Karnowsky Creek
Stream Restoration Project

Environmental Assessment

Siuslaw National Forest
South Zone Ranger District
Lane County, Oregon

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Comments received in response to this solicitation, including names and addresses of those who comment, will be considered part of the public record on this proposed action and will be available for public inspection. Comments submitted anonymously will be accepted and considered; however, those who only submit anonymous comments will not have standing to appeal the subsequent decision under 36 CFR part 215. Additionally, pursuant to 7 CFR 1.27 (d), any person may request the agency to withhold a submission from the public record by showing how the Freedom of Information Act (FOIA) permits such confidentiality. Person requesting such confidentiality should be aware that, under the FOIA, confidentiality may be granted in only very limited circumstances, such as to protect trade secrets.

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Why is this project needed, and what evidence established this need? CHAPTER 1

Chapter titles are framed as questions intended to focus the writing and to alert readers to judge whether the answers provided are adequate. For readers accustomed to earlier environmental documents, chapter 1 is equivalent to the "Purpose and Need for Action" section.

The Planning Area

The planning area for the Karnowsky Creek Stream Restoration Project Environmental Assessment (EA) lies in the Divide sub-watershed of the Siuslaw River basin. The planning area is about 40 air miles west of Eugene, Oregon (map 1); it covers about 1,850 acres. Karnowsky Creek drains into Duncan Inlet of the Siuslaw River, about 9 miles from the Pacific Ocean. The lower ¾-mile of Karnowsky Creek is tidally influenced and is primarily privately owned at this time. In 1992, the Forest Service acquired the upper 1½ miles of mainstem and its tributaries. The project area is located in portions of Township 18 South, Range 11 West; sections 14 and 22-27, Lane County.

The Proposed Project

The Karnowsky Creek Stream Restoration Project EA describes and analyzes the effects of restoring the natural hydrology, sediment regime, and wetland conditions in Karnowsky Creek and associated tributaries by re-constructing the historic meandering channel, adding large wood, decommissioning an adjacent road, and planting riparian trees and shrubs.

The Existing Conditions

The Lower Siuslaw Watershed Analysis (USDA 1998b) and the Late-Successional Reserve Assessment, Oregon Coast Province Southern Portion (USDA, USDI 1997) describe the attributes of the Lower Siuslaw watershed much more fully than does the short summary that follows. Existing watershed conditions that impair properly functioning aquatic habitat:

- ⇨ Past agricultural management has altered the natural estuarine, wetland, and stream processes of Karnowsky Creek.
- ⇨ Before public ownership, 93 acres of the valley bottom were cleared, channelized, and diked to accommodate pastureland for the original settlers over the last century.
- ⇨ The channel has become deeply entrenched and the stream is disconnected from its floodplain.
- ⇨ It contains few large logs or woody material in either the current stream or floodplain
- ⇨ Large conifers in riparian areas are lacking.
- ⇨ The channel has low complexity, reduced summer flows, and corresponding reduced summer rearing habitat for salmonids.

The Problems (Issues) To Be Addressed

Based on available information, including the direction from the Northwest Forest Plan (the Plan), the Lower Siuslaw Watershed Analysis, and the Karnowsky Creek Stream Restoration Proposal (Steckler et al. 2001), District Ranger Ed Becker identified the following problems:

- ✓ Past alteration of Karnowsky Creek, its tributaries, and the surrounding valley has resulted in improperly functioning estuarine, stream, and wetland habitats. Thus, he saw a need to improve the function of Karnowsky Creek and surrounding aquatic habitats.

- ✓ The shortage of properly functioning aquatic habitat in the Oregon Coast Range limits recovery of cold-water species such as coho salmon. Thus, he saw a need to increase the amount of high quality fish habitat and wetlands in Karnowsky Creek.

Evidence Used by the District Ranger in Deciding to Address These Problems

The record of decision (USDA, USDI 1994b) for the Northwest Forest Plan--based on physical, biological, and societal evidence provided in the Forest Ecosystem Management Assessment Team report (USDA, USDI, et al. 1993) and described in the Plan's environmental impact statement (USDA, USDI 1994a)--is intended to provide for healthy forest ecosystems, including protecting riparian areas and waters.

The Plan identified concern for anadromous fish in the Oregon Coast Range Province (which includes the Siuslaw National Forest) because of its isolation and harvest history (chapters 3 and 4; p. 21). The record of decision, which amended the Siuslaw Forest Plan, allocated federal lands in the Lower Siuslaw watershed into one or more of the following:

- ⇨ Late-successional reserve;
- ⇨ Riparian reserve; or
- ⇨ Matrix (lands not included in the other two allocations).

The Plan identified specific environmental conditions and appropriate commodities and amenities to be produced and maintained in each land allocation. It also outlined the rules and limits governing possible activities for achieving desired conditions in each allocation.

The project area involves about 1,850 acres, with all acres in late-successional reserve, and most acres (1,747) also in riparian reserve. There is no matrix land in the project area.

The project area is located in Management Area (MA) 15 as defined in the Siuslaw Forest Plan (USDA 1990). The goal of MA 15 is "to provide a mix of resources and outputs in an integrated and comprehensively planned manner".

The Assessment Report for Federal Lands in and Adjacent to the Oregon Coast Province (USDA 1995) describes the in-stream fish habitat on federal lands throughout the Province as being in marginal to poor condition. It recommends specific actions to improve fish habitat on federal land by:

- ⇨ Stabilizing, decommissioning, or obliterating roads;
- ⇨ Restoring immediate habitat conditions by adding large wood to streams; and

- ⇨ Restoring long-term habitat by reestablishing natural riparian areas through actions such as riparian planting.

For needing to restore Karnowsky Creek

The Plan's Aquatic Conservation Strategy is intended to restore and maintain the health of watersheds and the aquatic ecosystems they contain. The Lower Siuslaw Watershed Analysis (USDA 1998b) and the Karnowsky Creek Stream Restoration Proposal (Steckler et al. 2001) identified the following adverse effects on Karnowsky Creek and its tributaries:

- ⇨ The natural stream channel was diverted into an artificial channel that is narrower and deeper than the natural channel, creating a channelized condition; material excavated from the artificial channel was placed adjacent to it, creating a diked condition—these actions have resulted in reduced spawning and rearing habitats for salmonids.
- ⇨ The existing main stem lacks woody debris and pool complexity.
- ⇨ Riparian vegetation—including trees—has been removed and converted into pasture which has reduced shade and simplified the riparian community.
- ⇨ Exotic and invasive weeds and grasses are established on the valley floor inhibiting the growth of native vegetation, including trees.
- ⇨ The stream channel has been severely down-cut with subsurface flow and lacks connectivity with its floodplain.
- ⇨ The watershed analysis has rated the aquatic habitat conditions as poor.

Decision To Be Made

The decision to be made by the District Ranger is whether to implement the Karnowsky Creek Stream Restoration Project or defer action at this time by selecting the no-action alternative.

Scoping

To help identify public concerns about the proposed project, interested citizens, organizations, regulatory agencies, and local governments were informed about this proposal. Public comment on the proposed project—in conjunction with the Lower Siuslaw Landscape Management Project—was solicited through the Siuslaw National Forest's quarterly "Project Update" publications, public scoping letters, and the The Siuslaw News in Florence, Oregon. Scoping letters were mailed on June 8, 2001. A news release was published in the Siuslaw News on June 9, 2001. Comments were requested by June 25, 2001. Comments regarding both projects were received from 12 commenters.

Why are the projects needed?

What alternatives were developed to meet the identified needs? CHAPTER 2

In chapter 2, we considered several alternative proposals that were not fully developed for reasons disclosed. We describe one fully developed alternative proposal for resolving the problems and meeting the needs identified in chapter 1; it is equivalent to the traditional section, "Alternatives Including the Proposed Action". (The "we" in the previous sentence and throughout the document is our interdisciplinary team).

We designed the alternative based in part on priorities and recommendations identified in the Lower Siuslaw watershed analysis, and the Karnowsky Creek Restoration Proposal. We evaluated stream characteristics--such as stream meander, gradient, connectivity to floodplains, in-stream large wood, shading, and numbers of conifers in the riparian zone, and amount of diked and drained estuary and wetland--to help identify areas for restoration. Actions for restoring aquatic function and habitat include increasing stream meander, re-creating wetlands and ponds; road decommissioning; placing large wood in streams; and planting trees in the riparian zone to increase future shade and large-wood sources.

In addition to meeting the identified needs, the range of alternatives considered reflects concerns identified during public scoping for this EA, public involvement with recent Forest projects such as the Five Rivers Landscape Management Project (USDA 2002b) and the Enchanted Valley Stream Restoration Project (USDA 1998a), and concerns raised during monitoring of District projects.

Alternatives Considered But Eliminated from Detailed Study

Two other alternatives were considered for restoring Karnowsky Creek, but eliminated from detailed study:

Use of explosives to reestablish the meandering channel—Explosives have been used to build new channels. This method was used in the South Slough National Estuarine Restoration Reserve where equipment could not access inundated tidal areas. Equipment is used when feasible in the reserve to maintain control over channel depth and width. Because blasting would substantially affect listed species nesting nearby, would not provide control over channel depth and width, and would not provide a source of fill material needed to fill old ditches, the District Ranger decided not to fully develop this alternative.

Dam the valley bottom and allow restoration to occur naturally—An Oregon Department of Fish and Wildlife fish biologist suggested we construct a dam at the bottom of Karnowsky Creek to flood the entire valley and allow it to restore itself over time. There is a roadbed that crosses the tidal portion of the valley and currently blocks flow to all but 10 feet of the valley floor where the creek moves in and out with the tide. A dam could be constructed at this location, and a large pond would form above it similar to a beaver dam. In theory, this would allow sediment to drop out of storm flow, fill ditches in and above the ponded area, and would provide ample rearing habitat for salmonids in the lower valley throughout the year.

The District Ranger decided against fully developing this alternative for several reasons:

1. The final condition of Karnowsky Creek would not mimic natural historic conditions. Although ditches would fill with sediment in and just above the ponded area, upper-valley ditches would remain in a degraded condition.
2. A dam placed in the lower valley would be a hindrance to spring and summer migration of salmonids, given that tidal influence and normal flow would be disrupted. Fall migration of adults might also be affected as salmon would be forced to wait for high flows or high tides in order to migrate upstream.
3. As with beaver dams, a large, open, surface area of water would be very susceptible to solar heating in summer time, causing rearing areas to exceed state standards over the long term.
4. Any structure built to dam the valley over time would require maintenance. Failure of any such structure could have devastating impacts to estuarine habitat below.
5. Although the idea has merits, it is not a proven restoration technique; whereas stream reconstruction has shown promising results in the nearby Enchanted Valley Stream Restoration Project.
6. The site for the potential dam is on private land and the landowner has not expressed an interest to participate in the restoration at this time.

Alternatives Considered in Detail

Design criteria (appendix A) outline the practices to be used and their timing and duration when planned actions and activities are implemented. We believe that mitigation measures for all proposed actions are covered by the design criteria.

Alternative 1: Karnowsky Creek Stream Restoration (Forest Service's Preferred Alternative)

Actions included in this alternative are designed to address the problems identified by the District Ranger. The actions incorporate the standards and guides established by the Siuslaw Forest Plan, as amended by the Northwest Forest Plan; the design criteria (appendix A); and monitoring protocols outlined in appendices A and B. To improve the function of Karnowsky Creek and surrounding aquatic habitats, the following activities (maps 2 and 3) will be implemented in three phases. Timing of each of the elements in these phases is subject to change based on the ability to obtain permits for the construction:

Phase I (expected to occur within one year after decision):

- Excavate the channel above the tidal channel for 5,300 feet, plug the current channel, create off-channel ponds at tributary junctions, fill drainage ditches, and remove culverts at Skunk Cabbage Creek;
- Remove the middle-valley dikes and plug drainage ditches;
- Excavate 2,370 feet of remnant channel at the top of the valley mainstem, place large wood in the new channel, and regrade portions of valley bottom; and
- Use native grass seed for disturbed sites and plant trees and shrubs near streams at selected sites for the entire valley.

Phase II (expected to occur within 3 years of phase I):

- Plug the old channel at the top of valley mainstem, place additional wood in the new channel, and plant trees and shrubs near streams;
- Place about 120 mature conifers and about 250 mature alders into the stream and on the floodplain using a helicopter and heavy equipment;
- Excavate and regrade tributary valleys to re-establish historic streamcourses and plant trees near tributaries;
- Use native grass seed for disturbed sites and plant more trees and shrubs near streams; and
- Decommission the road adjacent to Karnowsky Creek.

Phase III (expected to occur within 5 years of phase II):

- Complete the channel reconstruction work in three tributaries totaling about 5,600 feet.
- Complete the road decommissioning work adjacent to Karnowsky Creek; and
- Remove the dikes and tide gates in the estuary (would only occur if the Forest Service acquires adjacent private land to the north or under cooperative agreement between the Forest Service and the landowner).

A summary of all three phases:

- Restore natural stream channels by reconstructing historic meandering channels on about 3 miles of stream in the Karnowsky Creek valley;
- Place large wood in Karnowsky Creek and associated tributaries totaling about 3.5 miles of stream reach;
- Plant trees, shrubs, and wetland plants on the valley floor of Karnowsky Creek and associated tributaries totaling about 93 acres; and
- Decommission about 2 miles of non-system road currently adjacent to Karnowsky Creek by removing fills and culverts at stream crossings.

What alternatives were developed?

Map 2

Map 2

Map 3

Map 3

Alternative 2: No action

The no-action alternative is required by Council of Environmental Quality regulations (40CFR 1502.14(d)). The no-action alternative forms the basis for a comparison between meeting the project needs and *not* meeting the project needs. This alternative provides baseline information for understanding changes associated with the action alternative and expected environmental responses as a result of past management actions. Selecting this alternative would continue the following resource management actions:

- ✓ Forest management would rely on natural processes to restore watersheds.
- ✓ No additional projects would be proposed or evaluated for 10 years.

