native plant growth. Changing irrigation techniques such as converting from seeping unlined ditch systems to closed pipe systems may affect riparian vegetation developed along the ditch.

Agricultural Management Techniques—Animal Facilities

Because animal facilities typically are highly disturbed areas and devoid of natural vegetation, significant impacts of drainage and waste management improvements on vegetation are not anticipated. There is some risk that noxious and other weeds might spread when weed seed incorporated in animal wastes and mire is transported off-site for disposal.

Use of wastes as a soil amendment may increase competition with both crops and desirable native vegetation by encouraging the encroachment of weeds and other undesirable species.

Creating or expanding wetlands for treatment of animal wastes reduces upland vegetation, which may include high-quality native habitats or habitat for rare, threatened, or endangered plant species.

Agricultural Management Techniques—Grazing

High levels of grazing can also break and compact vegetation and soils through repeated animal walking, trampling, and lying down.

Because riparian areas provide both palatable plants and a water supply, they are especially vulnerable to negative impacts from frequent livestock use. This impact translates into an increased risk of vegetation impacts wherever watering facilities are constructed.

The use of fences to manage livestock access reduces soil disturbance in sensitive areas, but may generate unintended impacts as well. Livestock tend to walk along fences, creating soil-worn paths devoid of desirable vegetation. Fences may concentrate animals in a smaller area, favoring the propagation of less palatable and undesirable vegetation.

Grazing can benefit vegetation as well. Grazing can reduce shrub density, release trees from competition, reduce fire fuels, and create habitat diversity between grazed and ungrazed areas.

Planned grazing systems, including deferred grazing and allotment rotations, allow vegetative ground cover to increase. Planting or seeding native or adapted perennial or biannual forage plants can improve the quantity and quality of vegetative cover during these rotations.

Road Management Techniques

Road construction directly removes vegetation and results in long-term soil compaction.

Restricting road access with fences and gates can prevent potential vegetation loss from recreational activities and other public uses. Restricting uses could also protect sensitive plant communities, including recently planted areas, riparian areas, and high-quality wetlands.

Building fences and gates requires that minor amounts of vegetation be removed as post holes are dug. Vegetation is trampled and soils compacted by vehicles and equipment and at material staging areas.

After construction or maintenance, native seed mixes are typically used to revegetate disturbed surfaces. Occasionally, rapid-growing, non-native plants would have to be used to secure soil before the wet, winter season. It may then be slow and difficult to change from stands of non-native plants back to native species; more vegetation management techniques might be needed.

Pioneer vegetation on many closed roads may include many less desirable plants, including noxious weeds, unless the roads are intensively managed and monitored.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Forest management techniques considered here, that may disturb vegetation, include the harvest of trees and units, log yarding, wildfires started by equipment, prescribed burns, stand thinning, planting of trees and other vegetation, other site stabilization methods, and livestock grazing.

Log yarding may damage the remaining trees in harvested stands. Understory trees and shrubs and herbaceous ground flora, including threatened, endangered or sensitive plants, may also be stressed, injured, or completely removed.

Wildfires can severely damage soil and vegetation. In these areas, fuel management programs, including prescribed burns at intervals to reduce fuels, present less risk of high-intensity fires; over time, they can reduce the numbers of fire-intolerant species and increase numbers of fire-tolerant species. However, prescribed fire in areas where suppression has allowed fuels to build up must be approached with caution, because vegetation can be significantly damaged. For example, overstory trees might be killed as fires burn hotter and longer in a given place.

Thinning and timber harvest can alter the component species and would change the structure of forest stands.

Revegetation efforts would determine the species of trees in successive forest stands. Where seeding takes places, non-native seed mixtures or live plantings can lead to disease-prone stands and the spread of noxious weeds.

Some non-native seed may be spread through livestock excreta as animals are transferred to various grazing allotments.

Urban Area Techniques

The use of soil-stabilizing seed mixes that contain weed seed may encourage the spread of noxious weeds and other undesirable plants.

Recreation Management Techniques

When campgrounds, trailheads, sanitation facilities, and other recreational facility gates are developed, vegetation is removed through digging for structures, fence posts, tent/trailer pads, trails, and other structures. Vegetation is trampled and soils compacted by vehicles and equipment and at material staging areas.

When recreational facilities are relocated or expanded, vegetation is cleared, possibly removing threatened, endangered, or sensitive plant species. Non-native plants and noxious weeds may encroach on disturbed areas as seeds from distant sources are incidentally transported by recreationists.

Mining and Mine Reclamation Techniques

Mine reclamation efforts would result in the gradual restoration of vegetation communities on sites that were already severely disturbed. The use of seed mixes that contain weed seed might encourage the spread of noxious weeds and other undesirable plants.

4.3.4 Potential Program-Wide Mitigation Measures - Vegetation

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigaton measures, as appropriate to protect the environment.

- Incorporate a weed control plan in consultation with local weed control officials.
- Survey for listed or other plant species of concern before disturbing lands for planting, if the USFWS identifies such species as potentially occuring in the vicinity of the project area.
- Acquire seeds and plants from stock derived under similar environmental conditions. Local stock is preferred; on-site stock is the ideal.
- For projects involving wetland creation or expansion, survey for and avoid sensitive features during early planning.
- For projects involving vegetation control, develop specific protocols for use of herbicides, mechanical, and biological methods, in cooperation with local weed control boards. Protocols could be adapted from the USFS Final EIS for Managing Competing and Unwanted Vegetation (USFS 1988).
- For projects involving vegetation control, conduct weed control programs more efficiently and with a greater regional effect by using joint multi-agency planning.

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4.4 WILDLIFE

4.4.1 Context

- **Legal.** Section 7 of the ESA requires Federal agencies to ensure that their actions do not jeopardize the continued existence of any threatened or endangered species. Officially designated critical habitat for listed species cannot be adversely modified. The USFWS maintains considerable responsibility and regulatory authority over waterfowl and other migratory birds, as defined under the Migratory Bird Treaty Act. States maintain control over wildlife, especially over game species. States and tribes generally have the authority to regulate hunting and hunting seasons.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: adversely affecting a species listed or proposed for ESA listing; adversely modifying designated critical habitat for listed species; adversely affecting candidate species under the ESA, or species listed by state fish and wildlife or tribal agencies as species of special concern (such as endangered, sensitive, monitor, etc.); or removing habitat that has been identified by state or tribal agencies as unique, rare, or important to wildlife distribution (such as big game winter range, waterfowl nesting areas, late-successional forest, native shrub-steppe).

4.4.2 Impacts of Alternatives: Potential Effects on Wildlife

Alternative 1: No Action

As Watershed Management Program projects continue to be implemented under the No Action Alternative, wildlife habitats and species would continue to be affected. Wildlife disturbance would occur during the implementation of projects that involve heavy machinery and equipment that makes noise. Benefits would occur where, for example, natural and planted vegetation in riparian areas improved riparian wildlife habitat and meets aquatic objectives for shade, cover, and bank stability. As it also administers wildlife mitigation projects, BPA typically requires seasonal restrictions to avoid disturbing sensitive wildlife habitats; however, no standardized program would be established to ensure program-wide mitigation.

Alternative 2: Base Response (Common to All Alternatives)

Alternative 2 presents less risk of wildlife disturbance and degradation of other wildlife habitat than under the No Action Alternative, primarily because a consistent planning approach would help recognize areas of high-value habitat.

Alternative 3: Aquatic Habitat Objectives Emphasis

This alternative has the greatest potential for short-term disturbance, displacement, and habitat loss for wildlife. It also has the greatest potential for long-term gains in riparian habitats and riparian-dependent species. Because Alternative 3 would work aggressively to restore channel structure, streambank stability, and riparian vegetation, wildlife communities that depend on existing riparian areas might be temporarily disturbed by frequent human presence and heavy equipment as channels are modified, and as large-scale vegetation planting and wetland creation take place.

Eventually, however, as fish and water quality benefit from functional aquatic and riparian ecosystems, wildlife would also reap coincidental benefits. No significant or long-term wildlife impacts are expected.

Alternative 4: Cost and Administrative Efficiency Emphasis

Alternative 4 has a low potential to disturb wildlife because it emphasizes passive, rather then active, management techniques. Many techniques would be used across the watershed and/or in developed or managed areas of low-to-moderate value to wildlife (urban areas, agricultural fields, roads). Wildlife would benefit from revegetation efforts, primarily those in riparian areas, but not as much as under Alternatives 3 and 6. No significant or long-term wildlife impacts are expected.

