



United States
Department of
Agriculture

Forest
Service

June 2002



Environmental Assessment

Badger Creek Culvert & Road Closure Project

Lookout Mountain Ranger District, Ochoco National Forest
Wheeler County, Oregon

T13S, R22E, Sec. 17, 18, 8

The Responsible Official has identified Alternative 2 as the Preferred Alternative.

For Information Contact: Barb Franano
P.O. Box 490, Prineville OR, 97754
541-416-6485
bfranano@fs.fed.us

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

Table of Contents

Introduction	1
Background	1
Purpose & Need for Action.....	1
Proposed Action	2
To Be Made.....	4
Public Involvement	4
Issues	4
Comparison of Alternatives, including the Proposed Action	5
Alternatives.....	5
Alternative 1	5
Alternative 2	5
Alternative 3.....	7
Mitigation Measures Common to All Alternatives	7
Comparison of Alternatives	7
Geology	9
Roads	9
Environmental Consequences.....	10
Competing and Unwanted Vegetation	10
Alternative 1	10
Alternative 2 and 3.....	10
Heritage Resources.....	10
Alternative 1	10
Alternative 2 and 3.....	11
Management Indicator Species (MIS).....	11
Alternatives 1 and 3	11
Alternative 2	11
Recreation	12
Alternatives 1 and 3	12
Alternative 2	12
Soils.....	12
Alternative 1	12
Alternative 2	12
Alternative 3.....	13
Threatened, Endangered and Sensitive Species.....	13
Aquatic Species	13
Alternative 1.....	13
Alternative 2.....	14
Alternative 3.....	14
Plants	14
Alternative 1.....	14
Alternative 2 and 3.....	15
Wildlife.....	15
Alternative 1.....	15
Alternative 2.....	15
Water Quality, Temperature and Sediment	16
Alternative 1	16
Alternative 2 and 3.....	16
Consultation and Coordination.....	18

INTRODUCTION

Background

Badger Creek is located in the Ochoco Mountains, the westernmost extension of the Blue Mountains of Central and northeastern Oregon. The headwaters of Badger Creek, Dent Springs, provides perennial flow fed by several tributaries and springs, draining 11,516 acres. Of Badger Creek's approximate 8.6 miles in length, 5.1 miles flow within the Ochoco National Forest's boundaries. Badger Creek drainage runs northeast to southwest in Wheeler and Crook Counties.

Forest Road 22 serves as a link between the Prineville and Mitchell areas. Forest Road 22 also provides access for a number of ongoing administrative, commercial and recreational activities. Administrative uses include multi-agency resource monitoring activities, timber sales, fire suppression, and livestock management. Forest Road 22-800 provides dispersed recreation sites used mostly during hunting season.

Forest Roads 22-800 and 22-754 were originally built to service timber sales in the area. Further sales in the area are not planned at this time.

In 1999, Mid-Columbia River steelhead trout were listed as threatened under the Endangered Species Act by the National Marine Fisheries Service. Habitat for Mid-Columbia steelhead trout includes 13 Central Oregon counties including Wheeler and Crook Counties, through which Badger Creek flows.

Purpose & Need for Action

The culverts on Badger Creek currently servicing Forest Roads 22, 22-800 and 22-754 are inadequate to pass anticipated 100-year flows and they obstruct passage for fish year round. The undersized culverts have created instability upstream. At high flows the culvert creates a backwater and bed material deposits in the channel upstream. As flows recede, the bed and/or banks erode around the culvert resulting in a chronically unstable channel bed, increased bank erosion, or culvert failure.

Roads function as extensions of the stream system by directing overland flow through of ditches intended to move water off of the traveled way or by development of rill erosion in the area. This hydrologic connection accelerates the rate of run-off by increasing drainage density. Forest Road 22-800 serves to direct run-off to Badger Creek and away from the meadow systems.

Forest Road 22-754 was previously decommissioned and crosses a meadow and Badger Creek. The road is approximately ¼ mile long. The crossing consists of ruts and a 12-in culvert that is flattened and nonfunctional. The purpose is to reduce sediment in the watershed and restore channel function to upper Badger Creek. Currently the road is decommissioned.

Although the entry to the road is fenced and gated, visitors use the area for dispersed camping. This area is upstream from the Forest Road 22 and 22-800 proposals.