Because the existing environment is not static, environmental consequences from selecting this alternative are expected.

Comparing likely effects

Table 1 compares how well the alternatives address the issues.

Table 1. Comparing likely effects of Alternatives 1 and 2, based on the issues, objectives, and outcomes

Issue, objective, and outcome	Alternative 1	Alternative 2
Karnowsky Creek Stream Restoration Project Restore meandering stream channel, wetland, and pond conditions to approximate historic conditions	Recreates meandering stream channels, wetlands, and ponds	Slower change; avoids adding sediment above existing conditions
Aquatic conservation objectives	Moves toward historical conditions and meets all objectives	Watershed differs from historical conditions and does not meet all objectives

What alternatives were developed?

What environmental effects are predicted for each alternative? CHAPTER 3

In chapter 3, we predict the likely effects of each action (or non-action) under each alternative; it is equivalent to the traditional section "Environmental Consequences". The Northwest Forest Plan, FEMAT report, and the Lower Siuslaw Watershed Analysis provide evidence for baseline environmental conditions from which direct, indirect, and cumulative effects are analyzed in chapter 3. These broad-based assessments of environmental conditions provide a cumulative view of environmental conditions at different landscape scales and consider past, present, and reasonably foreseeable actions.

One advantage of concurrently planning the Karnowsky Creek Stream Restoration Project and the Lower Siuslaw Project is an improved analysis of cumulative effects. Knowing the site-specific details of all projects in a large geographic area, allows us to predict cumulative effects with more certainty than if projects were analyzed individually. The analysis of direct and indirect effects in this chapter inherently includes cumulative effects because all foreseeable future federal actions in the watershed are included in the analysis. Cumulative effects are summarized on pages 28 though 30 and include how all actions (including those expected from other landowners) affect each resource.

In this chapter, we predict the likely environmental effects of the proposed alternatives, whose outcomes are based on the assumption that the project design criteria (appendix A) have been followed. These criteria were also used during formal consultation with the National Marine Fisheries Service and were used by the U.S. Fish and Wildlife Service to evaluate effects on listed species in their biological opinions (USDI 2001; USDI 2002). The use of these criteria is reflected in the amount of take and in the terms and conditions provided in the biological opinions issued by these agencies.

Based on the science literature and our collective experience, we are confident in the accuracy of our analysis of the **current** conditions discussed in chapter 1. In chapter 3, when we describe the environmental effects of each alternative, we are **predicting** those effects based also on the literature and our collective experience; however, we recognize that predictions are inherently uncertain, some just a little and some highly.

When the District Ranger chose the members of the interdisciplinary team, he considered possible scenarios for this environmental assessment and determined what disciplines would illuminate decisions about them. Relying on his professional judgment and expertise, he chose the disciplines and formed the team of Forest experts in those disciplines. Team members reviewed areas where actions are proposed, reviewed relevant refereed literature and Forest assessments for this planning area, and consulted disciplinary colleagues in the Forest Service, other agencies, universities, and elsewhere. Often, literature reviewed by team members was deemed incomplete and, though studies of similar environments and similar scenarios were reviewed, the expert's professional judgment was required to determine what information can be appropriately used here--and how strongly it supports predictions about what the environmental effects of proposed actions will be. Although team members benefit from the array of research information and the insights of colleagues, they are valued most highly for their experience in and knowledge about the Karnowsky Creek planning area.

Consultation with other experts helps assure that the literature review did not miss a valuable resource, and it provides opportunity to debate and strengthen the team expert's conclusions about how proposed actions are likely to affect the environment. After several team meetings and one-on-one discussions among team members on how each one's predictions might affect or be affected by all of the others, each team member wrote a section of this chapter. Then all of them reviewed the whole chapter to be sure they find the others' predictions clear and supportable.

In this chapter, team members' names accompany their written contributions to indicate that they believe the cited references are relevant, the inferences drawn from them are appropriate, and the predictions are supported by the cited literature and their own professional judgment. In this section, a single author uses "I"; when "we" is used, it means one or more other team members concur.

Predicted Effects of Actions To Improve the Function of Karnowsky Creek and Surrounding Aquatic Habitats

Channel shape and hydrology, sedimentation, water temperature, and soils (*Johan Hogervorst*)

In discussing effects, the best comparison can be drawn with Bailey Creek of the Enchanted Valley Stream Restoration Project (USDA 1998a). Sections of the Enchanted Valley Monitoring Report (USDA 2001) will serve as supporting documentation for the effects of this project proposal.

Channel shape and hydrology—Galay (1983), documenting riverbed degradation all over the world, explains that channelization can lead to losses of land, reduction of groundwater levels and reduction of overbank flooding. Results can also progress either upstream or downstream, causing overall changes in slope and gravel-moving capability.

Compared to a natural stream, a stream that has been channelized for the purpose of draining an area of land will exhibit the following characteristics:

- Location on the side of the valley as opposed to down the middle;
- Less adjacent vegetation for shading;
- Less wood in the channel;
- Very little meander;
- Often will be cut down into the valley floor much deeper than a natural channel;
- Higher velocities, especially at peak flow; and
- Eroding banks as the stream seeks to reestablish meander.

In the Forest Service portion of Karnowsky Creek, there is 21,650 feet (4.1 miles) of channelized stream, and these channels show the same results documented by Galay (1983). This includes 10,000 feet (1.9 miles) of mainstem channel and 11,650 feet (2.2 miles) of side tributaries (map 2). Three of the four straightened tributary channels go dry in late spring or early summer due to the fact that severe upstream degradation (down cutting) has occurred, causing dewatering of the valley bottoms in these areas. The fourth tributary maintains some flow in summer but most likely greatly reduced flow due to down cutting and subsequent drop of the water table. In much of the valley, there are drainage ditches on both sides to catch hill slope runoff.

Given the straightened, down cut condition these channels, there is little potential for floodplain connection or storage in a water table that can be released slowly throughout the summer/fall after winter recharge. Figure 1 compares the summer water tables of entrenched (A) reconstructed (B) channels. In the mainstem, there are locations where slides have entered the stream and gravel is accumulating above, causing the bed elevation to rise and the channel to be more connected to the floodplain. In these locations, peak flows escape from the channel and connect to floodplains, but not at the frequency or duration of the historic channel.

As part of Alternative 1, newly constructed channels would replace the existing channels by creating meandering, shallower, wider channels that quickly flood their banks during winter. Figure 1 shows a conceptual cross sectional drawing of an existing channelized condition (A) and a reconstruction of the natural condition (B). Maps 2 and 3 show channel and ditch locations.

The lower and middle mainstem of the reconstruction would include two different channel types (Map 3, lower and middle main-stem sections). The lower 5,200 feet would simulate the character of a very low gradient stream channel with high sinuosity and a rectangular cross section (about 14 feet wide and 2.25 feet deep) with potential for undercut banks. Its floodplain would include hummocky surfaces with large wood that is often submerged under water, ponds and old cutoff meanders, wetland vegetation and tidal influence at some times of year (Rosgen channel type ‘E’).

The reconstructed middle main-stem channel (4,100 feet long) would have a slightly lower sinuosity, a shallower, smaller cross section (about 14 feet wide and 1.5 feet deep in riffles), more in-channel wood and a mixture of wetland and tree/shrub vegetation in the floodplain (Rosgen channel type ‘E/C’). Although this area would flood often, it would not be subject to tidal influence.

Reconstruction of the upper mainstem would include 2,150 feet of new channel (map 3, upper mainstem). There is still a remnant channel in the middle of the valley here, and where possible, the old location and sinuosity will be maintained. Because the valley gradient is steeper here and there is less flow, the new channel will be less sinuous and will have a smaller cross section than the channels below (about 10 feet wide and 1 foot deep; Rosgen channel type ‘C’). Tributaries 1, 2, and 3 will have similar channel dimensions to the upper mainstem due to the fact that gradient on these tributaries is comparable.

About 1,700 feet of existing channelized mainstem would be kept in its current position to protect the bulk of the valley’s highest quality spawning and rearing habitat in this section (map 3). Whole trees added by helicopter to this section are expected to help connect the stream with its floodplain.

Table 2 summarizes the lengths and characteristics of the constructed channels and the lengths of current channels to be filled as part of Alternative 1.

Table 2. Estimated fill to be excavated from new channels and fill needed to plug old ditches.

Channel section description	Length of new channel to reconstruct (feet)	Amount of fill generated (cubic yards)	Length of ditch to fill in this area (feet)	Amount of fill needed (cubic yards)	Extra fill needed from adjacent areas (cubic yards)
Lower mainstem, 'E' channel	5,200	6,000*	3,300	4,300	4,300
Middle mainstem, 'E/C' channel	4,100	3,200	2,440	5,775	2,575
Existing spawning channel	0	0	2,125	2,150	2,150
Upper mainstem	2,150	700	1,025	6,670	5,970
Tributary #1, 'C' channel	2,040	750	2,500	4,875	4,125
Tributary #2, 'C' channel	2,600	960	2,365	3,665	2,705
Tributary #3, 'C' channel	950	210	880	3,265	3,055
Totals	17,040	11,820	14,635	30,700	24,880

* fill will be used on site to form hummocks around large wood near 'E' channel.

Leopold (1994) has shown in his research of similar natural channels across the United States that once this new channel has found equilibrium, it may continue to shift its meander pattern laterally and slightly downstream on the valley floor, but will maintain a consistent cross sectional area over time. Results from the Enchanted Valley Stream Restoration Project (USDA 1998a) have shown little change to cross sectional area of the new stream channel after one winter. However, the first winter of 2000-2001 was mild in character. Although there have been some high flows in this new channel, one mild winter is insufficient data to show success of this design.

At this writing, there have been at least two flood flows during the winter of 2001-2002 and these flows have not greatly altered channel course in Bailey Creek. Therefore, based on initial monitoring of Bailey Creek in 2001 (USDA 2001), observations of Bailey Creek in 2002, and Leopold's research, the new channels are expected to adjust slightly but maintain their overall character, shape and function.

Currently portions of the stream go dry in late spring and early summer because the existing channel bed has down cut and the water storage capacity of the valley floor has been greatly reduced. Because the base level of the new stream channel will be at a higher elevation on the valley floor, the water table in the valley will likely rise under Alternative 1 (figure 1, drawing B). With the higher water table, storage and release of water will change in the valley, especially in the higher gradient upper mainstem and three tributary streams that feed the mainstem. While we expect year-round flow may be restored in some areas, it is not certain to what extent flow restoration will occur. Presently, a series of 35 ground-water wells are being monitored throughout the valley to establish the current level of the water table and to track any

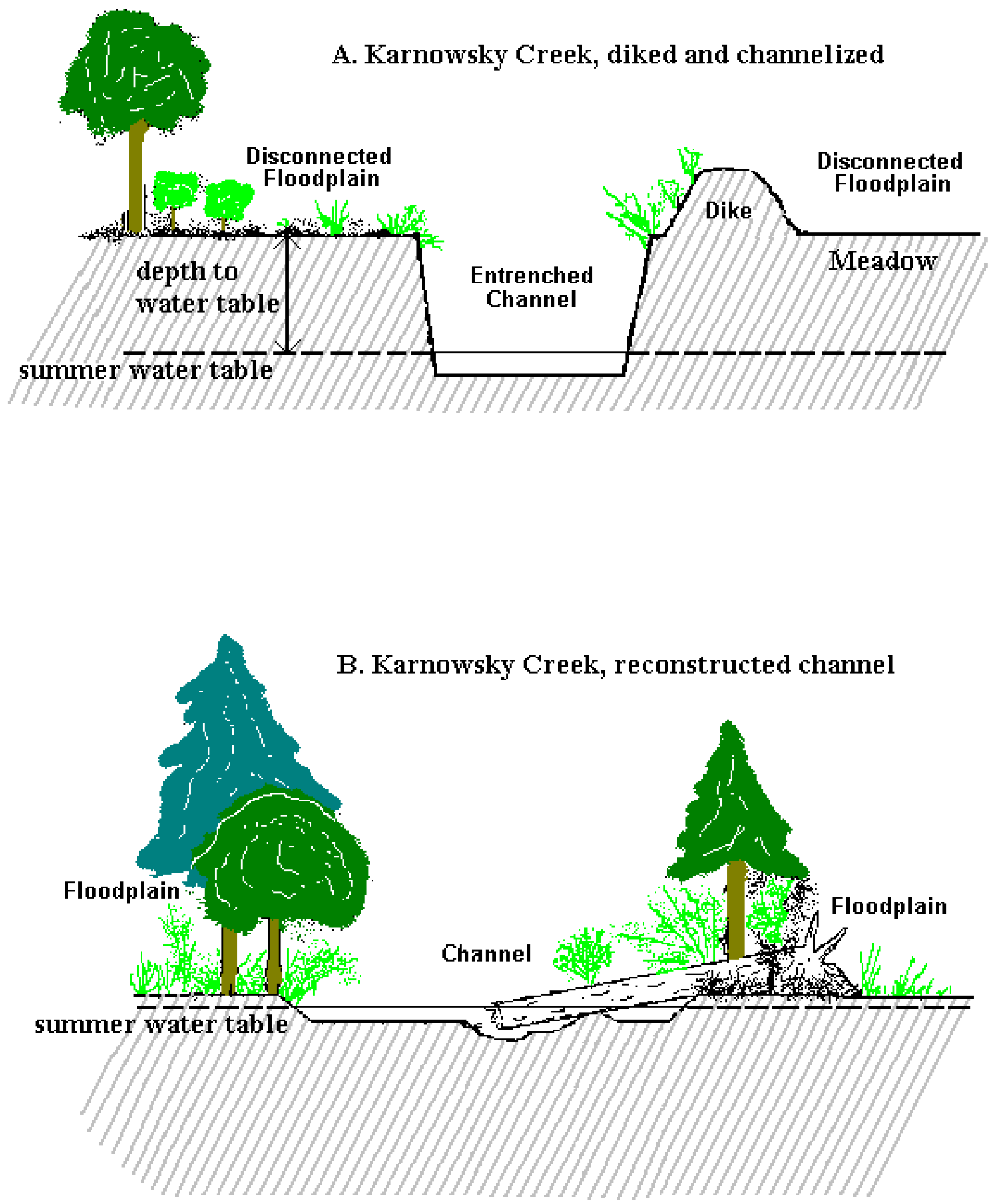

Figure 1. Representative cross sections of Karnowsky Creek

changes as a result of the restoration.