Alternative 5: General Environmental Protection

Under Alternative 5, only minor disturbances to wildlife would be expected because the more intensive habitat improvement techniques would be seldom used. There may be fewer coincidental benefits for wildlife from revegetation (compared to other alternatives) because conservative methods would be used. However, with program-wide mitigation measures applied, no significant or long-term wildlife impacts are expected.

Alternative 6: Balanced Action

Under BPA's preferred alternative, projects would include a wide range of techniques that could disturb wildlife habitat. However, with program-wide mitigation measures applied, no significant impacts are expected.

4.4.3 Impacts of Techniques: Potential Effects on Wildlife

In-channel Modifications and Habitat Improvement

Healthy streams and associated riparian areas are beneficial to wildlife, especially in alluvial systems where floodplains and terraces help provide habitat diversity.

In-channel modifications can disturb or reduce riparian wildlife habitat as heavy equipment is operated during clearing and as materials are placed in streams and near-stream staging areas.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Programs to increase desired plant communities would increase plant diversity and dominance of native plant species and communities. These changes would benefit most native wildlife species, including those listed as threatened or endangered and many Federal candidate or state-listed species of concern.

Planting activities conducted during spring and early summer can disturb nesting birds (including bald eagle and other species, such as Swainson's hawk, a species recognized as sensitive in several states) that nest in agricultural areas and are sensitive to disturbance during spring and early summer.

Creating or expanding wetland areas to provide near-channel aquatic habitat and/or water storage, while also increasing habitat for wetland wildlife species, would decrease habitat for upland species. In some cases, high-quality upland habitats could be removed.

Other control methods may also have impacts. Active control of exotic annuals and other undesirable plants can provide long-term increases in the abundance and distribution of native wildlife species, including those with significant population decline in the Columbia River Basin. Use of biological methods to control undesirable plant species may disrupt natural wildlife species and systems as well. The temporary loss of ground cover may reduce small mammal populations or destroy habitat for ground-nesting birds. Herbicides can be toxic to some wildlife species.

The acquisition of sensitive riparian areas through easements and leases would provide coincidental benefits for riparian-dependent species.

The effects of prescribed burning on wildlife are variable and depend largely on the intensity of the fire, size of the area burned, topography, type of soils, and the type of past fire management. Prescribed fire temporarily destroys habitat, but can result in better wildlife habitat over the long term. Prescribed fire could kill smaller, less mobile animals. However, most animals are sufficiently mobile to escape the characteristically "cool and slow" burns of prescribed fire, either by moving out of the area or by retreating underground.

Agricultural Management Techniques—Crops and General

Lands under intensive crop production typically provide little habitat for non-game wildlife, other than for common species associated with agricultural lands (e.g., raven, vesper sparrow, crows, meadowlarks, and swallows). However, crop production can be managed to provide seasonally important food sources for migrating or wintering waterfowl; for game birds, such as pheasant (non-native) and quail (both native and introduced); for small mammals; and for

raptors. Crop lands co-managed for wildlife are most likely to use conservation farming practices such as no-till or minimum-tillage methods and the establishing of buffer strips. These practices tend to mitigate some of the potential adverse effects that active crop production may have on wildlife.

Agricultural Management Techniques—Irrigation

Irrigation runoff can create local wetland habitats that benefit waterfowl, amphibians, and other wetland-associated species.

Agricultural Management Techniques—Animal Facilities

Because animal facilities typically are highly disturbed areas devoid of vegetation, and sites of frequent activity, wildlife use is generally low, although some wildlife may be drawn to feeding areas. As most techniques considered address drainage and waste management issues, significant effects on wildlife are not expected. Some improvement in surface water quality near these sites may draw wildlife near to animal facilities, creating a potential for conflict with farm and ranch animals.

Agricultural Management Techniques—Grazing

Intensive grazing can damage habitat by removing desirable plants, by displacing native species, and by decreasing vegetative productivity as soil erosion and compaction increase (Kennedy 1991). Riparian and other habitats can be successfully protected with proper timing and stocking of cattle, such as limiting cattle use to dry seasons when riparian soils are less vulnerable to physical disturbance (Marlo 1987).

Fences used to control livestock access to streams can become barriers to wildlife movements. Fences may also injure wildlife caught or tripped while attempting to cross them.

The development of livestock water supplies, such as the development and protection of springs and/or watering troughs, may provide coincidental benefits to wildlife.

Road Management Techniques

Road construction removes wildlife habitat directly. It can also remove habitat indirectly by increasing human presence. Several types of animals (such as American marten, wolverine, woodland caribou, wolf, and grizzly bear) typically avoid areas containing roads. Road maintenance generally has little effect on wildlife use other than adding human disturbance along the road corridor. Road decommissioning can improve habitat directly and can also reduce human disturbance in areas containing sensitive wildlife species.

Restricting road access could protect sensitive wildlife areas, including recently planted areas, riparian areas, nesting areas (e.g., heron colonies), and wildlife concentration areas (e.g., wintering areas for waterfowl or for deer).

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Any forest practice that disturbs vegetation increases negative impacts, or the risk of negative impacts, on wildlife. Forest stand species and structure are integral components of wildlife habitat. Those forest management techniques considered here that may disturb vegetation include the harvest of trees and units, log yarding, wildfires started by equipment, prescribed burns, stand thinning, planting of trees and other vegetation, other site stabilization methods, and livestock grazing.

Techniques involving SMAs are intended to preserve the integrity of the aquatic and riparian environments. Coincidental benefits to wildlife include travel corridors; forage, food and water; thermal cover; and habitat diversity.

The effects of prescribed burning on wildlife are variable and depend largely on the intensity of the fire, size of the area burned, topography, type of soils, and the type of past fire management. Prescribed fire temporarily destroys habitat, but can result in better wildlife habitat over the long term. Prescribed fire could kill smaller, less mobile animals. However, most animals are sufficiently mobile to escape the characteristically "cool and slow" burns of prescribed fire, either by moving out of the area or by retreating underground.

Prescribed burning can be used in place of grazing as a habitat management strategy, thereby avoiding grazing's adverse effects on wildlife (e.g., loss of riparian vegetation and increased competition for forage plants).

Livestock grazing may compete with wildlife dependent on similar forage.

Urban Area Techniques

The implementation of urban area techniques for improvements in water resources and fish habitat is not expected to have negative effects on wildlife. Improved water quality would benefit downstream wildlife populations as stress and mortality that may currently result from toxic compounds are reduced.

Recreation Management Techniques

Relocation of some trails and campgrounds into habitat used previously only for undeveloped recreation (e.g., hunting) can increase the frequency of human disturbance of wildlife. Trails, campground access roads, and fences can fragment wildlife habitat and become barriers across wildlife migration routes.

Mining and Mine Reclamation Techniques

Mine reclamation efforts have the potential to disturb wildlife as heavy equipment is operated during project implementation. Wildlife populations in these severely disturbed areas, however, are expected to be low.

Wildlife may eventually repopulate vegetation communities that are gradually restored.

4.4.4 Potential Program-Wide Mitigation Measures - Wildlife

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Before implementing any active management technique, identify sensitive wildlife habitats or features (e.g., eagle and other raptor nests, mule deer winter range) and establish buffers and timing restrictions in consultation with state and/or tribal wildlife biologists.
- Restrict access, either seasonally or spatially, to protect sensitive wildlife areas, including recently planted areas, riparian areas, nesting areas (e.g., heron colonies), and wildlife concentration areas (e.g., wintering areas for waterfowl or for deer).
- Use interpretive signs and on-site custodial care to reduce adverse impacts of recreation on sensitive wildlife habitats.
- For projects involving introduction, reintroduction, or augmentation of wildlife populations, test animals for diseases before release.
- Coordinate wildlife control efforts with state wildlife agencies and with Animal Damage Control, U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service. If threatened or endangered species are involved, coordinate with the USFWS.
- Avoid vegetation removal during the nesting season for birds. Where removal is unavoidable, conduct nest surveys for sensitive bird species before disturbing lands.
- Conduct inventories and establish fire breaks around riparian areas before conducting prescribed burns (unless riparian areas are expected to benefit from the treatment).
- Inventory vegetation in areas proposed for land-disturbing activities and avoid high-quality native vegetation communities (as defined by state or tribal agencies).

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4.5 LAND AND SHORELINE USE

4.5.1 Context

- **Legal.** Land-use regulation is most commonly carried out at the county level, although some state land-use restrictions may also apply, especially in sensitive areas such as shorelines. County regulations may include plans, policies, and ordinances that define zones where certain land uses are allowed and others are prohibited. Examples of typical county zoning and/or comprehensive plan designations include the following: multi-family residential, single-family residential, commercial, industrial, agricultural, forestry, mining resource lands, and open space. Additional zones may also identify special emphasis on environmental protection, such as view protection districts, scenic design areas, floodplain zones, and natural areas.

  Counties typically review projects occurring within their jurisdiction for consistency with their plans, policies and ordinances, and may require conditional use permits for projects affecting private lands, as well as formal mitigation agreements as part of permit approval.

  Section 1539 of the Farmland Protection Act, Public Law 97-98 (December 22, 1981), was established to minimize Federal actions that result in the unnecessary and irreversible conversion of farmland to non-agricultural purposes. Under the Act, Federal agencies must examine their actions for potential adverse effects on farmlands, as determined by applying the criteria established in Federal rules (7 CFR 658.4). See Chapter 5.

  Shorelines are protected under the Clean Water Act, as well as by state acts and regulations. See Chapter 5.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: converting to non-agricultural purposes farmland with a rating of 160 or greater according to the USDA rating system (7 CFR 658.4); establishing uses not compatible with adjacent land uses and ownerships; conflicting with adopted environmental plans and goals of the community where the project is located; or disrupting or dividing the physical arrangement of an established community.

4.5.2 Impacts of Alternatives: Potential Effects on Land and Shoreline Use

Alternative 1: No Action

Without a standardized program, impacts on land and shoreline use could vary widely, depending on the circumstances surrounding each project. Often watershed improvement

projects will have no effect on land and shoreline uses. Examples of where projects can negatively affect land and shoreline use include: redirecting, reducing or concentrating streamflow through the use of multiple or alternative channels; prohibiting access to lands, despite easements, through the removal or replacement of hydraulic structures at road crossings; and large-scale application of animal wastes to land over a shallow aquifer, degrading the groundwater used by adjacent properties. As a general rule, however, BPA project managers would continue to work with project proponents, local authorities, and the public to address land and shoreline use issues, thereby minimizing potential conflicts.

Alternative 2: Base Response (Common to All Alternatives)

Land-use impacts under Alternative 2 would be less than those under No Action, primarily because a consistent planning approach would help identify land use issues and concerns. Large-scale land conversions are not considered to be a typical management practice under the Watershed Management Program.

Alternative 3: Aquatic Habitat Objectives Emphasis

Under Alternative 3, Project Management Plans would focus narrowly on obtaining aquatic habitat objectives rather than on compatibility with local land uses. Therefore, changes to land and shoreline use at mitigation and improvement sites might be greater than under the other alternatives. This would be particularly true where channel modfications affect riparian areas. For example, reclamation of former side-channel depressions (multiple channels, oxbows, etc.) for habitat improvement might affect adjacent land uses (water tables, structures, access). Streambank stabilization might delay natural channel adjustments at a site and transmit them downstream, affecting downstream land uses.

Alternative 4: Cost and Administrative Efficiency Emphasis

Alternative 4 has a low potential for significant changes in land or shoreline use. The number and size of in-channel and riparian habitat improvement projectswould be reduced as mitigation efforts are redirected to include upland areas with pre-existing land uses. Large-scale land conversions are not considered to be a typical management practice under the Watershed Management Program.

Alternative 5: General Environmental Protection

Alternative 5 also has a low potential for significant changes in land or shoreline use. Conflicts in land or shoreline use would be avoided or minimized during early project planning, which would involve a high degree of stakeholder involvement. In addition, application of program-wide mitigation measures, as appropriate, would minimize impacts on land and shoreline use. Project Management Plans would include measures to protect sensitive land uses and to minimize or eliminate conflicts with local land-use laws.

Alternative 6: Balanced Action

In combination with the proposed standard planning process, and with BPA's preferred requirements under Alternative 6, conflicts between in-channel and riparian habitat improvements and land and shoreline use would be avoided or minimized. Project managers would apply potential program-wide measures, as appropriate, to avoid inconsistencies with local land-use regulations and to avoid disruption of land use on lands adjacent to mitigation areas (see Section 4.5.4, below).

4.5.3 Impacts of Techniques: Potential Effects on Land and Shoreline Use

In-channel Modifications and Habitat Improvement

In-channel modifications can affect land use by the following means: redirecting, reducing or concentrating streamflow through the use of multiple or alternative channels; increasing downstream sediment yields; and decreasing downstream water quality. Decreases in streambank stability can increase the loss of land adjacent to stream channels.

Channel modifications may alter (increase or decrease) the elevation of the various floodplains (annual, 100-year) and terraces and increase flood damage and water quality degradation; decrease floodprone areas, and/or change suitable land use and land-use regulations.

Land use can be affected through the removal or replacement of hydraulic structures at road crossings.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Recognizing and committing to the importance of riparian areas, wetlands, windbreaks, filter strips, and other vegetation features requires a commitment of land that might otherwise be put to other uses.

Prescribed fire can affect adjacent landowners and land uses if fire escapes, burning adjacent lands, or if smoke drifts. Under certain conditions, smoke can drift onto roadways and cause serious traffic accidents. Careful consideration of weather, fuel, and other conditions can significantly reduce the potential for smoke drifting onto roadways.

Water level manipulation may unintentionally affect adjacent landowners by increasing the water table and restricting land use.

The acquisition of sensitive riparian areas through easements and leases would provide for possible uses such as short-term grazing that can modify existing land use by reducing the intensity of land management practices typical of animal, crop, and timber production. These changes in land use may conflict with local and multi-jurisdictional land-use plans and policies.

If a project were inconsistent with local comprehensive land-use plans, a variance amendment or special use permit might be required, along with public review.

Agricultural Management Techniques—Crops and General

Land-use planning, including re-zoning of county lands withina watershed and the securing of water rights, can alleviate future demands for withdrawal (fresh) and discharge (exhaust) of agricultural water from surface and groundwater sources.

Withdrawing land from crop production, apart from intermittent conservation cropping sequences, may encourage re-zoning to land uses with greateror lesser water demand, soil disturbance, and waste generation.

Agricultural Management Techniques—Irrigation

Major shifts in irrigation practices may affect adjacent landowners by reducing available water or by raising the water table.

Agricultural Management Techniques—Animal Facilities

Drainage improvements and waste management should generaly have favorable (if any) effects on lands adjacent to animal facilities, as surface water and air quality are improved.

Large-scale application of wastes to land may degrade the value of lands over shallow aquifers, through accumulation of nitrates and other contaminants.

Agricultural Management Techniques—Grazing

Implementation of grazing management techniques considered here are not expected to have adverse impacts on land and shoreline uses. However, fencingof sensitive areas may interfere with or preclude other, unknown land uses, including travel and access patterns on the landscape.

Road Management Techniques

Most road management techniques would not affect land and shoreline uses. Landowner easements must, however, be recognized.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Some forest practices may affect neighboring land and shoreline uses. However, since most techniques considered are for the purpose of forest stand improvements, no significant impacts are anticipated.

Urban Area Techniques

Assuring recognition of near-stream lands as important to the fisheries resource through land-use planning, zoning laws, and state and Federal regulations would determine the land uses and practices by existing and future landowners. No negative impacts are anticipated.

Land-use zoning that restricts development on floodplains generally results in fewer flood impacts on structures.

Recreation Management Techniques

Use of recreation management techniques is not anticipated to affect land and shoreline uses significantly . Most recreational facility relocations are expected to remain near original facilities. Designating alternative fishing locations could create undesirable traffic levels on roads and access routes.

Mining and Mine Reclamation Techniques

Efforts to reclaim abandoned mine waste disposal areas can lead to land-use changes, resulting in alternative uses such as grazing, off-road recreational vehicle (ORV) trails, and other developed uses. Such changes would occur gradually, taking perhaps decades to become effective.

4.5.4 Potential Program-Wide Mitigation Measures - Land and Shoreline Use

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Meet with county officials during early planning of mitigation areas, to try to develop the project in a manner consistent with county zoning and planning efforts.
- For projects involving land-use changes, meet with county commissioners and land-use officials, who can provide local wisdom and help ensure coordinated, efficient, and effective use of multi-jurisdictional resources.
- Elicit public input, which allows for application of local knowledge and for development of plans consistent with the local land-use values.
- Survey proposed alignments of water distribution systems to ensure that no rights-of-way or access routes are blocked.

- For projects involving prescribed burns, identify acceptable weather conditions and air quality concerns, and develop contingency plans in the event of fire escaping to adjacent lands.