Under Alternative 2, Karnowsky Creek would be left in its current channelized condition (map 2). Thus, it would continue to exhibit the following characteristics:

- Location on the side of the valley as opposed to down the middle;
- Less adjacent vegetation for shading;
- Less wood in the channel;
- Very little meander;
- Cut down into the valley floor much deeper than a natural channel;
- Higher velocities, especially at peak flow; and
- Eroding banks as the stream seeks to reestablish meander.

Under Alternative 2**,** loss of perennial flow would not be recovered until enough sediment (both gravel and fine sediment) came down into the mainstem and tributary channels to raise streambeds and recover floodplain connection and the water table. In addition, it would take time for spaces in the gravel to be filled with enough fine sediment that water would once again flow on the surface instead of under ground. Currently, where gravel is accumulating in the upper mainstem, sub-surface flow occurs for most of the summer. Over the long term, sources of sediment would come from hill slope failures. Gravel would then have to migrate and fill channels, some of which have down cut up to 10 feet in places. Thus, recovery could take decades to over a century, depending on storm intensity and slide occurrence over the long term.

Sedimentation—Table 2 gives conservative estimates of fill to be removed from various sections of new channel and the fill to be placed as plugs in old channels in the Karnowsky valley as part of Alternative 1. Since most of the disturbed soils will be placed in the old channel, sediment production will most likely come from the raw edges of the new channel and the edges of the ditch plugs. Use of old roadbeds, slide deposits and stable toe slopes as borrow sites for fill material will open up possibilities for surface erosion. Ditch plugs will also be sites of open soil with potential to erode, thus contributing fine sediment to surface water.

Based on monitoring results of Bailey Creek in the Enchanted Valley Stream Restoration Project, a constructed meandering stream channel mimics the natural process of slowing storm velocity, allowing connection with the floodplain, and then allowing sediment to drop in floodplains and inside meander bends. Table 3 shows turbidity monitoring results in Bailey Creek from two storms. Site 1 starts above the new channel, sites 2 through 6 are in the project area, and site 7 is at the mouth of Bailey Creek just below the project area. These results reveal that as storm flow moves through the project area, turbidity increases at first and then is reduced as floodplain connection allows sediment to deposit. The lower three sites are also influenced by backup of Mercer Lake and resultant whole-valley flooding where sediment is allowed to fall out before water enters the lake.

Table 3. Peak flow turbidity monitoring as part of the Enchanted Valley Stream Restoration Project.

Monitoring Site #	Description of site	12/15/00 (NTUs*)	11/15/01 (NTUs)	Comments
1	Old channel above project, cross-section #24	11.4	16.0	11/15/01 – heavy organics; variable readings
2	Upper design channel, cross-section #2	27.1	22.0	11/15/01 – heavy organics; variable readings
3	Mid-design channel, cross-section #7	12.8	19.0	11/15/01 – heavy organics; variable readings
4	Lower-design channel, cross-section #13	5.5	17.0	11/15/01 – heavy organics; highly variable readings
5	Upper pilot channel, cross-section #19	6.0	24.0	11/15/01 – heavy organics; highly variable readings
6	Lower pilot channel, just above willows	3.1	10.0	11/15/01 - Light organics
7	Mouth of new channel, shore of Mercer Lake	3.1	8.0	11/15/01 - Light organics

* NTU = Nephelometric Turbidity Unit

Karnowsky Creek does not have a lake below it, but tidal influence will have a similar attenuating effect on storm flows. Currently, the entire ¾-mile tidally influenced section of the lower valley becomes flooded during winter flows as tides and fresh water meet. Because tidal flooding is similar to the flooding in Enchanted Valley, it is expected to slow sediment-laden water in winter storms and allow sediment to deposit.

Thus, under Alternative 1, there would be some short-term turbidity and sediment deposition, but the total amount of sediment produced over the long-term would be substantially less than the no-action Alternative. Compared with the old channel, the shape and meander of the new channel will cause much slower sediment routing during storm events.

Under Alternative 2, bank erosion would be the largest contributor of fine sediment to the current channel. A straightened stream channel seeks to reestablish its natural meander pattern, and will erode banks laterally until meander is reestablished. In the process, collapsing stream banks will input tons of both fine and course sediment as the stream channel seeks its equilibrium. An excessive amount of fine sediment released into spawning gravels can reduce oxygenation of buried salmon eggs, reducing survival rates. Given that floodplains are disconnected in most of these straightened channels, fine sediment is confined to the channel instead of having opportunities to drop out on floodplains.

It is difficult to predict the amount of erosion that will occur under Alternative 2 because the channel will be both migrating laterally to regain meander and will be aggrading (filling) with incoming gravel from upstream. It is roughly estimated that 20,000 cubic yards of material would have to erode from both the tidal and non-tidal sections of the valley before equilibrium would be attained. There are also about 1,500 cubic yards of dike material that could be undermined and eroded downstream throughout the valley. The actual amount of soil eroded could be several times this estimate.

Temporary channel obstructions created by fallen trees or large wood accumulations could speed up bank erosion and channel development in localized areas, but they would be unlikely to change the overall stream development process. Obstructions would likely be eroded around quickly and the stream would return to the existing channel because it is much lower than the valley bottom. They would be unlikely to cause major, long-term diversions or immediate large-scale changes in stream channel location.

Although the rates of erosion and channel development are unknown, it would likely take decades to a century to fully recreate a stable stream channel. Most of this sediment would migrate into the tidal influence zone and would eventually make its way into the estuary below.

Water temperature—Table 4 shows water temperature data from 5 locations in Karnowsky Creek monitored in the summer of 2001. Water temperatures are very good throughout the valley with no seasonal maximums exceeding the State standard of 64^{O}F. Reasons for this include the small basin size (2.8 square miles), relatively intact riparian vegetation above open pastures, adequate shade along valley margins, and the large volumes of gravel causing sub-surface flow in Karnowsky Creek.

Under Alternative 1, the new channel would be located in the middle of the valley and would be wider and shallower than the current channel, exposing more water surface area to solar heating during summer. Although increased solar radiation has potential to increase water temperatures, heightened water tables due to reintroduction of streams back onto the valley floor may increase cool water inputs from subsurface interaction. The degree to which these two variables will either increase or decrease stream temperatures is not fully understood at this time. Thus, there is a potential to increase stream temperature above the State standard of 64 degrees in the short term. Riparian planting with trees, shrubs and wetland plants will eventually provide shade, but it would take several years for this vegetation to grow tall enough to affect the stream. As evidenced in the Enchanted Valley project, willow planted in stream banks of the new channel would provide stream shading more quickly than other types of vegetation.

Table 4. Temperature monitoring for Karnowsky Creek, 2001

Location	Dates Deployed	Seasonal Max Temp	Days Daily Max Temp		Highest 7-day Avg Max & Date	Days 7-day A.M.> 64° F
			> 58° F	>64° F		
Willow patch	6/26-10/17 (81 days)	60.8	18	0	60.8° F 08/07/01	0
Cattle feeder tributary	6/26-10/17 (81 days)	56.6	0	0	56.4° F 08/29/01	0
Below log stringer bridge	6/26-10/17 (81 days)	62.0	59	0	62.0° F 08/07/01	0
Skunk Cabbage Creek tributary	6/26-10/17 (81 days)	59.3	13	0	59.0° F 08/31/01	0
Mainstem below Skunk Cabbage Creek	7/5-10/17 (72 days)	61.0	36	0	60.4° F 08/29/01	0

Two other factors that may have an effect on the stream temperature in localized areas are the reintroduction of large wood into the project area and the return of beaver to the valley. Large wood would be added to the new stream channel to encourage the development of deep pools. These pools will be the best locations to intercept ground water, and fish will use the bottom of these pools for thermal cover. As beavers build dams in this area, some riparian vegetation would be lost and standing ponds behind dams may also locally increase water temperature. However, ponds would also encourage more subsurface flow around beaver dams (hyporheic flow), which can cool water as it moves downstream.

Under Alternative 2, since there would be no changes to the current channel or adjacent riparian vegetation, water temperature would most likely remain at current levels.

Soil—The Karnowsky Creek valley includes three main soil types: Nestucca silt loam, Nekoma silt loam and Meda loam (Lane County Soil Survey, 1981). Nestucca silt loam soil is found in the lower third of the valley where there is tidal influence. It is formed in silty alluvium (fine sediment transported by streams), is somewhat poorly drained and is subject to flooding from winter rains and daily tidal activity. Another third of the Karnowsky valley in the mid-valley area has Nekoma silt loam, a deep, well-drained soil formed in mixed alluvium. The final third of the valley is Meda loam, found in the upper main valley and all the tributaries to the valley. It is also a deep, well-drained soil but it is formed in alluvium and colluvium, gravel and fine material that enters the area from slides that come from the adjacent hillslopes.

All three soils types are subject to changes in productivity due to compaction and displacement. Although residual soil effects are likely on the valley floor due to past homesteading, stream alteration, and agricultural practices, the only readily apparent effects are the change in vegetation and the unnaturally smooth valley surface.

Under Alternative 1, effects on soil would be primarily from use of heavy equipment on the valley floor of Karnowsky Creek. Access by tracked vehicles or dump trucks will be restricted to existing roadbeds or designated routes in the existing pastures. In addition, all work will be done at the driest time of year (after August 6th) when soils are most resistant to compaction. Contracts requiring the hauling of material on-site will specify wide-track or wide-tire vehicles and reduced tire pressure to distribute ground pressure to the greatest extent. To the extent possible, vehicles used for channel construction will drive the staked-channel route as this route will soon be dug up to create the new channel, thereby eliminating long-term residual soil compaction in this area. Thus, based on specific season of operation restrictions and other project design criteria, soil damage under Alternative 1 will be kept below 15% on the site.

Under Alternative 2, soil disturbance in the Karnowsky valley is limited to past homesteading, stream alteration, and agricultural practices. A road constructed in the 1880s contains about 2.2 (out of 93 total acres) acres of compacted surface. The compacted surface area of this road now has little productivity for trees and shrubs, but does maintain grass that serves to prevent surface erosion.

Loss of subsurface soil and gravel from ditched and straightened streams will continue, and this material will accumulate in stream channels and tidally influenced areas downstream. Since grazing was removed in 1997, vegetative recovery has been occurring and this passive restoration will also likely aid in the alleviation of compacted surface soil as wetland and upland species recover. Forest Service personnel have documented both wetland and willow patch recovery since grazing ended in this valley. Compacted areas are expected to slowly recover as roots from vegetation naturally breaks up compacted surfaces.

Aquatic species (*Paul Burns*)

The Lower Siuslaw Watershed Analysis identified characteristics of properly functioning aquatic habitat to include the following:

- Streams would contain 80 pieces of large woody debris per mile;
- Stream gradients of less than 2% would have more than 55% of the area in pools;
- Stream gradients between 3-5% would have more than 40% of the area in pools;
- Stream gradients greater than 5% would have more than 30% of the area in pools; and
- More than 20% of all pools would be considered deep (greater than 3 feet).

Table 5 displays the environmental baseline conditions of Karnowsky Creek and the effects of the actions. This checklist is used in the consultation process with the National Marine Fisheries Service to display long-term and short-term effects of a project. There have been no recent stream surveys of Karnowsky Creek that would display accurate estimates of stream condition; therefore, professional judgment from more recent observations by Oregon Department of Fish and Wildlife and Forest Service biologists have been used to determine the baseline. Effects of the actions were primarily based on effects of past similar projects, such as the Enchanted Valley project.

Table 5. Checklist for documenting environmental baseline and effects of proposed action(s) on relevant indicators for the Oregon Coast Provice.

Administrative unit: Siuslaw National Forest Project area/7th field watershed: KARNOWSKY

Project Name: Karnowsky Restoration Project Section 7 Watershed: Lower Siuslaw

Prepared by: Karla Reeves and Paul Burns Date: March 3, 2002

	------------Environmental Baseline---------—			-----------Effects of the Actions-------—		
Indicators	Properly Functioning	At Risk	Not Properly Functioning	Restore	Maintain	Degrade
Water Quality						
Temperature	FS Data				X	X2
Turbidity		PJ		X		X1
Chemical Contaminants/Nut	No Data				X	X1
Overall (303d reaches)	Not listed	With DEQ			X	
Habitat Access						
Physical Barriers			PJ	X		
Habitat Elements						
Substrate/Sediment		ODFW		X		X1
Large Woody Debris (LWD)			ODFW	X		
Pool Area %		ODFW		X		
Pool Quality		ODFW		X		
Pool Frequency		ODFW		X		
Off-Channel Habitat		ODFW		X		
Channel Condition and Dynamics						
Streambank Condition		PJ		X		
Floodplain Connectivity		PJ		X		
Watershed Condition						
Road Des. & Loc.			LSWA	X		
Disturbance History			PJ	X		
Stream Influence Zone			PJ	X		
Refugia		PJ		X		

Note: Effects of the actions are based on which way this project is likely to move the relevant indicator, but no change in the baseline condition is expected.
SS: Stream survey
PJ: Professional judgment
LSWA: Lower Siuslaw Watershed Analysis
ODFW-personal communication George Westfall. Mapleton, OR 6/25/01
X1: Short-term degradation effects to last less than 1 year
X2: Several years

By reconstructing the stream channel, Alternative 1 would create a more naturally functioning floodplain and restore adjacent wetlands habitat, imitating the low energy, highly productive salmonid-rearing habitat that was historically present in the system. Additional complexity and off-channel areas would develop over time as the new channel interacts with the floodplain, riparian vegetation and placed large wood.

Bailey Creek applied the same principles as those being used in developing this project. The primary channel was lengthened by about 1/3 and the pool volume doubled. Since the main channel in Karnowsky Creek will be increased by about 1/3 we expect a similar response in pool volume as found in Bailey Creek, thus increasing the amount of suitable rearing habitat (Monitoring Report for the Enchanted Valley Stream Restoration Project, 2001). Thus, pool habitat components would be properly functioning.

Sedell and Luchessa (1981) documented that large wood was abundant in Oregon coast streams during the early years of European settlement. They documented that organized stream cleaning projects since the late 1800s have removed most wood from Pacific Northwest streams. Maser et al. (1988) summarize conclusions that wood provides stream complexity, retains sediment and organic material, and creates off-channel and flood-plain habitats. In reaches with gravel or cobble substrates, they found that large wood increases pool area and maximum pool depth.

Placing large wood in the stream, especially in the upper 3 miles of the project area, will substantially increase complex pool rearing habitat in affected reaches and improve floodplain interaction. The complex pool habitat created by large wood will increase summer rearing potential for juvenile salmonids by providing more physical space and greater habitat diversity. Large wood will also increase available food resources by providing a suitable substrate for aquatic insects and by trapping leaves and other detritus.

Increasing the amount of large wood from 10 pieces per mile to 60 pieces per mile moves this component to the 'at risk' category of the NMFS matrix with a trend towards 'properly functioning'. Without further treatments or major landslide events, recruitment of large wood will be dependent on growth, maturation and mortality of riparian conifers to provide a large wood source. By planting conifers along two miles of Karnowsky Creek, establishment of a future source of large wood is accelerated by 20 to 40 years. Thus, we expect this component to reach the properly functioning level in 200 to 300 years.

Beaver ponds are among the most productive rearing habitats for juvenile coho and cutthroat trout (Nickelson et al., 1992). Recreating the slow, low energy stream habitats in the lower portion of the valley, reducing entrenchment and stream power in the upper portion of the valley, and planting willows and other riparian vegetation will create conditions that will be more attractive to beavers, and likely result in the creation of new beaver dams and ponds. Should beaver pond complexes occur, they would pond additional water, inundate more wetland meadow area, and substantially increase complexity and quality of aquatic habitat.

Table 6 gives a range of temperatures for juvenile rearing of various salmonids adapted from Reiser and Bjornn (1979) and Beschta et al. (1987). It includes all species thought to use habitat in Karnowsky Creek and the addition of Chinook salmon, which may or may not use this creek.

Table 6. Water temperature requirements, in degrees Fahrenheit, for juvenile salmonids in western North America.

Species	Juvenile Rearing		
	Preferred	Optimum	Upper Lethal
Coho	53.2-58.3	--	78.4
Steelhead	45.1-58.3	50.0	75.4
Cutthroat	49.1-55.2	--	73.4
Chum	52.2-58.3	56.3	78.4
Chinook	45.1-58.3	54.0	77.4

A properly functioning stream will have temperatures that do not exceed 64 degrees. Since temperatures in Karnowsky Creek do not exceed 64 degrees (table 4) it is considered to be properly functioning at this time. Based on monitoring of the Enchanted Valley project, diverting the stream into a newly excavated channel will likely cause a short-term increase in stream temperature above the Oregon state standard of 64 degrees. Over the long-term, stream temperatures are expected to return to a functioning condition as vegetation becomes established and provides shade; the channel reconnects to the water table, stores more subsurface water, and increases summer base flow.

Thus, actions may degrade the conditions in the short term, but restore the conditions in the long term. Based on current temperatures of Karnowsky Creek and the additional pools we expect from adding large wood and from beaver activity, benefits to coho salmon rearing habitat under Alternative 1 would far outweigh any local short-term temperature increases that may occur as a result of the project.

Robison et al. (1999) documented that upstream migration of juvenile salmonids is prevented or restricted at culverts when outlet drops exceed 6 inches, gradients exceed 0.5%, velocities exceed 2 feet per second, or the depth is less than 12 inches. A non-functioning culvert at the mouth of Skunk Cabbage Creek will be removed to allow free passage of fish and other aquatic organisms.

Coho and Chinook essential fish habitat—Actions to restore watershed health under Alternative 1 may affect Oregon Coast coho and Chinook salmon or their habitat. These actions may adversely affect coho and Chinook salmon or their habitat, but the effects will be short term. Potential effects may result from increases in turbidity, temperature and sediment from road decommissioning, increased bank instability from adding wood to streams, and the risk of hitting these salmon when large wood is placed in streams. There are about 514 miles of coho habitat and 148 miles of Chinook habitat in the Siuslaw River basin. The project will affect about 3 miles of coho habitat and 0.5 miles of Chinook habitat. Since this represents less than 0.6% of coho habitat and 0.3% of Chinook habitat, the short-term effects are limited in context when compared to both the amount of habitat in the basin and to the long-term habitat improvement expected from these actions. Therefore, no long-term, adverse effects to essential fish habitat for coho and Chinook salmon are expected from project actions (USDA 2002a).

Fish populations—Preliminary monitoring of Bailey Creek as part of the Enchanted Valley Restoration Project (USDA 1998a) indicates there were five times the numbers of Coho salmon in the new channel when compared to reaches that were not treated (Table 7). Since similar conditions exist in Karnowsky Creek, we expect the same response in fish survival and use of the re-constructed channel as found in Bailey Creek.

Table 7. Enchanted Valley stream restoration project area and control area snorkel estimates pre- and post- project.

	Project Area			**Control Above Project Area**		
Year	**New/Old Channel**	**Pool Volume (m^3)**	**Estimated # of Coho**	**New/Old Channel**	**Pool Volume (m^3)**	**Estimated # of Coho**
1998	Old	2,649	754	Old	3,787	1,541
1999	Old	3,135	918	Old	4,323	2,490
2000	Project Implementation			Project Implementation		
2001	New	5,632*	8,776**	Old	4,239	4,067**

*Pool volume doubled with new channel **Control numbers up 2x; project numbers up by 10x

Solazzi et al. (1998) documented that wood additions to streams increase freshwater survival and smolt production of juvenile salmonids in Oregon coast streams, including tributaries to Lower Siuslaw. Therefore, adding wood and removing upstream migration barriers (road decommissioning) under Alternative 1 are expected to improve freshwater survival and production of juvenile salmonids over existing conditions.

Alternative 2 will maintain current poor salmonid habitat conditions, limiting salmonid use.

Terrestrial species (*Doug Middlebrook*)

Listed species—As required by the Endangered Species Act of 1973, as amended, biological assessments (project-file documents) and biological opinions (USDI 2000, 2002) have been prepared for this project. This assessment evaluates and describes the potential effects of proposed actions on species listed—under the Endangered Species Act—that may be found on the Siuslaw National Forest. The biological opinions are US Fish and Wildlife Service documents that authorize incidental take and concur with effects determinations made for the proposed action. Because the planning area is outside the range or contains no suitable habitat for the Oregon silverspot butterfly, brown pelican, Nelson's sidalcea, western lily, or western snowy plover, none of the alternatives affect these species.

Bald eagle—One known active nesting pair occurs approximately 7/10 of a mile west of Karnowsky Creek. Project actions proposed under Alternative 1 will occur outside ¼-mile (1/2 mile line-of-sight) from the nest site and are not expected to affect known nesting eagles due to noise disturbance. Project design criteria developed for mature tree removal for in-stream structure avoids the potential for removing suitable nest trees; therefore, this activity will have no effect on bald eagle suitable habitat. Operations will occur within ¼-mile of suitable unsurveyed habitat during the nesting season, but the potential for undetected nest sites in the project area should be minimal since Karnowsky Creek lies within the expected territory of the existing nesting pair. Therefore, operations within ¼-mile (1/2 mile line-of-sight) of unsurveyed suitable bald eagle habitat will have no effect on nesting bald eagles. By placing large wood in streams, fish numbers in these streams are expected to increase. Thus, Alternative 1 is likely to benefit eagles in the long term by increasing eagle forage opportunities.

Alternative 2 will maintain existing conditions and is expected to have no effect on bald eagles.

Northern spotted owl—Under Alternative 1, no known active owl nest sites are within ¼-mile of the proposed project area. Areas including tributary 1 and portions of the project upstream from tributary 1 are within ¼-mile of unsurveyed suitable habitat. Since project activities are scheduled to occur during the nesting season, but outside the critical portion of the nesting season (after July 7), noise generated by the project may affect, but is not likely to adversely affect nesting owls due to disturbance. Alternative 1 would remove about 120 mature trees for creating in-stream structures. This action has the potential to modify or reduce spotted owl suitable habitat. Project design criteria, such as avoiding removal of suitable nest trees, known nest trees, and trees that buffer suitable nest trees, will mitigate potential adverse effects (appendix A, pages 5 and 6). Therefore, this action may affect, but is not likely to adversely affect northern spotted owl suitable habitat. Table 8 summarizes the effects on spotted owls.

Alternative 2 will maintain existing conditions and is expected to have no effect on northern spotted owls.

Marbled murrelets—There are no known occupied murrelet sites within ¼-mile of the project area proposed under Alternative 1. All areas downstream of tributary 1 lie within-¼ mile of unsurveyed suitable habitat. Since project activities are scheduled to occur outside the critical portion of the nesting season (after August 5), noise generated by the project may affect, but is not likely to adversely affect nesting murrelets due to disturbance. In addition, motorized operations in and above tributary 1 are subject to daily operating timing restrictions. Removing mature trees for creation of in-stream structures has the potential to modify or reduce murrelet suitable habitat. Project design criteria, such as avoiding removal of suitable nest trees, known nest trees, and trees that buffer suitable nest trees, will mitigate potential adverse effects. Therefore, this action may affect, but is not likely to adversely affect, marbled murrelet suitable habitat. Table 8 summarizes the effects on murrelets.

By maintaining existing conditions, Alternative 2 will have no effect on marbled murrelets.

Table 8. Effects on northern spotted owls and marble murrelets by realigning the lower channel of Karnowsky Creek.

Activity	Operating Period and Effects Determination For Karnowsky Creek Restoration			
	March 1 to	July 8 to	August 6 to	Oct. 1 to
	July 7	August 5	Sept. 30	Feb. 28
Spotted owl	MA-LAA	MA-NLAA	MA-NLAA	NE
Marbled murrelet	MA-LAA	MA-LAA	MA-NLAA	NE
Stream channel realignment (miles)	0	0	3	0
Individual tree removal and placement (trees)	0	0	120	0

MA-LAA = May affect, likely to adversely affect,
MA-NLAA = May affect, not likely to adversely affect,
NE = No effect

Sensitive species—The only sensitive species with a likelihood of being affected by project actions under Alternative 1 is the western pond turtle. Although no formal surveys have been conducted to determine presence or absence, casual surveys along Karnowsky Creek have found no turtles in the area. Proposed stream restoration activities at Karnowsky Creek have the potential to provide long-term benefits for this species by increasing large structure complexity in the creek coupled with its effect on raising the creek to near bank level. However, planting tall shrubs and trees near the creek has the potential to degrade suitable, potential habitat in the long term because of expected increases in stream shading. Project design criteria, such as retaining some areas free of tall vegetation near the creek to aid in turtle thermoregulation, and creating or maintaining elevated areas in the form of earthen mounds and hummocks dominated by grassy vegetation are expected to enhance existing suitable habitat for this species. Proposed treatments are expected to have no adverse effects on western pond turtles (USDA 2002c).

No sensitive plant species or potential habitat is known or suspected in or adjacent to the Karnowsky project area. Thus, Alternative 1 will have no direct or indirect effects on these species.

Alternative 2 will maintain the existing marginal, potentially suitable pond-turtle habitat.

Land birds—Under Alternative 1, creek channel improvements, along with increasing shrub vegetation complexity in the valley, are likely to improve foraging and/or nesting conditions for a variety of land birds, including swallows, sparrows, waterfowl, heron, hawks, flycatchers, and blackbirds which currently use the project site. Such improvements would be short-term, however, if the valley develops into a completely forested condition. The early-seral/shrub/wetland habitat mix is a rarity on the Forest, yet supports the richest species opportunities. To optimize land-bird habitat in the Karnowsky Creek project area, no more than 60% of the existing open bottomland will be converted to a forested condition (appendix A).

Alternative 2 will not change existing conditions and therefore, will have no effect on land birds.

Survey-and-manage species—Under Alternative 1, mature tree removal for in-stream placement has the potential to impact existing red tree vole nest sites. Previous surveys on the District have revealed no active or inactive vole nests in areas proposed for large tree removal (along open-stream channels, roads, and existing edges). Comprehensive site-specific surveys are conducted prior to large tree removal to avoid adverse effects to existing red tree vole nest sites (USDA, USDI 2000).

Potential habitat exists in the project area for eight survey-and-manage category A and C plant species that require pre-disturbance surveys. Survey-and-manage protocols comply with the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USDA, USDI 2001). During the course of these surveys, four new sites for the lichen *Plastimatia lacunose* were found in proposed source tree areas for the large wood to be placed in Karnowsky Creek. Because there is only one other known site for *P. lacunosa* in the Lower Siuslaw watershed, a 300-foot buffer (measured from the site location) has been placed around each site. Since this is twice the height of the surrounding trees, this should provide ample protection for the species and retain options for future management of the sites.