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4.6 CULTURAL AND HISTORIC RESOURCES

4.6.1 Context

- **Legal.** The National Historic Preservation Act (NHPA) requires that Federal agencies take into account the potential effects of their undertakings on properties on or eligible for the National Register of Historic Places (National Register). The Native American Graves Repatriation Act (NAGPRA) requires that Federal agencies consult with Native American tribes when activities and operations encounter cultural items or when cultural items are newly discovered. The Archeological Resources Protection Act (ARPA) prohibits the purposeful excavation and removal of archeological resources on Federal land without a permit from the Federal land manager. See Chapter 5.

  Section 10(e) of the Northwest Power Act states that nothing in that Act "shall be construed to affect or modify any treaty or other right of an Indian tribe." Because the proposed watershed mitigation measures would be taken pursuant to Northwest Power Act authority, BPA's actions shall not affect or modify the tribes' treaty rights.

  None of the six alternatives would affect or modify the tribes' treaty rights because none of the mitigation measures would change those rights. The treaty rights would remain the same as they were prior to BPA's action. The tribes' ability to exercise their treaty rights would not be diminished. Opportunities for the tribes to exercise their treaty rights could be enhanced by improved fish and wildlife habitat.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: adverse effects on properties on or eligible for the National Register, or disturbance of Native American cultural items or religious places, or adverse effects on the exercise of Native American religion, pending consultation with the appropriate tribe(s).

4.6.2 Impacts of Alternatives: Potential Effects on Cultural and Historic Resources

Alternative 1: No Action

Under No Action, BPA would continue to lead cultural resource protection efforts on a project-by-project basis.

Alternative 2: Base Response (Common to All Alternatives)

Watershed Management Program mitigation and improvement projects under Alternative 2, as with all alternatives, are generally compatible with cultural resource protection. Few opportunities for large-scale ground-disturbing activities are likely in previously undisturbed areas.

Most projects seek to improve protective, vegetative cover of soils using methods that minimize ground disturbance.

Potential impacts from ground-disturbing activities would occur to varying degrees under any of the alternatives.

Alternative 3: Aquatic Habitat Objectives Emphasis

Alternative 3 has the highest potential among the alternatives for ground-disturbing activities in channels and riparian areas. It therefore has the highest potential to disturb associated cultural resources. Relatively high amounts of ground-disturbing activities would be expected during the initial phases of each new project, as a wide range of management techniques would be implemented.

Over the long term, potential impacts would decrease as revegetation efforts retarded soil loss, roads were decommissioned or closed, and land-use practices on forest and agricultural lands were improved.

Alternative 4: Cost and Administrative Efficiency Emphasis

Potential impacts on cultural resources would be relatively minor under Alternative 4 because mitigation and restoration plans of smaller scope initiate projects across the watershed. Projects in previously disturbed areas (urban areas, cropland, roads) would be emphasized. Most projects also seek to improve protective, vegetative cover of soils using methods that minimize ground disturbance.

Ongoing commercial uses in the vicinity of mitigation and improvement projects (crop, timber, and forage production) would continue the potential to disturb cultural resource sites.

Alternative 5: General Environmental Protection

Alternative 5 proposes the least amount of ground disturbance during project implementation. Program-wide mitigation measures would be applied, as appropriate, to protect cultural resources. Hence the risk of negative effects on cultural resources is the smallest among alternatives.

Alternative 5 does promote commercial and recreational uses of lands near project sites where economic and/or recreational benefits could be obtained along with aquatic habitat objectives. Therefore, some disturbance of cultural resources associated with these activities might occur over time.

Alternative 6: Balanced Action

Under BPA's preferred alternative, a moderate amount of ground would initially be disturbed at mitigation and improvement sites in riparian areas. Program-wide mitigation measures would be applied, as appropriate, to protect cultural resources.

4.6.3 Impacts of Techniques: Potential Effects on Cultural and Historic Resources

In-channel Modifications and Habitat Improvement

Rechanneling streams can result in sites being washed/eroded. Heavy equipment use near stream channels can disturb archeological and historic sites through incidental excavation, soil compaction and crushing, and vegetation disturbance or removal.

Channel modifications that increase flood elevations can inundate and bury previously undisturbed sites through overbank deposition of sediment.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Plant propagation techniques that disturb soil may also disturb archeological resources. Planting techniques, including hand-transplanting and use of machinery, can disturb surface and subsurface sites. In the long-term, plant propagation would reduce erosion and therefore the potential for site disturbance by erosion.

Propagation of native plant species would benefit tribal traditional values because many native species are also traditional use species.

Fire associated with prescribed burns can affect archeological sites by exposing them to discovery, or by disturbance through potentially increased erosion.

Fire can also damage or destroy historic buildings. Because prescribed burns would be conducted under controlled conditions, there would be less likelihood of adversely affecting historic buildings than during wildfires.

Mechanical removal of vegetation can directly disturb archeological sites. Water level manipulation can also cause site exposure by erosion.

Managing vegetation with preference for native plant species would benefit tribal traditional values because many native species are also traditional-use species. Use of herbicides during plant harvest times can conflict with tribal traditional uses, and/or create health concerns.

Agricultural Management Techniques—Crops and General

Agricultural practices that disturb soils can also disturb archeological sites. Implementation of the techniques for crops considered in this assessment would have no negative impacts on cultural and historic resources unless the tilled land area were expanded.

Agricultural Management Techniques—Irrigation

Agricultural practices that disturb soils can also disturb archeological sites. Using the irrigation techniques considered here would have no negative impacts on cultural and historic resources unless irrigation facilities (e.g., tailwater recovery systems) were constructed on previously untilled land.

Agricultural Management Techniques—Animal Facilities

Construction of facilities for drainage control, alternative water sources, and site maintenance, as well as activities that disturb the soil, may disturb archeological sites.

Agricultural Management Techniques—Grazing

Grazing can compact archeological sites, and can also expose site through erosion. Techniques that disperse and alternate grazing impacts on a site reduce the risk of archeological impacts. Techniques that disturb soils, such as alternative water supply construction, may also uncover and disturb cultural and historic sites. Fencing can cause trailing along fences, which may disturb cultural resources.

Road Management Techniques

Maintenance of existing roads could affect cultural and historic resources where cultural sites and historic facilities and landmarks occur right next to roads. Road surfacing stockpiles and equipment staging areas may inadvertently affect cultural sites.

Road access limitations and road closures can help maintain archeological sites by discouraging public access that can lead to vandalism.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Any forest practice that disturbs soils increases the risk of disturbing cultural and historic sites. Forest management techniques considered here that may disturb soils include log yarding,

wildfires started by equipment, prescribed burns, stand thinning, planting of trees and other vegetation by hand and machine, other site stabilization methods, and livestock grazing.

Fire associated with prescribed burns can affect archeological sites by exposing them to discovery, or by disturbing them through possible increased erosion.

Fire can also damage or destroy historic buildings. Because prescribed burns would be conducted under controlled conditions, there would be less likelihood of adversely affecting historic buildings than during wildfires.

Urban Area Techniques

If bridges are considered historic features, improvements for drainage control may detract from their historic appeal.

Urban area techniques are not anticipated to affect cultural resources negatively.

Recreation Management Techniques

Heavy equipment use during recreational facility relocation can disturb archeological and historic sites through incidental excavation, soil compaction and crushing, and vegetation disturbance or removal.

Improved access to archeological sites by relocation of recreational facilities can lead to vandalism of these sites.

Mining and Mine Reclamation Techniques

Mine reclamation efforts would occur on severely disturbed lands, with virtually no risk of impacts on cultural or historic resources, since they most likely would already have been destroyed during the mining.

4.6.4 Potential Program-Wide Mitigation Measures - Cultural and Historic Resources

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Enter into Programmatic Agreements with SHPOs, tribes, and others to ensure the following:
    - * Consultation with the SHPO and affected tribes to identify potential occurrences of cultural resources;

* Where there is potential for adversely affecting cultural resources, cultural resource surveys to document any resources present;
* Where properties on or eligible for the National Register are under management control, incorporation of a cultural resource management plan; and
* Identification of opportunities to foster public appreciation of the relationship between natural resources and tribal culture.

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4.7 ECONOMICS

4.7.1 Context

- **Legal.** Executive Order 12898 of February 11, 1994, directs all Federal agencies to ensure that their actions do not result in disproportionately adverse environmental or human health effects on minority and/or low-income populations. In addition, Federal agencies must analyze the environmental effects of their actions, including human health, economic and social effects, and effects on minority and low-income communities.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: involuntary displacement of property owners or restriction of commercial use; disruption of traffic or business activities during construction or ongoing operation; reduction of local tax revenues, either directly or indirectly, to the extent that greater than 1 percent of total annual revenues is lost.

4.7.2 Impacts of Alternatives: Potential Effects on Economics

Alternative 1: No Action

Under No Action, no standardized program would be applied to provide coincidental benefits to local economies. Implementation of management activities would continue to provide some temporary employment, service, and supply revenues to the local economies.