Survey-and-manage species will not be affected by Alternative 2.

Management-indicator species—Two species, pileated woodpecker and American marten, are identified in the Siuslaw National Forest Plan (USDA 1990) as management indicator species. Both of these are species are intended to indicate health of late and old forests. Proposed management activities under the Karnowsky Creek Stream Restoration Project, with the exception of large tree removal for in-stream structures, occurs outside suitable habitat for these species and is not expected to have adverse effects on local populations or habitats. Large tree removal for in-stream structures is not expected to have adverse effects on either species since selected trees are located along edges, roads, and no group selection will occur.

Alternative 2 will not affect management-indicator species.

Noxious and undesirable weeds (*Dan Segotta*)—Ground disturbing activities which result in exposed mineral soil on sites with moderate to full sunlight exposure, greatly increase the potential for noxious or undesirable weed colonization and establishment. Stream channel reconstruction and adjacent ground scarification proposed under Alternative 1 will increase the potential for weed colonization and establishment. Preventive measures in appendix A are expected to provide adequate resistance to noxious weed colonization over the majority of the project area.

By following preventive measures in the appendix A, the risk of noxious weed infestation on disturbed areas should be reduced to acceptable levels over most of the project area. By monitoring the effectiveness of preventative measures and including additional weed treatments where warranted, weed infestation levels are not expected to exceed current levels and may likely be reduced below current levels in the project area in the foreseeable future.

Because no ground disturbance will occur under Alternative 2, there is no increase in risk for the spread of noxious and undesirable weeds.

Wetlands and associated plant species (*Dan Segotta*)

Channel reconstruction in the upper 3/4 of the valley will restore the connectivity of the valley-bottom floodplain (currently dominated by non-native upland pasture grasses and forbs) to Karnowsky Creek. The low gradient, gentle-bank slopes and natural meanders of the reconstructed channel are expected to restore channel-floodplain function and improve wetland hydrology. While it is not possible to predict the exact increase of wetlands in the upper project area, the percentage of obligate and facultative wetland plant species is expected to increase dramatically in the area through seeding, planting, and natural colonization resulting from a raised water table and increased periods of inundation during high water flows.

Native wetland species that are expected to benefit with a substantial increase in percent cover in the upper valley area include willow (*Salix hookeriana* and *S. scouleriana*), slough sedge (*Carex obnupta*), common rush (*Juncus effuses*), creeping spike rush (*Eleocharis palustris*), small-flowered bulrush (*Scirpus microcarpus*), and Douglas spiraea (*Spiraea douglasii*).

Although non-native wetland weed species, primarily reed canary grass (*Phalaris arundinacea*), are present in the project area, competitive seeding of disturbed areas following channel construction and planting of willow and other wetland shrub species—in conjunction with monitoring and treatment as needed—should prevent its domination of the site.

Under Alternative 2, restoring the channel-floodplain function and improving wetland hydrology will not occur. Existing conditions—converted pasture with a narrow, channelized stream-riparian area—would persist. Plant succession would continue to occur in both the narrow channel and pasture areas. No net increase in wetlands would be expected under this alternative in the foreseeable future.

Public and management access *(Ken McCall)*

Lane County Road 499 (beginning on private land) and an unclassified (non-system) road through Forest Service land farther up the Karnowsky Creek valley accesses the project area. The County road is gated at the beginning on the private parcel and is closed to the public. Since there is no current public access and future management access is not required, decommissioning of the valley-bottom road will not affect public use or management of the area.

Fire *(Edward Garza)*

Under Alternative 1, placing logs in Karnowsky Creek and riparian planting near the creek will not measurably change existing fuel conditions in the project area. Because the current road condition limits public access, decommissioning the road will not substantially change existing public access or increase the response time of initial fire-suppression efforts in the Karnowsky Valley.

Human uses and influences

Heritage resources (Phyllis Steeves)—Field inventories will follow protocols established under our programmatic agreement with the State Historic Preservation Office (SHPO). Concurrence from SHPO will be received prior to project implementation. Under Alternative 1, field inventories will be required where ground-disturbing actions will occur on previously undisturbed ground. These actions include placing large wood in streams by ground-based equipment, stream-channel reconstruction, and riparian planting. Pre-field consultation with the State Historic Preservation Office (SHPO) will determine which activity sites may be monitored during placement, in lieu of standard compliance review. Riparian planting will not be allowed in the immediate area of homestead building sites identified during pre-field review. No adverse effects are anticipated to known sites because of protection and avoidance measures to be taken when woody debris is placed in streams and trees are planted in riparian areas.

Because the area falls in an identified high probability zone for prehistoric sites, the reconstruction of the Karnowsky Creek channel to its historic configuration will require on-site monitoring by a certified heritage resource technician or Forest archaeologist during operation of heavy equipment.

Under Alternative 1, decommissioning the 2-mile road will have little or no potential to affect historic properties, as they occur at previously surveyed and/or disturbed sites. These actions will be reviewed according to our programmatic agreement with SHPO.

Recreation (The Team)—Since the road into Karnowsky Creek is behind a closed gate on private land, there is no public vehicular access. The public can walk into the area from adjacent public lands. Thus, decommissioning the road adjacent to Karnowsky Creek under Alternative 1 will not change current public access to the area.

Proposed actions under Alternative 1 are designed to improve fish habitat in Karnowsky Creek and subsequently, should benefit recreational fishing in the long term. Alternative 2 will maintain poor fish habitat conditions in Karnowsky Creek and is not expected to benefit recreational fishing.

Scenery (The Team)—Actions proposed for improving Karnowsky Creek function are consistent with the scenic quality objectives of maximum modification for the planning area. By speeding the growth and development of trees in plantations, thinning actions are expected to move landscape scenic conditions to a less fragmented, more natural forest setting sooner.

Forest stand conditions *(Dan Karnes)*

Under Alternative 1, planting conifers will increase the rate at which large-diameter conifers are established in riparian areas of Karnowsky Creek and its tributaries.

Partner involvement and project cost *(Johan Hogervorst)*

Partners in the Karnowsky Stream Restoration Project and their financial contribution include the following:

Oregon Watershed Enhancement Board --$195,297
National Forest Foundation -- $49,500
Forest Service Planning/Contract/Monitoring -----------------------------------$119,800
Forest Service Helicopter wood placement --------------------------------------$165,000
Combined In-kind contributions from the Siuslaw Institute, Siuslaw Middle School Stream Team, Salmon/Trout Enhancement Program, Siuslaw Watershed Council, and Siuslaw Soil and Water Conservation District--- $17,100

$546,697

Cumulative Effects (*The Team*)

Alternative 1

The Council on Environmental Quality defines cumulative effects on the environment as those that result from the incremental actions of a proposal added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes them (40 CFR 1508.7).

For purposes of analyzing cumulative effects, the geographic area potentially affected by Alterantive 1 is the 1,850-acre planning area of the Karnowsky Creek sub-watershed. Since the Lower Siuslaw Landscape Management Project is being concurrently analyzed with the Karnowsky Creek Stream Restoration Project, the Team considered the need to extend the geographic area for each of the affected resources. However, we believed that the types of activities proposed for Karnowsky Creek were substantially different activities than those of the Lower Siuslaw Landscape Management Project. Thus, we concluded that analyzing cumulative effects outside of the Karnowsky Creek sub-watershed was not meaningful or measurable.

The analysis provided for each alternative and resource area reflects the sum of most planned actions on federal lands in the near future. In addition to actions proposed in the Karnowsky Creek Stream Restoration Project area, other likely future actions on federal lands in the sub-watershed include ongoing road maintenance and repair of ATM roads, decommissioning 1.8 miles of road, commercial thinning 33 acres of plantations, precommercial thinning 59 acres of plantations, and harvesting of special forest products such as firewood, salal, swordfern, and moss.

On 250 acres of nonfederal land near the mouth of Karnowsky Creek (14% of the planning area), the Team expects the three private landowners to continue current practices and uses of their land and no changes to current county and state land-use regulations. Private industrial timber companies own 80% of this land (about 200 acres), which is being harvested on less than 80-year rotations. Currently, most of the stands on these properties are younger than 25 years. The other 20% of the private property (about 50 acres) is tidally influenced bottomland. Two-thirds of this bottomland is under a conservation easement and is regularly inundated by tidal waters, while the final third is diked off pastureland being seasonally used for livestock grazing.

Cumulative effects are measured relative to the baseline conditions described in chapter 1. Where specific effects are not described for a particular resource, cumulative effects are not expected to be measurably different from those under baseline conditions. Restoration actions under Alternative 1 are expected to have the following cumulative effects:

Sediment production—Building new channels, adding large wood to streams, and decommissioning a valley-bottom road will increase sedimentation in the short term (1-2 years). Stabilizing and closing reopened roads and closing and decommissioning other roads will reduce sedimentation in the long term. Overall, Alternative 1 is expected to cumulatively reduce sedimentation in the project planning area.

Soil productivity—Less than 5 percent of the project area will be in a detrimental soil condition (i.e., compacted and/or displaced), considering past and proposed actions in the project planning area. This is well under the 15 percent threshold established by the Siuslaw Forest Plan for National Forest system lands.

Water temperature—Based on project design, building new channels is likely to increase stream temperature over the short-term (10 years); road decommissioning, adding large wood in streams, and riparian planting are likely to improve watershed function and lower stream temperatures resulting in a cumulative decrease in temperature over the long-term.

Aquatic species—When viewed as a whole, all proposed actions are likely to have minor adverse effects on aquatic species during project implementation and up to 2 years later. In the long term, net improvements to aquatic habitat are expected to accrue with reduced sedimentation and risk of failure from roads, accelerated growth of trees in riparian areas of managed stands, and input of large wood. These actions are expected to substantially benefit aquatic species.

Terrestrial species (listed, sensitive, survey-and-manage, management-indicator)—In the short term, disturbances from noise, road work, adding large wood to streams, and thinning managed stands are likely to have minor adverse effects on all terrestrial species to some degree. The dispersal in timing and distribution of these actions across the sub-watershed, however, are such that impacts are expected to be localized and not lead to adverse cumulative effects. In the long term, accelerated development of late-successional forest conditions is expected to cumulatively benefit species dependent on these conditions. Habitat for species dependent on early-seral conditions will be reduced as decommissioned roads and other forest openings become forested over time, except for openings that are created and/or maintained as early-seral habitat.

Public and management access—Closing and decommissioning roads in the sub-watershed will reduce public and management vehicle access to public lands for recreation, hunting, special forest products gathering, and Forest Service monitoring. Road maintenance costs will be reduced and limited maintenance funds will be shifted to maintaining the ATM road system. Open-road density on National Forest system land would be reduced from 2.1 miles per square mile to 1.3 miles per square mile.

Fire—Since there is limited vehicular access and public use is low, adverse cumulative effects from fires are not expected.

Heritage resources—Building new channels, and adding large wood in streams will increase the potential for affecting undiscovered sites. Since much of the area has previously been disturbed, adverse cumulative effects are not expected.

Recreation—Closing and decommissioning roads will cumulatively shift the recreation experience from motorized to nonmotorized.

Scenery—All actions will be consistent with the scenic quality objectives for the planning area. By speeding the growth and development of trees in plantations, thinning actions are expected to move landscape scenic conditions to a less fragmented, more natural forest setting sooner.

Listed, sensitive, and survey-and-manage plant—No cumulative effects on listed, sensitive, and survey-and-manage species are expected.

Noxious weeds—Current weed infestation levels will be maintained and infestation levels are expected to decline in the foreseeable future.

Alternative 2

- Sedimentation from non-ATM roads will increase as roads deteriorate from lack of maintenance.
- Shading and large wood for streams will take longer to develop before sub-watershed temperatures will be reduced and watershed function will not be improved because of continued use of nearly the entire road network.
- Aquatic species habitat recovery will depend on natural processes and take much longer.
- Habitat preferred by species dependent on late-successional forest will take longer to develop; mid-seral species habitat will remain on the landscape longer; habitat preferred by early-seral species will gradually decline as trees encroach on existing meadows and other forest openings; and short-term cumulative effects will be limited to noise disturbance from maintaining and repairing ATM roads.
- Fire response time will increase as roads fail or roadside vegetation grows and closes roads naturally.
- Recreation experiences will become more non-motorized as roads close naturally; landscape scenic conditions will take longer to achieve a more natural setting; and public and management access and road maintenance costs will remain unchanged, except where roads fail.
- Managed-stand health and growth will continue to decline, increasing the severity and extent of damage from insects, disease, and wind; late-successional forest conditions in managed stands will take longer to develop.

In summary, considering other ongoing and likely actions on federal, state, county and private lands in the Lower Siuslaw watershed, Alternative 1 is expected to reduce the adverse cumulative effects of past actions, thereby accruing net beneficial cumulative effects for most resources. The cumulative effects are generally beneficial over time and an improvement over existing conditions.

Consistency with Aquatic Conservation Strategy Objectives *(Johan Hogervorst, Paul Burns, Doug Middlebrook)*

Alternative 1

We have evaluated the consistency of all actions under Alternative 1 with the nine aquatic conservation strategy objectives of the Northwest Forest Plan. Project activities will not retard or prevent attainment of any of the strategy's objectives. We have concluded the following for each objective:

Objective 1--Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.

> Presently, Karnowsky Creek has been straightened and moved to the valley margins, wood has been removed from both the stream and floodplain, and all woody vegetation has been removed from the valley floor. Reconstructing a sinuous channel, decommissioning roads, planting trees in riparian areas, and adding wood to streams and floodplains will restore diversity and complexity throughout the Karnowsky valley. Aquatic and terrestrial systems will be put on a trajectory to recover natural process and function over time.