Alternative 2: Base Response (Common to All Alternatives)

Implementation of mitigation projects can provide some temporary and/or seasonal local employment, services and supplies revenues. Use of a consistent planning approach established under Alternative 2 would identify opportunities for incorporating local skills and resources. However, few, if any, full-time employees would be required for most mitigation projects.

It is unlikely that the use of water for mitigation projects would reduce water available to other water users because any water used would be used according to State law that prevents new or changed uses from "injuring" existing water rights. Thus there would be little or no reduction in agricultural productivity or other water-dependent revenues. Conversion of private lands to public or loss of commodity production on public lands could diminish local tax bases. Watershed management projects would not be sufficient in scale to cause broader impacts within regional economies.

Alternative 3: Aquatic Habitat Objectives Emphasis

Alternative 3 provides the greatest potential for short-term economic benefits derived from local employment and use of services, supplies, and equipment. Over the long term, however, economic benefits would be minimal because project activities would likely taper off after initial implementation. For projects that require long-term maintenance, local services and supplies might be used indefinitely. In a few cases where large foodplains and riparian areas were acquired for management, loss of commodity production would reduce economic returns from those areas.

Alternative 4: Cost and Administrative Efficiency Emphasis

Alternative 4 would likely have little effect on local or regional economies. Short-term use of services, supplies, and equipment would be reduced because projects would be smaller. In order to reduce costs, increased volunteer labor would be sought.

Alternative 5: General Environmental Protection

Like Alternative 4, Alternative 5 would include actions with coincidental benefits to local economies. In addition, application of program-wide mitigation measures, where appropriate, would minimize impacts on, and maximize benefits to, local economies.

Commercial uses that are consistent with aquatic habitat objectives would be encouraged, including crop, livestock, and timber production. Project managers would also monitor local economic indicators and adapt management to better benefit the human environment, including local economic conditions.

Alternative 6: Balanced Action

BPA's preferred alternative would apply program-wide mitigation measures, as appropriate, to minimize impacts on, and maximize benefits to, local economies. This alternative would provide only minor increases in local revenues from employment, services, and supplies.

4.7.3 Impacts of Techniques: Potential Effects on Economics

In-channel Modifications and Habitat Improvement

In-channel modifications to improve habitat would be short-term activities benefiting biologists, water resources specialists, equipment operators, and associated support and materials services. Associated revenues would also be short-term, and would not generate significant long-term income, local retail business, or governmental tax revenues.

The cumulative effect of numerous habitat improvement projects could increase the gradual, long-term economic benefit of larger fisheries to tribal, commercial, and sport fishermen. In addition, flood control and management benefits would increase

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Employment and income generated by vegetation transplanting and reseeding could temporarily benefit local economies. Transplanting would provide more long-term employment than would reseeding, which is less labor-intensive but which can provide more funds for equipment rental. The employment generated by these activities is likely to be only temporary, or at best seasonal.

In addition, because positions would likely be low-skill, income generated by these two vegetation programs would not likely be a significant benefit to local retail businesses or governmental tax revenues.

The creation of wetlands would also provide some temporary employment and funds for equipment rental (e.g., excavators, backhoes, and graders) during construction.

Aerial spraying of herbicides would benefit crop-dusting businesses, while vehicle-mounted herbicide application and mechanical removal would benefit commercial applicators or farmers and others already possessing tractors and trucks with the appropriate equipment.

Hand-pulling of weeds and backpack herbicide application are the most labor-intensive of the vegetation management techniques. However, as with transplanting, seeding, and wetland creation, they would involve short-term, low-paying laborer positions, and would not noticeably benefit the area economically.

The acquisition of sensitive riparian areas through easements and leases can reduce the economic returns of commodity production on these areas. In general, commercial use of lands acquired for mitigation actions would occur only as they are consistent with the overriding project goals and objectives. Because commodity production would be secondary (or, in some cases, irrelevant), local economic activity would be reduced if farming and associated economic activities were lost (i.e., equipment sales, local services). In most cases, the amount of land removed from commercial purposes would be very minor in relation to lands remaining available for these uses in the general area of mitigation sites.

Agricultural Management Techniques—Crops and General

Several of the techniques presented require initial investments at the cost of the agricultural landowner. Elevated costs may be associated with techniques such as conservation cropping systems, terracing, planting windbreaks, evaluation of fertilizer rates and timing, and implementation of alternative pest management strategies. Quantifying benefits is more difficult, however. Benefits accrue as soil erosion is prevented, soils higher in productivity are maintained, applied fertilizer is more effective, and pesticide use is reduced, increasing crop yield and perhaps greater profits per unit yield.

Agricultural landowners can implement many of the techniques with existing equipment. Employment opportunities associated with such implementation are not expected to reach significant levels.

Agricultural Management Techniques—Irrigation

Construction and long-term maintenance of irrigation diversions, water conveyance structures, and alternative water sources such as wells, spring development, and impoundments, would generate some income through local labor, equipment, services, and supplies. The amount generated depends strongly on the size of the facilities and structures, their design, the materials used, and other factors.

Employment and income generated by these activities would vary from very short periods to 1 or 2 years. Construction would thus provide employment opportunities ranging from temporary to year-long full-time jobs. Types of jobs would range from low-skill laborer positions to journeyman and management positions with construction and engineering firms.

Depending on the size of the construction project, these structures could require substantial purchases of pipe, rock, concrete, and other materials, as well as acquisition of water rights. Funds would be provided for equipment rental (e.g., excavators, backhoes, and graders) during the construction activities. These purchases and the additional employment would benefit local retail businesses and would increase governmental tax revenues.

Much of the economy of the Pacific Northwest (i.e., agriculture, navigation, power, industry, domestic supplies, and recreation) is closely tied to or depends upon the availability of water. Conflicts over these rights and access (as evidenced during recent debates about hydropower generation versus fisheries mitigation) are common during periods of reduced annual precipitation. Most irrigation techniques considered in this assessment conserve or protect water supplies and would not create significant concerns regarding economic impacts on other water users such as ranchers and farmers.

Agricultural Management Techniques—Animal Facilities

Several of the techniques presented require initial investments at the cost of the agricultural landowner. Elevated costs may be associated with techniques involving drainage improvements.

Agricultural landowners can implement many of the techniques with existing equipment. Associated employment opportunities are not expected to reach significant levels.

Agricultural Management Techniques—Grazing

Construction and long-term maintenance of water conveyance structures and alternative water sources such as wells, spring development, and impoundments would generate some income

through local labor, equipment, services, and supplies. The amount generated depends on the size of the facilities and structures, their design, the materials used, and other factors.

Employment and income generated by these activities would generally be short-term. Types of employment would range from low-skill laborer positions to journeyman positions with construction and engineering firms.

Depending on the size of the construction project, these structures could require substantial purchases of rock, concrete, pipe, and other materials, as well as water rights. Funds would be provided for equipment rental (e.g., excavators, backhoes, and graders) during the construction activities. These purchases and the additional employment would benefit local retail businesses and would increase governmental tax revenues.

Employment and income generated by vegetation transplanting and reseeding could temporarily benefit local economies. Transplanting would provide more long-term employment than would reseeding, which is less labor-intensive but which can provide more funds for equipment rental. The employment generated by these activities is likely to be only temporary, or at best seasonal.

In addition, because positions would likely be low-skill, income generated by these two vegetation programs would not likely be a significant benefit to local retail businesses or governmental tax revenues.

Road Management Techniques

Construction, long-term maintenance, and decommissioning of roads and road drainage structures would generate moderate income through local labor, equipment, services, and supplies. The amount generated depends on the size and the extent of the road network and landscape characteristics (such as soil characteristics, hillslope gradient, stream drainage density, and the vigor of typical roadside vegetation).

Associated employment and income would generally be seasonal but long-term. Road decommissioning, however, would offer only one-time, short-term employment per project. Types of employment would include both skilled equipment operators and low-skill laborer positions with construction firms.

Depending on the size of the road maintenance project, substantial purchases of rock, gravel, concrete, culverts, and other materials could be required. Road maintenance activities also would provide funds for equipment rental (e.g., excavators, backhoes, and graders) during the construction activities. These purchases and the additional employment would benefit local retail businesses and would increase governmental tax revenues.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Forest operations such as harvesting, thinning, planting and fertilizing, slope stabilization, and prescribed burning would generate moderate income through local labor, equipment, services, and supplies. The amount generated would depend on the size and extent of the forest stand and landscape characteristics such as hillslope gradient and stream drainage density.