Objective 2--Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.

> Spatial and temporal connectivity in and between watersheds will be improved through reconnecting Karnowsky to its floodplain, decommissioning roads, and adding wood to streams. Road decommissioning will reconnect channels, allowing unobstructed passage of sediment, wood, and both terrestrial and aquatic species. Wood additions will increase the degree of connectedness among stream channels and their floodplains. Improved connectivity will allow aquatic and riparian-dependent species better access to and between refugia to allow diverse life-history types to develop.

Objective 3 --Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

> Design criteria for all activities will prevent adverse effects to the physical integrity of the existing aquatic system while restoration seeks to rebuild stream function. Road decommissioning will reduce management-related sediment inputs in the long term and restore the function of natural processes that deliver sediment and wood. Large-wood additions will restore sediment routing and riparian vegetation processes that develop the physical integrity of the aquatic system.

Objective 4--Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Stream reconstruction will eventually restore water tables and allow perennial flow where portions of the valley are currently drained. This has implications for water quality, especially in summer low-flow periods. Summer water temperature, which is currently below state standards, may increase in the short term until riparian vegetation takes hold and ground water dynamics are restored. Long-term water quality will be enhanced as wetlands and riparian areas recover to near natural conditions. By decommissioning roads and adding wood to streams, Alternative 1 is expected to improve water quality faster than would the no-action alternative.

Objective 5--Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Short-term increases in fine-sediment production associated with channel reconstruction, road decommissioning, and wood additions will be minor. Eliminating constructed ditches, decommissioning roads, and adding wood will help restore the natural sediment regime.

Objective 6--Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Reconstructing the channel to a more natural sinuosity, decommissioning roads, and adding wood to streams will restore stream flows to a more natural regime. Where water tables are brought back up in the valley, perennial flow may return where it is now intermittent. Restoring wetlands as well as reestablishing the connection of the stream to its floodplain will both help to attenuate peak flows, which now cause bank erosion and sedimentation during high flows.

Objective 7--Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

In the short term, reconstructing the channel, adding large wood to streams, and decommissioning and closing roads will restore the timing, variability, and duration of floodplain inundation and water-table elevation. In the long term, riparian planting will increase the rate that large conifers are developed in riparian areas, which will increase the future supply of large wood to stream channels. Increasing the future supply of large wood to stream channels is needed to restore attributes of this objective.

Objective 8--Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Species composition and structural diversity have been greatly altered as a result of past activities in the Karnowsky valley. By restoring the water table, existing seed sources as well as riparian planting throughout the valley will restore complexity and diversity of plant communities. Logs and whole trees placed in wet, inundated areas will also serve as nurse logs. Also, hummocks will be built into floodplains to recover the diversity of topography that once existed for various plant communities.

Objective 9--Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

All activities are designed to restore natural processes that develop habitat for native riparian-dependent species.

Alternative 2

The Lower Siuslaw Watershed Analysis identified existing adverse watershed conditions, listed on pages 1 and 2 of this EA. Taking no action, Alternative 2 would rely on natural processes, which are expected to take much longer than Alternative 1 to correct these conditions. Where roads are affected by natural hydrological processes, roads may fail. Watershed health will remain degraded or subject to periods of degradation from road failure until natural processes have removed sediments associated with road fills. Because current watershed conditions will not be maintained or improved and road fill is expected to remain in the watershed for tens to hundreds of years, Alternative 2 is not expected to meet the objectives of the Northwest Forest Plan's aquatic conservation strategy.

Short-Term Uses and Long-Term Productivity (*The Team*)

The use or protection of natural resources for long-term sustained yield is the legislated basis of management and direction for the Forest Service (USDA, USDI 1994a, p. 321). Short-term uses include actions such as stream enhancement, and road decommissioning. The design criteria were developed to incorporate the standards and guides of the Siuslaw Forest Plan as amended by the Northwest Forest Plan. We expect that applying them to the proposed management actions will reduce the potential for long-term loss in productivity of forest soils that may result from short-term uses. They will also allow for the long-term development of late-successional habitat and restoring aquatic ecosystems.

Unavoidable Adverse Effects (*The Team*)

Implementing the action alternative would result in some adverse environmental effects that cannot be avoided. The design criteria, along with Forest standards and guides, are intended to keep the extent and duration of these effects within acceptable rates, but adverse effects cannot be completely eliminated. The following adverse environmental consequences would be associated to some extent with Alternative 1:

- ⇨ Short-term, localized reductions in air quality from dust, smoke, and vehicle emissions resulting from management actions and forest users.
- ⇨ Disturbance to wildlife when their habitat is disturbed by management actions or recreation activities.
- ⇨ Decrease in habitat for wildlife species dependent on early-seral forest conditions.

Irreversible Resource Commitments (*The Team*)

Irreversible commitments of resources are actions that disturb either a nonrenewable resource (for example heritage resources) or other resources to the point that they can only be renewed over 100 years or not at all. The design criteria--along with Forest standards and guides--are intended to reduce these commitments, but adverse effects cannot be completely eliminated. For example, the continued use of existing roads that access the Forest is an irreversible commitment of the soil resource because of the long time needed for a road to revert to natural conditions.

Irretrievable Commitment of Resources (*The Team*)

An irretrievable commitment is the loss of opportunities for producing or using a renewable resource for a period of time. Almost all activities produce varying degrees of irretrievable resource commitments. They parallel the effects for each resource discussed earlier in this chapter. They are not irreversible because changing management direction could reverse them. The following irretrievable commitments of resources would be associated to some extent with the alternative:

⇨ Loss of vehicular access through the Forest as roads are closed or decommissioned.

Environmental Justice (*Bruce Buckley*)

McGinnis et al. (1996) found that the average per capita income in Lane County is slightly below the average for the state of Oregon. Weber and Bowman (1999) found that Lane County has a poverty rate of 11 to 14.8%. These rates are in the average range for Oregon. Based on local knowledge, small pockets of low-income populations live in the planning area and some gather firewood and pick brush to augment incomes. Some farms exist in the planning area and domestic-use water systems include individual wells and spring-fed systems.

None of the proposed actions are expected to physically affect farms or water quality of domestic-use water systems.

In summary, effects of alternatives on the human environment (including minority and low-income populations) are expected to be similar for all human populations regardless of nationality, gender, race, or income. No disproportionately high and adverse human health or environmental effects on minority populations and low-income populations are expected as a result of implementing actions described for Alternative 1.

Other Disclosures (*The Team*)

Based on the Team's evaluation of the effects, we concluded:

- ⇨ Minority groups, women, and consumers may benefit from employment opportunities; the no-action alternative would have neither adverse nor beneficial effects. None of the alternatives adversely affects civil rights. All contracts that may be awarded as a result of implementation would meet equal employment opportunity requirements.
- ⇨ None of the proposed actions will affect known prehistoric or historic sites. As outlined in the American Indian Religious Freedom Act, no effects are anticipated on American Indian social, economic, or subsistence rights.

- ⇨ The actions are consistent with the pending Reservation Plan and Forest Land Restoration Proposal (1999) submitted by the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw for management of federal lands south of the Siuslaw River, including parcels addressed in this environmental assessment.
- ⇨ The actions are expected to benefit the existing wetland and floodplain. No farm land, park land, or range land will be affected.
- ⇨ This environmental assessment is tiered to the Siuslaw Forest Plan, as amended by the Northwest Forest Plan, and is consistent with those plans and their requirements.
- ⇨ The proposed project is not in or adjacent to an inventoried roadless area.
- ⇨ The proposed project is consistent with the Coastal Zone Management program.
- ⇨ None of the proposed actions are expected to substantially affect human health and safety.
- ⇨ The proposed project is not expected to measurably affect global warming. The USDA Forest Service will continue an active leadership role in agriculture and forestry regarding the reduction of greenhouse gas emissions.

Consultation with Others

The National Marine Fisheries Service (NMFS) is being consulted about effects on coho through a fisheries biological assessment that was completed for this project on March 21, 2002. The NMFS biological opinion on the assessment is pending.

In their biological opinions from the following consultation documents, the US Fish and Wildlife Service (FWS) has concurred with our findings that the project will not jeopardize the existence of northern spotted owls, marbled murrelets, and bald eagles. The FWS terms and conditions will be applied to the project design criteria:

- Formal and Informal Program Consultation on FY 2001 Routine Habitat Modification Projects within the North Coast Province, October 4, 2000 (as extended through 2002); FWS reference #: 1-7-00-F-649.

- Concurrence letter for the Lower Siuslaw (Karnowsky Creek) Restoration Project, November 29, 2001.

- Formal and Informal Program Consultation on FY 2002-2003 Routine Habitat Modification Projects within the North Coast Province, April 4, 2002; FWS reference #: 1-7-02-F-422.

The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw were informed of the proposed actions during scoping. Their concerns centered on cumulative effects on stream flows, fine sediments, sediment loading; and effects on cultural resources and wildlife habitats.

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Appendix A

Karnowsky Creek Stream Restoration Project
Design Criteria

These design criteria for the Karnowsky Creek Stream Restoration Project were developed to ensure that standards and guides of the 1990 Siuslaw Forest Plan (SFP) as amended by the 1994 Northwest Forest Plan (NFP) are met. Where applicable, pertinent standards and guides from these Plans are cited. The design criteria apply to all action alternatives, unless otherwise specified. Appropriate specialists will be consulted before any design criteria for proposed activities are changed.

I. Design Criteria

1. Formal and informal consultation

The National Marine Fisheries Service (NMFS) is being consulted about effects on coho through a fisheries biological assessment that was completed for this project on March 21, 2002. The NMFS biological opinion on the assessment is pending.

In their biological opinions from the following consultation documents, the US Fish and Wildlife Service (FWS) has concurred with our findings that the project will not jeopardize the existence of northern spotted owls, marbled murrelets, and bald eagles. The FWS terms and conditions will be applied to the project design criteria:

- Formal and Informal Program Consultation on FY 2002-2003 Routine Habitat Modification Projects within the North Coast Province, April 4, 2002; FWS reference #: 1-7-02-F-422.

- Concurrence letter for the Lower Siuslaw (Karnowsky Creek) Restoration Project, November 29, 2001.

- Formal and Informal Program Consultation on FY 2001 Routine Habitat Modification Projects within the North Coast Province, October 4, 2000 (as extended through 2002); FWS reference #: 1-7-00-F-649.

Coho salmon

a. No new permanent roads will be built. The density or adverse effects of existing classified (permanent) or unclassified (permanent) roads in the Karnowsky Creek valley will be reduced.

Northern spotted owl and marbled murrelet habitat

a. Comply with the standards of the 13 May 1997 biological opinion addressing the effects of implementing the Northwest Plan standards and guides on designated murrelet critical habitat (USDI 1996) for all thinning and individual hazard-tree removals that may affect critical habitat or suitable habitat of the marbled murrelet.

b. Except for hazard trees, do not remove individual known nest trees or trees with nesting structure from areas where, in the opinion of the unit biologist, the loss of such a tree would limit nesting. A known nest tree may be removed only when it is a hazard tree **and** when the tree is unoccupied by nesting birds or young.

c. For all projects affecting listed species, include a wildlife biologist in their planning and design.

Bald eagle, northern spotted owl, and marbled murrelet disturbance

a. Do not implement any project within 0.25 miles or a 0.5-mile sight-distance of a known bald eagle nest site between January 1 and August 31.

b. Do not treat any area within 0.25 miles of a spotted owl nest site or activity center of any known pair, or within 0.25 miles of an occupied murrelet site, during the critical nesting period. The distance and timing may be modified by the unit wildlife biologist, based on site-specific information, but all changes must be appropriately documented and the Fish and Wildlife Service notified before they are implemented.

c. Do not use blasting for part of any proposed action from March 1 through September 30.

d. Restrict helicopter operations to October 1 through February 28 to reduce potential disturbance to listed species such as the northern spotted owl and the marbled murrelet.

e. Limit motorized activities within Tributary 1 and portions of Karnowsky Creek/Meadow upstream from Tributary 1 will occur only during the period after August 5 in a given calendar year.

f. Do not begin motorized activities in areas within Tributary 1 and portions of Karnowsky Creek/Meadow upstream from Tributary 1 until two hours after sunrise and end activities two hours before sunset during the period of August 6 through September 15.

2. Channel reconstruction and ditch filling

a. Obtain a U.S. Army Corps of Engineers 404 permit and Division of State Lands Fill Permit prior to stream restoration activities. Placing in-stream structures in the existing channel of Karnowsky Creek would likely be covered under the State's General Authorization for Fish Habitat Enhancement.

b. Operation of heavy equipment or placement of fill within wetted stream channels will be restricted to the dry season—late July to September 15. Operation outside of these dates may be possible if stream flows remain low, adult salmon have not yet entered the stream, and a waiver is obtained from ODFW and NMFS.

c. Limit extent of temporary access roads used for restoration activities to protect soil from compaction and displacement. After use, subsoil all temporary access roads depending on the amount of use and subsequent compaction. Plant roads with pasture grass and forage mix, native vegetation, and conifer seedlings as appropriate.

d. Refuel equipment at least 150 feet from live water or at developed sites that will allow for spill containment and easier cleanup should a spill occur. Make available fuel and oil absorbent mats at all project sites involving heavy equipment operating in the stream in the event of fuel or oil spill or leakage.

e. Place waste material from channel excavation and dike removal—as individual work sites and design specifications permit—using the following criteria. This will minimize or eliminate potential impacts to wetlands from fill placement and reduce potential colonization sites for noxious weeds:

   1. Use waste to the maximum extent possible in engineered designs for stream plugs and ditch fill of non-wetland sites.

   2. Use waste to create low, irregular hummocks in non-wetland areas and plant with hardwood/conifer mix.

3. Noxious weed prevention and mitigation:

a. Seed disturbed sites lacking canopy cover (waste areas, constructed channels, dike removal, and borrow sites) with a seed mix of 50% blue wild rye (source identified Siuslaw 3C) and 50% annual ryegrass at a rate of 22 lbs. per acre. Include 2 lbs. per acre slough sedge, 1 lb. per acre stream bank lupine, and 0.25 lb. per acre common spike rush when seeding in wetland areas and low areas of the riparian zone. Fertilize seeded sites with slow release 16-16-16 fertilizer (or 16-0-0 for areas with water-quality concerns) at a rate of 150 lbs. per acre to get vegetation established. Test all seed purchased for use in Karnowsky Valley to ensure no seeds from the All States Noxious Weed List are contained therein.

b. Plant hardwood, conifer or brush species to provide canopy cover for long-term weed prevention where appropriate and according to the vegetation plan designed for this project.

c. To prevent the spread of noxious and undesirable weeds, maintain canopy cover to the extent possible when decommissioning the road.

d. To prevent release of new weed species in the project area, include an Equipment Cleaning provision in service and construction contracts (use language similar to C6.35 of timber-sale contracts) for all ground-based equipment.

e. Control non-native or unwanted vegetation in meadows during periods identified to be most effective for the target species. Treatments should be limited to manual, mechanical, and biological methods (including additional competitive seeding). Use biological methods over manual methods, if they are available and more effective in controlling unwanted vegetation.