Employment and income generated by these activities would generally be seasonal in nature, but could be long-term if multiple watersheds were involved. Types of jobs would include skilled equipment operators, low-skill and unskilled laborers, professional foresters, and government agency personnel (in a consulting role).

Depending on the watershed size, large purchases or rental of equipment, supplies, and forest road maintenance items (rock, gravel, concrete, culverts, etc.) could be required. Maintenance and repair of forest equipment (e.g., yarders, tractors, trucks) during forest operations would provide some additional employment and benefit local services and increase governmental tax revenues.

Urban Area Techniques

Implementation of urban area techniques such as sewer and septic system improvements would generate some income through local labor, equipment, services, and supplies. Other opportunities would fall to state and community transportation and utility crews. Many of the techniques are voluntary in nature, generating no income and only minor demand for services and supply businesses.

Employment and income generated by construction activities would generally last only months. Types of employment would include low-skill laborer positions, skilled equipment operator positions, and engineer and surveyor positions with construction and engineering firms.

Recreation Management Techniques

Implementation of recreation management techniques would generate only occasional income through local labor and provision of equipment, services, and supplies.

Employment and income generated by construction activities would generally last perhaps days to weeks. Types of employment would include low-skill laborer positions and skilled equipment operator positions with construction firms. Employment and income afforded by

campgrounds and areas of heavy ORV use could decrease where campgrounds and ORV trails were closed or relocated.

Mining and Mine Reclamation Techniques

Implementation of mine reclamation techniques would generate some income through local labor, equipment, services, and supplies. Employment and income generated by reclamation projects would generally last from weeks to months. Types of employment would include low-skill laborer positions, skilled equipment operator positions, and engineer and surveyor positions with construction and engineering firms.

4.7.4 Potential Program-Wide Mitigation Measures - Economics

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Encourage using available local supplies and labor to accomplish project goals and objectives.
- Train and maintain a qualified and adequate work force to plan and implement various watershed restoration projects safely and effectively.
- Establish inter-local agreements with fire districts, the USFS, and other appropriate agencies to assist in controlled burn activities.
- Involve local and downstream water users and local water agencies to ensure that project water users do not significantly affect productivity or production costs of water-dependent agriculture.

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4.8 RECREATION/VISUAL

4.8.1 Context

- **Legal.** Fishing is generally regulated by Federal, state, and tribal fish and wildlife agencies. Off-road vehicle use is regulated by local and state law enforcement and may also be regulated by local, state, tribal, or Federal land management agencies.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: creating hazards that might pose a risk to the public; disrupting recreational activities in stream channels and on lands adjacent to stream channels; and supporting recreational activities that conflict with aquatic habitat objectives or with tribal rights.

4.8.2 Impacts of Alternatives: Potential Effects on Recreation/Visual

Alternative 1: No Action

Without a standardized program, recreational opportunities would be developed on a case-by-case basis. In most cases, existing recreational uses would continue with little or no alteration (based on past mitigation projects). Some fisheries-oriented developed opportunities might be provided, such as fishing platforms and trails offering aquatic and riparian ecosystem education. Recreational access could be restricted near sensitive stream banks and high-value habitats.

Alternative 2: Base Response (Common to All Alternatives)

In most cases, significant impacts are not anticipated from changes in recreational use. The risk of changes to the range and quality of recreational experiences under Alternative 2 is less than that under No Action, primarily because a consistent planning approach would help recognize areas of high recreational value. Under all alternatives, recreational use near mitigation and improvement sites would be curbed where access restrictions were deemed necessary for fish and fish habitat protection.

Alternative 3: Aquatic Habitat Objectives Emphasis

Under Alternative 3, selected stream reaches would be closed to fishing or seasonal fishing windows modified under the jurisdiction of state agencies. Construction of habitat and channel protection structures (particularly those of non-natural appearance such as concrete weirs or riprap on stream banks) could alter the visual setting near some mitigation sites. Improvements to recreational facilities and experiences under Alternative 3 would be purely incidental to the achievement of aquatic habitat objectives.

Alternative 4: Cost and Administrative Efficiency Emphasis

Negative impacts might occur in association with access restrictions and stream and fishery closures. Improvement and relocation of campgrounds, trails, and other facilities could also affect recreational experience under this alternative. These benefits would be incidental to the achievement of aquatic habitat objectives. They would depend on their nearness to and influence on aquatic habitat, and they would be limited by the amount of resources available for recreation projects. Alternative 4 encourages the use of a permit system and allows access fees to be charged to visitors. These charges could discourage recreational use in some cases.

Alternative 5: General Environmental Protection

Recreational use of lands near mitigation and improvement sites would be encouraged under Alternative 5. This alternative would therefore potentially provide a net increase in the number and/or quality of recreational opportunities. In addition, application of program-wide mitigation measures, as appropriate, would minimize impacts on recreation. Alternative 5 encourages the use of a permit system and allows access fees to be charged to visitors. These charges could discourage recreational use in some cases. Placement of recreation-related structures (e.g., restrooms, garbage containers, traffic signs) could detract from the visual setting at some areas.

Alternative 6: Balanced Action

Under BPA's preferred alternative, recreational uses would be allowed, providing they do not interfere with achieving fish and fish habitat mitigation. Negative impacts might occur from access restrictions and stream and fishery closures. Access to recreational sites on sensitive stream banks would also be restricted to protect sensitive habitats, cultural resource areas, or other environmentally sensitive areas. Alternative 6 encourages the use of a permit system and allows access fees to be charged to visitors. These charges could discourage recreational use in some cases. Program-wide mitigation measures would be applied, as appropriate, to protect recreation and visual resources.

4.8.3 Impacts of Techniques: Potential Effects on Recreation/Visual

In-channel Modifications and Habitat Improvement

In-channel and near-channel habitat improvement projects may temporarily disturb and therefore reduce the quality of some recreation experiences. Turbid water, equipment noise, and non-natural vegetation patterns generated by these projects can detract from the recreation experience.

Construction activity that disturbs and deters fish can reduce the catch by sport fishermen. Habitat improvements from in-channel modifications can increase and improve recreational experiences associated with sport fishing.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Where plant propagation is taking place, recreational opportunities may be temporarily or permanently lost. Areas may need to be protected to avoid incidental damage to recently planted areas, which typically are vulnerable to disturbance.

In the long-term, improvement of riparian, wetland, and related vegetation on communities and associated wildlife populations may increase fish and wildlife-related recreational opportunities, as well as improve the natural character of mitigation lands.

Prescribed burning to reduce fuels can temporarily conflict with recreational use on or near mitigation lands. Recreation opportunities may be temporarily lost while sites are closed for prescribed fire operations and during the immediately following recovery period. Drifting smoke could disturb downwind recreational use. Over the long run, fuel reduction programs reduce the risk of high-intensity fires, which have a much greater chance of creating a long-term loss of recreational opportunity as well as short-term losses of scenic resources.

Flooding of areas to control reed canarygrass or otherwise to manage vegetation can restrict recreational access, but can also increase some opportunities associated with water, such as bird watching or hunting.

Agricultural Management Techniques—Crops and General

Agricultural management techniques for crops are not anticipated to affect existing recreational opportunities. Planting "green manure" crops may improve the visual diversity of the landscape during non-growing seasons.

Agricultural Management Techniques—Irrigation

Irrigation techniques are not anticipated to affect existing recreational opportunities or visual resources.

Agricultural Management Techniques—Animal Facilities

Techniques for the control of effluent runoff from animal facilities are not anticipated to affect existing recreational opportunities or visual resources.

Agricultural Management Techniques—Grazing

Techniques for grazing management would generally increase or maintain recreational opportunities associated with the wild or undeveloped character of the land. Wildlife viewing enjoyment and hunting success, for example, are likely to increase.

Road Management Techniques

Road access options and road decommissioning can limit (and potentially reduce) the amount and types of recreational activities. Where unrestricted access has been allowed, newly imposed access restrictions or road closures may diminish recreational opportunities. Because most private lands involve some form of restricted access, access restrictions as a road management technique on private lands would have a negligible impact on recreation.

Road construction and maintenance can also improve recreation access by improving the ease of access.

Forest Management Techniques

The consideration of forest management techniques in this assessment is *not* intended to satisfy NEPA and other regulatory requirements necessary to permit large-scale commercial timber harvests. Forest management techniques can be used to improve the health of forest stands and restore degraded conditions caused by natural disturbances, including fire and mass wasting, and human-caused influences.

Forest management techniques considered here may temporarily affect recreational opportunities through truck traffic on forest roads, noise generated from harvest or other forest equipment (e.g., planting machines), safety issues surrounding tree-falling, disruption of hiking trails, and ash and unpleasant burn residue remaining after prescribed fires. Maintenance of SMAs will provide continuity of riparian recreational opportunities such as sport fishing.

Urban Area Techniques

Urban area techniques would have only minor effects on visual resources, perhaps improving the attractiveness of neighborhoods. Adopt-a-stream and public education programs can have recreational benefits for some persons.

Recreation Management Techniques

The temporary or permanent loss of recreational opportunities may occur as facilities are relocated or improved. Improvements would generally increase the satisfaction sought by users of dispersed and developed recreation areas. However, some recreation sites favored by campers and ORV enthusiasts might be closed or relocated.

Fish stream closures may be unpopular with some fishermen.

Mining and Mine Reclamation Techniques

Mine reclamation efforts would improve the visual impact of severely disturbed landscapes. These techniques are not anticipated to affect existing recreational opportunities. With time,

some reclaimed sites may afford dispersed (e.g., hunting) and developed (e.g., off-road vehicle trails) recreational opportunities.

4.8.4 Potential Program-Wide Mitigation Measures - Recreation/Visual

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Identify safe public recreational opportunities that do not jeopardize project aquatic habitat objectives.
- Identify recreational opportunities suitable for physically disabled persons.

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4.9 AIR QUALITY

4.9.1 Context

- **Legal.** Several air quality programs under the Clean Air Act regulate prescribed burning and other activities. The National Ambient Air Quality Standards (NAAQS) are established to protect human health and welfare. Pollutant concentrations that exceed the NAAQS are considered injurious to public heath. Air pollutants for which NAAQS have been established are called "criteria" pollutants and include particulates (PM_{10}), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb).

  The Clean Air Act requires each state to develop, adopt, and implement a State Implementation Plan (SIP) to ensure that the NAAQS are attained and maintained for each criteria pollutant. These plans must contain schedules for developing and implementing air quality programs and regulations. SIPs also contain additional regulations for areas that have violated one or more of on the NAAQS (nonattainment areas). In general, nonattainment areas are located near large, urban centers with large traffic volumes and heavy industrial sources, although some rural areas are non-attainment for PM_{10} as a result of blowing dust.

  The Clean Air Act established the Prevention of Significant Deterioration (PSD) program: it prevents areas that currently have clean air from being degraded. Class I areas are subject to the most limiting restrictions on how much additional pollution can be added to the air while still protecting air quality. All National Parks and Wilderness areas are designated as Class I areas. Other jurisdictions that wish to limit degradation and that implement a plan approved by EPA can also qualify as Class I areas. Areas not in Class I are considered Class II areas.

  State and local governments have the authority to adopt their own air quality rules and regulations. These rules can be incorporated into the SIP if they are equal to, or more protective than, the corresponding Federal requirements. For example, many states have incorporated smoke management provisions for prescribed burning into their SIPs.

- **Desired Condition.** Project managers will seek to establish a desired future condition without incurring the following impacts: violating Federal, state, or local ambient air quality standards; causing or contributing to a new violation of the NAAQS; increasing the frequency or severity of an existing violation; delaying the timely attainment of a standard; emitting more than the threshold amount of a criteria pollutant in a non-attainment area; contributing to an existing or projected air quality violation; exposing sensitive receptors (e.g., campgrounds, businesses, or residences) to irritating or harmful pollutant concentrations.

4.9.2 Impacts of Alternatives: Potential Effects on Air Quality

Alternative 1: No Action

Under No Action, burning levels would be prescribed on a case-by-case basis. No standardized program would be established to prevent impacts on air quality, although existing state and local regulations would be followed. Noise, dust, and emissions associated with heavy equipment exhaust could increase, with potential impacts on local air quality. These impacts are local and short-term in their effect. Prescribed burning, currently used to varying degrees, can also adversely affect air quality.

Alternative 2: Base Response (Common to All Alternatives)

Prescribed burning, which would be used to varying degrees under all alternatives, can adversely affect air quality. Under some conditions, burning can reduce visibility, sometimes posing a safety hazard on public highways. Project managers would be required to coordinate with state officials to ensure that impacts on air quality would be minimal and within state-defined limits. In addition, because burning already occurs on various land types throughout the Columbia River Basin (e.g., crop-, range- and forest lands), burning levels might remain similar to current conditions. Use of a consistent planning approach established under Alternative 2 would reduce risk of degradation to air quality, relative to the No Action alternative, though the identification of air quality issues and concerns.

Alternative 3: Aquatic Habitat Objectives Emphasis

Relatively few impacts on air quality would be expected under this alternative because in-channel and riparian area work is emphasized. These areas are not conducive to effective or beneficial prescribed burning; and fertilizer or herbicide use is controlled and minimized. Use of prescribed burning and herbicide and fertilizer application on mitigation and improvement projects would be limited in frequency and limited to upland areas.

The potential for dust and emissions from heavy equipment and ground disturbance would be greatest under this alternative.

Alternative 4: Cost and Administrative Efficiency Emphasis

Alternative 4 has the greatest potential for use of prescribed burns because fire is often one of the best methods to obtain desired vegetation changes, and because many acres can be treated at relatively low cost. Therefore, this alternative could generate some of the highest levels of smoke in a watershed, especially during the first few years of each new project's implementation, when prescribed fires might be used with greater frequency.

Fertilizers and herbicides would be used as needed to promote vegetation development. Techniques employed might include aerial application over relatively large areas (greater than 16 hectares (ha) or 40 acres (ac.)) or local applications as needed in riparian areas.

Alternative 5: General Environmental Protection

Alternative 5 would include relatively low use of fire, fertilizers, and herbicides because protecting the environment would be a high priority. In addition, application of program-wide mitigation measures, as appropriate, would minimize impacts on air quality.

Alternative 6: Balanced Action

Relatively minor impacts associated with drifting smoke or applied herbicides and fertilizers would be expected under this alternative. A moderate potential for dust and emissions from heavy equipment and ground disturbance exists under this alternative. Program-wide mitigation measures would be applied, as appropriate, to minimize potential air quality impacts.

4.9.3 Impacts of Techniques: Potential Effects on Air Quality

In-channel Modifications and Habitat Improvement

Increases in noise, dust, and emissions associated with heavy equipment exhaust would occur during projects involving equipment operation, and could temporarily reduce local air quality.

Special Vegetation Treatment Techniques, Including Techniques for Wetlands and Riparian Areas

Aerial application of herbicides can locally deteriorate air quality.

Plant propagation, vegetation control, wetland creation, and the like do not significantly affect air quality. Increases in noise, dust, and emissions associated with heavy equipment exhaust occur during projects involving equipment operation, and could temporarily reduce local air quality.

Fire can significantly degrade air quality. Smoke effects are typically local, although the cumulative effects of agricultural and silvicultural burning and wind-blown erosion could cause regional effects, especially in Class I areas with pristine views.

Over the long term, prescribed burning decreases the risk of high-intensity wildfires and the associated air quality impacts. High-intensity fires generally create more smoke than prescribed burns because more fuel is burned per unit of area and greater areas of fuels are burned.

Agricultural Management Techniques—Crops and General

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality.

Agricultural Management Techniques—Irrigation

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality. Use of irrigation techniques should not otherwise affect air quality.

Agricultural Management Techniques—Animal Facilities

Handling and storage of concentrated wastes often generates unpleasant odors associated with urea and ammonia. When animal wastes are incinerated, smoke, ash, and odors are likely to increase in the atmosphere.

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality.

Agricultural Management Techniques—Grazing

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality.

Road Management Techniques

Noise, dust, and exhaust emissions from with heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality.

Unsurfaced roads may suspend dust above roads under heavy traffic conditions during dry weather, obscuring visibility and making breathing difficult.

Forest Management Techniques

Noise, dust, and emissions from heavy equipment exhaust would increase during forest operations, and could temporarily reduce local air quality.

Unsurfaced roads may suspend dust above roads under heavy truck traffic during dry weather, obscuring visibility and making breathing difficult.

Urban Area Techniques

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality.

Recreation Management Techniques

Noise, dust, and exhaust emissions from heavy equipment would increase during projects involving equipment operation, and could temporarily reduce local air quality. Equipment use associated with most recreational management techniques is expected to be minor.

Mining and Mine Reclamation Techniques

Noise, dust, and exhaust emissions from heavy equipment would increase during mine reclamation efforts, and could temporarily reduce local air quality.

Site restoration, including revegetation and soil stabilization, may result in reductions in windblown dust and noise.