4. **Road decommissioning** (NFP: RF-3c, 5, & 6; p. C-32, 33):

Road decommissioning definition—Activities that result in the stabilization and restoration of unneeded roads to a more natural state (Federal Register, January 12, 2001).

a. Review, using a team of planners and engineers, the road project sites before preparing design plans for road-decommissioning contracts. Planners and engineers will review any changes in design plans before they are incorporated into contracts.

b. Design fill-removal activities to minimize sediment entering stream channels. The objective is to restore stream processes and floodplain access by removing all fill material on the valley floor. Excavate slopes to approximate 1.5:1, where practical; do not encroach on natural slopes. Allow disturbed slopes to revegetate naturally or use erosion control measures (such as tree limbs and tops, native seed mixtures or plants), where a moderate to high potential for surface erosion exists. Because it can impede the establishment of natural vegetation and deplete soil of nitrogen, use straw as a last resort. Where feasible, restore the natural flood plain. Consult with watershed and/or fisheries staff where technical feasibility or economics limit meeting fill removal objectives (SFP: FW-123).

c. Place material excavated from stream crossings and unstable side-cast road fills on stable areas at least 100 feet away from stream channels or active flood plains. Suitable areas include roadbeds adjacent to cutbanks, or on previously designated waste areas (if locally available). Remove any alder or conifer from the cut bank before placing excavated material, to enhance soil-to-soil contact and long-term soil stability. Contour waste piles to approximate 1.5:1 to 2:1 slopes and allow to revegetate naturally. Seed piles with a mixture of native, certified weed-free species where a moderate to high potential exists for surface erosion, or where noxious weed infestation is likely. (SFP: FW-117, 171).

d. Use an interdisciplinary process to determine new sites for waste material before contracts are advertised, and to review existing waste sites to determine need for redesign or relocation. Where feasible, avoid placing waste material in areas that would impact access to future projects.

e. Level and seed long-term (multiyear use) waste areas after each season of use. Short-term (one-time use) waste areas should be shaped or graded to contour, seeded, and--where other resource objectives are not compromised--planted with appropriate tree species.

f. Place woody debris, if locally available, in stream channels where sediment is expected to erode from channels at amounts that equal or exceed three (3) cubic yards. This strategy will help reduce sediment rates as streams adjust to gradients during the next year's high flows.

g. Install water bars on both sides of excavated stream banks to route surface water away from newly excavated slopes (SFP: FW-123).

h. Stabilize unstable areas (such as road side-cast material) before a road is decommissioned, to prevent fine sediment from entering stream channels. Excavate side-cast fill material adjacent to stream crossings, where fill material could fail, enter streams, or both. Focus on areas where downhill slopes adjacent to roads are greater than 60%, and road fills are within 200 feet slope-distance of streams (SFP: FW-108, 117).

i. Design water bars to facilitate proper drainage of surface water and to prevent ponding. Place water bars in areas where drainage will not destabilize road fills. To keep streams within their channels when culverts are obstructed, build water bars immediately above existing culverts to become the overflow point. Use the Siuslaw National Forest Water Bar Construction Guide to determine water-bar spacing and design (SFP: FW-123).

j. Decompact surfaces of decommissioned roads where necessary, to allow water to percolate through the soil and accelerate the recovery of woody vegetation. Although subsoiling is the preferred method, use ripping if subsoiling is not feasible or economical. Consult a geotechnical specialist to determine feasibility of subsoiling (SFP: FW-162).

k. Transport off-site culverts removed from stream crossings and ditches to be recycled, reused, or disposed of at a landfill.

l. Do not apply specified reconstruction to roads that will be decommissioned.

5. In-stream wood placement (NFP: RA-1 & FW-1; WR-1, 3; p. C-37)

Tree selection

Wildlife biologists, with technical assistance from U.S. Fish and Wildlife Service biologists, will select approximately 120 trees to be placed in streams to enhance hydrologic function and water quality. First priority for tree selection will be to use suitable hazard trees or trees blown down across ATM roads. To protect interior forest habitat, existing or potential nesting structure, and neighboring trees with nesting structure from incidental damage, use the following criteria to select additional trees for placement in streams:

a. Select trees that will be dispersed within the first two lines of trees along the periphery of permanent openings such as road rights-of-ways and power line corridors, or along the periphery of nonpermanent openings such as plantation edges;

b. Select trees that will be less than or equal to 36 inches in diameter at breast height and lack existing or potential nesting structure (that is, for murrelets, limbs or other platforms greater than or equal to four inches in diameter);

c. In general, select individual trees; however, on rare occasions, select small groups of no more than three trees where appropriate;

d. Select trees (or small groups of trees defined above) that will generally be spaced about 100 feet apart; and

e. To the greatest extent possible, select trees to avoid any damage to existing or potential nesting structure in the stand during felling and removal operations.

The following trees will **not** be selected for removal:

a. Trees with potential nesting platforms and cavities suitable for murrelets, northern spotted owls, and bald eagles;
b. Known nest trees;
c. The largest trees in areas where the number of large trees is limited; and
d. Trees with the best opportunity to develop future nesting structure.

Other tree selection criteria:

a. To evaluate the effectiveness and feasibility of tree selection criteria associated with large wood for stream enhancement, the Forest Service will request technical assistance from the U.S. Fish and Wildlife Service before felling or removing any standing trees not posing an immediate hazard. This technical assistance may include meetings and field reviews as needed and would be both before and during the tree selection process. Additional assistance may also be needed during felling and helicopter operations.

b. Protect 4 lichen sites (*Plastimatia lacunose*, category C) in the Karnowsky Creek fish habitat improvement source-tree area. Use the GIS ortho photo for identifying site locations and for marking a 300-foot no-cut zone around each site on the ground. Source trees cut outside the no-cut zones should be directionally felled away from the zones.

In-stream placement of large wood

a. Large wood length should be at least 1.5 times bank-full width, and large wood diameters (measured at breast height on a tree) should approximate 2 times bank-full depth. Where trees more than 1.5 times bank-full width are not available, artificial anchoring of logs with cable and epoxy may be implemented.

b. Place logs in streams by helicopter beginning no earlier than October 1 to reduce potential disturbance to listed species, such as the northern spotted owl and the marbled murrelet. A waiver may be obtained from the National Marine Fisheries Service to extend log placement actions to October 15.

c. If ground-based equipment is used, place large woody debris (partial- and whole-tree length) in streams during the summer-to-fall low-flow period to minimize disturbance to fish and to lessen safety risks. Activities will occur between July 15 and September 15 unless a waiver is obtained by ODFW (SFP: FW-117).

d. Survey for heritage resources prior to and in areas where ground-based equipment will be used for placing large wood in Karnowsky Creek.

6. Riparian management

Riparian planting will be designed, based on historical photographs and other more intact watersheds in the general area, to create the vegetative variability and patchiness characteristic of late-successional riparian areas. Plantings will emphasize areas necessary to provide shade, bank stability, and moderate amounts of future large woody debris. They will include frequently inundated floodplain areas and will be wide enough to accommodate reasonably foreseeable channel migrations.

a. Hummocks created from excavated channel material and logs placed in wet flood plains will also serve as planting areas and nurse logs over the long term.

b. Because riparian planting is likely to be phased in over several years, follow these prioritization of planting areas:

   1. Streambank stability—Along reconstructed channels, dike removal and bank pullback areas (primarily willow cuttings).
   2. Disturbed sites—Waste areas and all other project associated disturbed sites where bank stability is not an immediate concern. Planting would follow the general prescription for each area.
   3. Himalayan blackberry and reed canary grass areas—Areas dominated by undesirable species would receive priority for planting over "general planting zone" areas without undesirable species present.
   4. General planting zone area—Areas without immediate/urgent weed or resource concerns.

c. Plant western red cedar, Sitka spruce, and willow or other native hardwoods in designated riparian areas. Close to the water or in wetter soils, plant only western red cedar, Sitka spruce, or willow. Base plantings on microsite conditions so that species are best matched to their site. Trees will generally be planted within 200 feet of stream channels. Include, at least, a fish biologist and a silviculturist in selecting planting sites. Implement animal control measures such as tubing or capping to benefit tree survival and growth. Release planted trees the 1st, 3rd, 5th, and 10th years after planting to maintain tree survival and growth.

d. Release previously planted trees in riparian areas in the watershed. Two types of release will be implemented: **Release from below**—cut all brush around individual trees at a distance of about twice the diameter of the drip-line around the crown of the tree to lessen competition from brush. **Release from above**—fell, girdle, prune, or top overhanging hardwoods to expose two tree crown sides to sunlight. One of the opened sides should preferably be on the south side of the tree to take advantage of the sun angle. As a general rule, trees will benefit most by the following order of sun exposure: south, east, west, and north.

e. Release natural conifer regeneration that lack adequate sunlight. Use the same techniques and procedures outlined for planted conifers.

f. For the most effective approach in reducing competition from brush and hardwoods, conduct all release work from late spring to late summer.

g. The Forest archaeologist will review plans for riparian planting projects to determine the need for heritage resource surveys. If needed, survey for heritage resources prior to any ground disturbing activity to protect known homesteads and other sites from potential impacts.

h. To benefit western pond turtles, create or maintain a total of 8 to 10 elevated, grass-covered hummocks within 50 feet of the stream channel. Design specifications and hummock locations will be outlined during implementation.

i. To provide for pond turtle thermoregulation, avoid planting overhead vegetation along at least 20% of the created stream channel.

j. To optimize land-bird habitat in the project area, do not convert more than 60% of the existing open bottomland to a forested condition.

7. Other requirements

a. Follow Siuslaw Plan standards and guides (FW-114 through FW-118) to meet water-quality standards outlined in the Clean Water Act for protecting Oregon waters, and apply practices as described in General Water Quality Best Management Practices, Pacific Northwest Region, November 1988. Design criteria, including these practices, are incorporated throughout the project, such as in project location, design, contract language, implementation, and monitoring. The State has agreed that compliance with these practices will ensure compliance with State Water Quality Standards (Forest Service Manual 1561.5, R-6 Supplement 1500-90-12).

b. If the total oil or oil products storage at a work site exceeds 1, 320 gallons, or if a single container (e.g., fuel truck or trailer) exceeds a capacity of 660 gallons, the purchaser shall prepare and implement a Spill Prevention Control and Countermeasures (SPCC) Plan.

The SPCC plan will meet applicable EPA requirements (40 CFR 112), including certification by a registered professional engineer. (SFP: FW-119, 120, 122).

c. The literature was searched for possible heritage resources (historical or archaeological sites) in the project planning area. No known sites were identified that could be affected by this project. In accordance with the Siuslaw National Forest's 1995 Programmatic Agreement with the State Historic Preservation Office (SHPO), conduct field inventories by certified heritage technicians and receive concurrence from the State Office after project design, but before stream enhancement actions are implemented on previously undisturbed ground. Riparian planting will not be allowed in areas identified as homestead building sites. Other actions will all be on previously disturbed ground and will not require field inventories. Should any heritage resources be discovered as a result of any project activities, the site will be preserved or treated in accordance with the National Historic Preservation Act.

d. Because the area is located in an high-probability zone for prehistoric sites, the reconstruction of the Karnowsky Creek channel will require on-site monitoring by a certified heritage resource technician or Forest archaeologist during operation of heavy equipment.

e. Follow the Vegetation Management Analysis to guide the managing of competing and unwanted vegetation. The plan was developed in compliance with the Record of Decision for the "Managing Competing and Unwanted Vegetation" FEIS (November 1988) and the subsequent Mediated Agreement.

f. Required survey-and-manage protocols will follow the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USDA, USDI 2001).

II. Monitoring Objectives

Monitoring items include those required for implementation and effectiveness monitoring. Implementation monitoring determines if the project design criteria and Siuslaw Forest Plan standards and guides, as amended by the Northwest Forest Plan, were followed. Effectiveness monitoring evaluates whether applying the management activities achieved the desired goals, and if the objectives of the standards and guides were met. Findings resulting from project observations and monitoring are expected to help influence designing future projects and developing future monitoring plans. Monitoring will be tiered to the Siuslaw Forest Plan. Refer to appendix B for specific monitoring plans for Karnowsky Creek.

1. Implementation monitoring

a. *Forest Plan standards and guides*—Before the contract is advertised, review project contracts for consistency with the standards and guides of both the Northwest and Siuslaw Plans and project design criteria.

b. *Contract and operations*—Involve appropriate specialists when developing project contracts or conducting District operations work to ensure activities are implemented as designed. The appropriate specialists will also participate periodically during contract work, especially when unusual circumstances arise that may require a contract modification.

c. Use plan-in-hand reviews and contract reviews of specifications as key checkpoints before the next phase of work begins to ensure key problem situations are addressed in the specifications.

2. Effectiveness monitoring

Channel morphology

a. Follow monitoring requirements for Army Corps of Engineers and the Division of State Lands excavation and fill permits as well as requirements of the Oregon Watershed Enhancement Board grant conditions for monitoring. These requirements include channel cross-sections, photo points, and seasonal water quality monitoring.

Vegetation management

a. Monitor trees planted in upland understories and riparian areas for survival and growth.

b. Monitor areas at risk for noxious weed infestation for a period of three years following project completion, areas should be visited annually to determine effectiveness preventive measures.

Road treatments

a. Field-review excavated slopes from road stabilization activities and note areas where eroded materials enter stream channels. Make observations after the first major rainfall and seasonally thereafter until vegetation reoccupies disturbed sites (about 2 to 5 years). If the surface is eroding and could adversely affect fish habitat, take steps to eliminate or reduce erosion.

b. Observe road surface treatments such as water bars to determine effectiveness and effects on the stability of the outer portion of the road prism.

c. Review the effectiveness of road closures to determine whether another form or location of closure will be required at or near road entrances.

Fish habitat treatments

a. Use Oregon Department of Fish and Wildlife and U.S. Forest Service stream surveys to assess changes from measured baseline data in fish habitat characteristics of streams where large wood was added.

III. Project Tracking

Forest Service direction, regulations, and standards and guides for resource protection may change over time. Should changes occur prior to completion of any actions under this project, an addendum will be done for the EA and contract specifications will be modified, if necessary.

Appendix B

Karnowsky Creek Stream Restoration Project Monitoring Plan

Monitoring items include those required for implementation and effectiveness monitoring. Implementation monitoring determines if the project design criteria and Siuslaw Forest Plan standards and guides, as amended by the Northwest Forest Plan, were followed. Effectiveness monitoring evaluates whether applying the management activities achieved the desired goals, and if the objectives of the standards and guides were met. Findings resulting from project observations and monitoring are expected to help influence designing future projects and developing future monitoring plans. Monitoring will be tiered to the Siuslaw Forest Plan.

Monitoring will include, but not be limited to:

Water quality

Thermographs—Install, maintain, and collect data from Hobo temperature recording devices through the summer months of June through September during the years that monitoring will be done.

Water quality tests—Through the Natural Resource Education Program, Mapleton schools will field test pH, dissolved oxygen, water and air temperature, turbidity, and salinity on a monthly basis.

Macro-invertebrates—Mapleton schools will conduct a macro-invertebrate sample in the fall and spring of the monitoring years.

Fish

Habitat surveys—Forest Service contractors will conduct surveys before the restoration project is implemented and two out of five years after project implementation.

Snorkel surveys—Conduct yearly surveys May through June to count juvenile salmonid populations, and to document juvenile fish use in the restored channels over time. Surveys will be conducted by the Forest Service and/or the Rapid Bio-Assessment Project team through the Siuslaw Watershed Council. The Forest Service will coordinate surveys conducted by the Bio-Assessment team.

Spawning surveys—The Forest Service will conduct and/or coordinate yearly spawning surveys through the months of November through January for coho and steelhead. These surveys will document fish use during spawning in streams before and after restoration.

Channel morphology

Photo points—Establish a series of photo points to provide a visual record of channel changes. Record photo points before and immediately after the restoration project. Document photo records yearly following the restoration project as well as following major floods or other obvious channel changes. The Forest Service will conduct these actions.

Channel cross sections and longitudinal profile—Establish a series of channel cross sections to provide information on channel movements and cross-sectional changes. Survey channel cross sections using a top-to-bottom profile on the new channel immediately following project completion. The Forest Service will conduct these surveys annually and surveys will be done after major floods or obvious channel changes.

Low-level aerial photography—Perform aerial photography yearly to document changes in meadows, riparian areas, wetlands, and sinuosity; and to measure long-term changes in vegetation types in the valley over time. The Forest Service will schedule these flights.

Vegetation management

Vegetation trans-sections—Establish linear plots to record changes in valley vegetation and annually conduct surveys. Students from Mapleton and Siuslaw high schools may assist the Forest Service in conducting the surveys.

Noxious weed detection—Conduct yearly surveys to monitor known problem species. Potential problem species include knotweed, gorse, tansy, and purple loosestrife. The Siuslaw Soil and Water Conservation District watershed conservationist will be responsible for conducting the surveys. The Siuslaw schools may also participate in the surveys.

Riparian establishment surveys—The Siuslaw Soil and Water Conservation watershed conservationist will conduct yearly surveys to evaluate the survival of planted vegetation and assess need for further treatment. Conduct surveys for six years after plantings. The landscape design coordinator will complete a map showing vegetation type locations after project implementation.

Groundwater monitoring

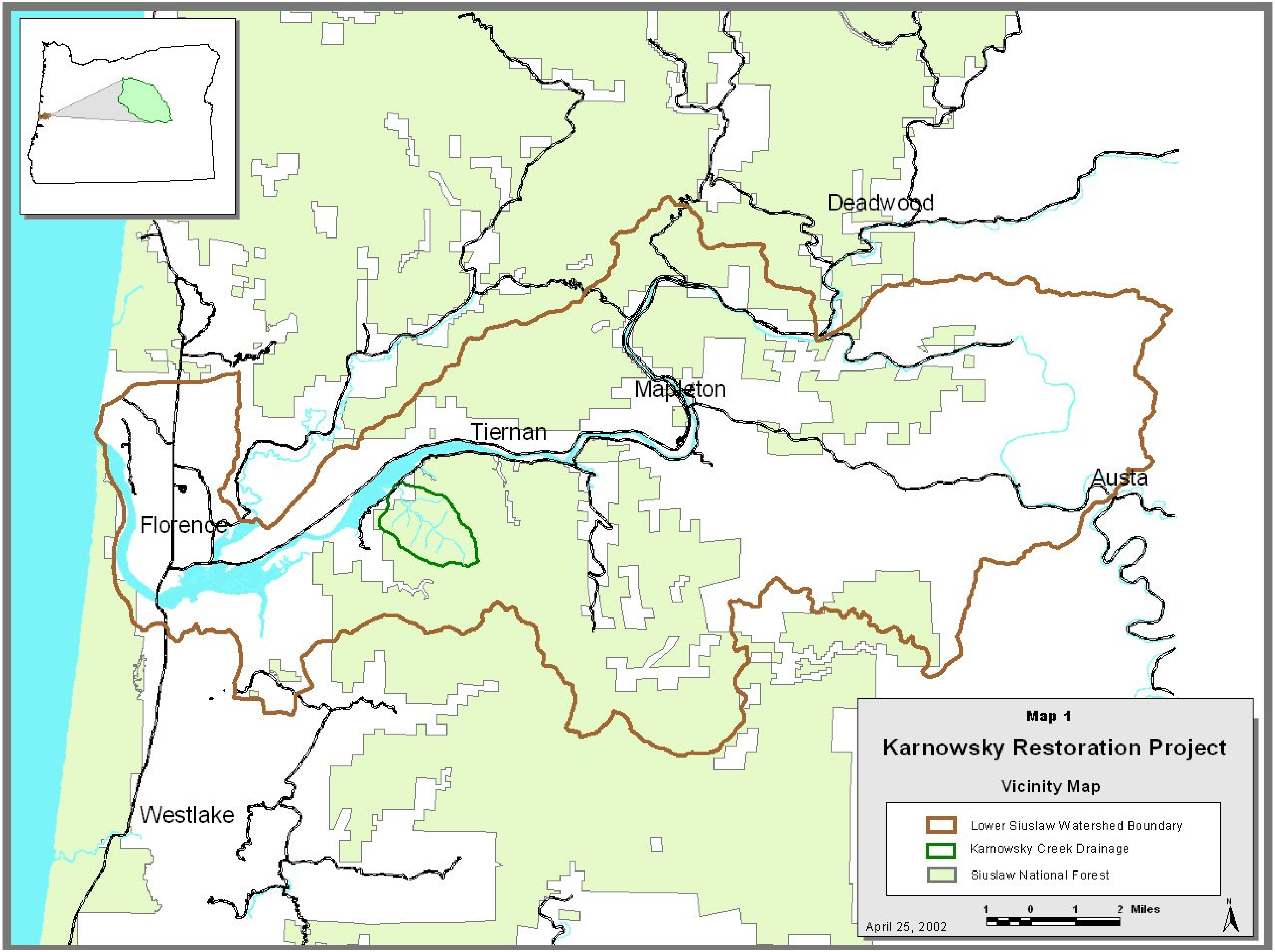
Groundwater-well monitoring—Measure groundwater levels monthly at 36 sites (wells) located throughout the valley. The Forest Service will conduct these surveys routinely during the first week of each month.

Monitoring reports

The Siuslaw Soil and Water Conservation District (SWCD) is responsible for monitoring and reporting to OWEB [need to spell out] for two years after project completion. The

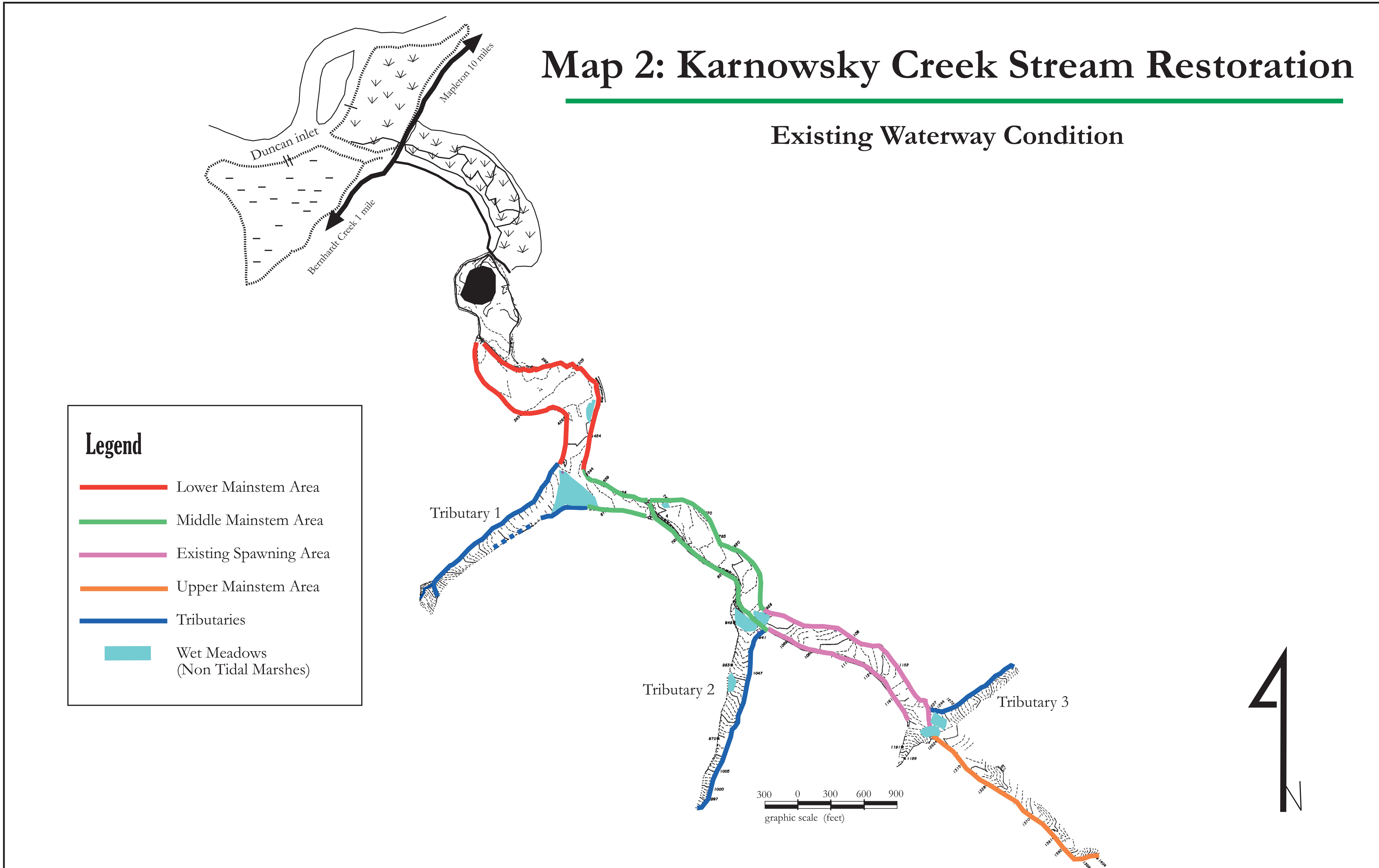
Siuslaw SWCD monitoring coordinator will also assist the Forest Service with the monitoring reports required by permitting agencies for two years after project completion.

The Forest Service will be responsible for monitoring reports required by permitting agencies. The Siuslaw SWCD will provide limited OWEB funds for monitoring for the two years following project completion.


Deadwood
Mapleton
Tiernan
Austa
Florence
Westlake
Map 1
Karnowsky Restoration Project
Vicinity Map
Lower Siuslaw Watershed Boundary
Karnowsky Creek Drainage
Siuslaw National Forest
1 0 1 2 Miles
April 25, 2002

Map 2: Karnowsky Creek Stream Restoration

Existing Waterway Condition



Map 3: Karnowsky Creek Stream Restoration

Conceptual Stream Reconstruction Design