4.9.4 Potential Program-Wide Mitigation Measures - Air Quality

Under Alternatives 5 (General Environmental Protection) and 6 (Balanced Action), project managers would apply the following program-wide mitigation measures, as appropriate to protect the environment.

- Restrict prescribed fire to specific conditions, such as when (1) weather conditions and forecasts are favorable to a controlled burn, (2) air quality is sufficiently high to allow local smoke emissions, and (3) smoke dispersion conditions are favorable.
- Use state-defined smoke management guidelines to determine allowable smoke quantities.
- For projects involving the aerial application of herbicides, develop specific protocols for use of herbicides, including protocols to protect air quality. Protocols could be adapted from the USFS Final EIS for Managing Competing and Unwanted Vegetation (USFS 1988).

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4.10 CUMULATIVE IMPACTS

Cumulative impacts can result from "individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). This section examines two levels of cumulative effects that may result from implementing BPA's Watershed Management Program: (1) impacts of all future BPA watershed management projects considered together, and (2) impacts of all future watershed management projects considered collectively with other past, present and future activities within the Columbia River Basin.

4.10.1 Cumulative Impacts of All Future Watershed Management Projects

The five action alternatives analyzed in this EIS would establish a standard planning process under which BPA could carry out a large number of projects. BPA could implement a number of individual watershed management programs within the Columbia River Basin over the next decade.

Individual projects would range in size from fractions of an acre to several hundred acres or more. Relatively minor impacts that might occur at individual projects could occur over many hundreds of acres when all individual projects are considered together.

However, when examined within the broad geographic extent of the project area, adverse impacts of each project would be localized and relatively minor. Overall, watershed management throughout the Columbia River Basin would provide a net benefit to water quality, fish, and fish habitat, as well as to other natural resources such as soils, vegetation, and wildlife. Other impacts, as described in this chapter, would affect only a small portion of lands available for such uses within the Columbia River Basin.

Cumulative benefits to fish would include improvements in many natural processes, including sediment transport, streamflow generation, large woody debris recruitment, and temperature regulation. As a result, healthy and viable populations of wild, native fish and other naturally spawning fish would be more likely to increase. As projects are implemented, the stability of streambanks and streambeds would result in increased cover and the stabilization of spawning gravel. Habitat complexity would increase within the channel, providing a diversity of habitat types. Sediment input to stream channels would become comparable to the capacity of the system to alternately store and transport it. A reduction in fine sediment would create clean gravel with greater spawning and overwintering success. Peak flows discharged from the watershed would not excessively scour redds or disrupt rearing fish. Riparian conditions would improve, shading streams and reducing thermal stress on fish. An increase in riparian trees would provide the supply of large woody debris for channel structure and cover. Trees and other vegetation would provide energy inputs to the food chain, secure groundwater for favorable maintenance of streamflow during dry weather, and help maintain channel stability. Fish would enjoy increased and easier access to all habitat types through the modification or removal of obstructions such as culverts and debris. Water quality improvements, including increased dissolved oxygen, decreased toxic chemical

concentrations, and a reduction in coliform and other pathogens, would benefit not only fish, but wildlife and humans as well.

4.10.2 Cumulative Impacts of All Future Watershed Management Projects Considered Together with Past, Present, and Future Human Actions in the Columbia River Basin

Impacts from implementing watershed restoration projects throughout the Columbia River Basin would add to past, present, and future impacts occurring from other human activities in the region. Negative effects of watershed management projects would be temporary and associated mainly with project implementation. Short-term negative effects would be compensated for by overall long-term improvements in watershed condition, and, ultimately, in increases in fish habitat and fish populations.

Prescribed burning for watershed improvement might add to existing or future regional air quality problems. Under certain climatic conditions, air pollution from field burning in the central Columbia Basin, wildfires or prescribed burning on forest lands, dust blown from exposed soils on agricultural lands, and urban air pollution from human population centers might combine to reduce visibility and general air quality over large areas.

The extent to which watershed management projects would create or aggravate negative cumulative effects on any given resource would be mitigated by establishing the eight-step ecosystem planning process with the associated prescriptions of the alternatives, which include coordinated planning with other Federal and state agencies, tribes, and private landowners as part of watershed activities. Negative cumulative impacts may be further minimized or avoided by applying, as appropriate, potential program-wide mitigation measures to protect the environment.

4.11 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

NEPA requires that EISs consider the effects of short-term uses on long-term productivity. *Short-term uses* of the environment are those that occur as discrete events or that can occur on a year-to-year basis. Examples include cattle grazing, timber harvest, recreation, and irrigation. To achieve mitigation goals, new watershed management projects may include a variety of short-term uses such as irrigation, controlled grazing, and selective harvesting of trees.

Long-term productivity refers to the capability of the land to provide resources, both market and non-market, for future generations. In almost all cases, development of new watershed management projects would increase the long-term productivity of the land in terms of capacity. Soils, which play a critical role in nutrient, water, and atmospheric cycles, are equally critical to the long-term productivity of the land. Because soil conditions would be maintained

or improved with watershed restoration projects, these sites would also support or improve the land's production capacity.

Grazing, farming, and timber harvesting may be excluded from some areas (e.g., SMAs) where they currently are allowed, or prescribed where they currently are not. However, the benefits of improved grazing, agricultural and forest practices and the resulting soil conservation may result in an overall increase in the productivity of these resources.

All of the watershed management techniques proposed would result in long-term increases in fish resources and stream productivity. Projects that produce short-term increases in stream productivity at the expense of long-term or watershed-wide productivity would not be used under any of the alternatives. For example, clearing streamside vegetation could result in a short-term increase in primary productivity by allowing more sunlight into the system, while causing a long-term decrease in production by increasing the stream temperature beyond the ideal range for fish downstream.

4.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible commitment of resources refers to use of non-renewable resources such as minerals and petroleum-based fuels. Watershed management projects may include the use of gravel, sand, and other non-renewable materials to construct drainage improvements, stabilization structures, and access roads, trails, and other features. Materials may come either from on-site borrow pits or from outside sources. Projects would also require some petroleum-based fuels for vehicles and equipment.

Irretrievable commitment of resources are those commitments that result in the lost production/use of renewable resources, such as timber or rangeland. Development of watershed management projects would minimize such commitments, except where state and Federal regulations and zoning ordinances so designate. These commitments are irretrievable rather than irreversible, because management direction could change in the future so as to allow these uses.

4.13 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Some adverse environmental impacts associated with the implementation of watershed management programs are unavoidable (i.e., cannot be fully mitigated). These impacts are disclosed in the "Alternative 2: Base Response" section of each resource impact assessment (e.g., soils, land and shoreline use, etc.) and are summarized below.

4.13.1 Soils

Soils would be disturbed during the implementation phases of most new construction projects. Depending on the level of human use allowed at each individual project site, and on the aggressiveness of improvements and restoration actions taken (e.g., planting programs), soils could be disturbed to various degrees over several years. On the whole, watershed management programs would serve to stabilize soils and provide long-term protection, especially at riparian areas, where soils are typically most likely to enter stream systems.

4.13.2 Fish and Water Resources/Quality

Activities under some watershed management programs would contribute sediments to adjacent surface waters during project implementation. However, state water regulations would be followed under all alternatives, and program-wide mitigation measures would be applied, as appropriate, under Alternatives 5 or 6. Therefore, no significant impacts are expected. Eventually, sediment contributions would decrease as riparian and other vegetation zones become established.

4.13.3 Vegetation

In many cases, it would not be possible to avoid removing some existing vegetation as part of watershed improvement activities (e.g., detention ponds, surfacing of high-use areas). Under all alternatives, rare, threatened, or endangered plant species or high-quality native plant communities would be protected.

4.13.4 Wildlife

Wildlife would be disturbed by noise and human activity where many watershed improvement projects were implemented. Overall, wildlife habitat would be maintained or increased as the overall watershed condition improves. With program-wide mitigation measures applied, as appropriate, only minor disturbance of wildlife would occur under Alternatives 5 or 6.

4.13.5 Land and Shoreline Use

Except for very few, very extensive watershed improvement projects, no significant changes in land use would occur.

4.13.6 Cultural Resources

Watershed management projects are generally compatible with cultural resource protection. However, ground-disturbing activities such as wetland construction or installation of pipelines can adversely affect archeological resources. Program-wide measures would help to protect cultural resources, but inadvertent impacts are possible.

4.13.7 Economics

No significant, negative economic effects are anticipated with the implementation of watershed improvement projects.

4.13.8 Recreation

Access restrictions would be necessary in some areas during project implementation.

4.13.9 Air Quality

Smoke from prescribed burning conducted to improve vegetation conditions or to manage fuel loads would reduce local visibility and air quality.