In 2000, the culvert on Forest Road 22, T13S, R22E, Sec. 8, was replaced with a bridge. Since then, in the low flow the creek has subsurfaced under the bridge. The voids below the substrate are larger than the fine sediments that move through the stream can fill. This is preventing fish passage during low flows. The purpose is to restore year round flow to the surface for fish passage and open 1-1/2 miles of habitat for fish and reduce erosion caused by the inadequately sized culverts.

The purpose of this project is to provide fish passage for Mid-Columbia River steelhead trout and redband trout, provide for adequate flow through the culvert on Forest Road 22 during 100-year events, and reduce sediment entering the creek from improper drainage and inadequately sized culverts on Forest Road 22-800 and 22-754. These actions are needed to provide all life stages of fish year-long access to upper portions of Badger Creek and to improve water quality by reducing sediment.

The Ochoco National Forest has made it a priority to seek funding to replace inappropriately sized culverts that are causing erosion and do not allow for year round fish passage for all life stages. The Ochoco National Forest conducted a culvert survey in anadromous watersheds for aquatic listed species that identified high priority culverts that need to be replaced for aquatic species and flood events.

In addition, the need for the initiative is based on the Ochoco National Forest culvert survey data. This action helps to achieve the goals and objectives outlined in the Ochoco National Forest Land and Resource Management Plan and helps move the project area towards desired conditions described in that plan (USDA Forest Service Ochoco National Forest, 1989), as amended by the Decision Notice/Decision Record Finding of No Significant Impact Environmental Assessment for the Interim Strategies of Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California, February 1995 (PACFISH). Natural stream processes have been interrupted by road building and undersized culverts. Past management practices have contributed to the present conditions.

Proposed Action

The actions proposed by the Forest Service to meet the purpose and need are:
The culvert on Forest Road 22 is undersized and has potential to cause the stream to overtop resulting in the production of sediment from road damage, ditch scouring, and increased sediment production. Replacing the culvert would improve fish passage and reduce sediment currently entering the stream from the existing undersized culvert. Reducing sediment over the long term would benefit water quality and habitat all aquatic species. For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas.

Forest Road 22 culvert replacement:

The culvert on Forest Road 22, T13S, R22E, Sec. 17, is under a 4-5-foot high fill. The project proposal would replace the existing culvert with a culvert that is sized for bank full, fish passage for all life stages and 100-year flood events. The old culvert would be removed and replaced with an aluminum box culvert with a natural bottom substrate, 43 feet long, 12 feet wide, with 34-inch clearance from the top of the culvert to the top of the footing. Approximately 315 cubic yards of material would be removed from the old culvert. The fill removed would be used to close Forest Road 22-800.

A bypass road would be needed to allow traffic to pass during implementation. When the culvert was replaced with a bridge on Forest Road 22 in 2000, the District closed the road during implementation. Local vehicle traffic drove through Badger Creek during the road closure and caused damage to fish habitat. There is not an alternate road to access the forest in close proximity to the project area.

The bypass road would be 128 feet long and 12 feet wide on the east side of the existing culvert in Badger Creek. Geotextile would be placed in the area off the main road and along the bypass. Pit run gravel from Varmint Material Source would be used for the approach to the bridge. Gabion basket footings 3 feet tall, 3 feet wide and 6 feet long would be placed for the bridge to span the creek. The temporary metal bridge with wood decking used for the bypass road would be 14 feet by 30 feet. After the project, the temporary bypass road and bridge would be removed. Any material

placed for the bypass road would be removed to reclaim the area. Approximately 270 cubic yards of pit run from the bypass road would be used for the road surface on top of the new culvert. Any excess pit run material would be placed back at Varmint Material Source.

For the rockwork, 10,000 gallons of water would be drafted from Badger Creek. Location of the drafting would be in a pool with a filter on the siphon. Flow would be maintained at $\frac{1}{2}$ the base flow at all times or a minimum of 1 cfs flow. At no time would the stream be dried up. Should the flow be below 1 cfs, water would be obtained outside of the project area. A screen would be placed on the siphon to keep gravels and fish from being sucked into the truck.

The old culvert would remain in place for flow while the footings are excavated for the new culvert. Silt fencing would be placed to reduce sedimentation to the stream. The old culvert would then be removed and the new culvert bolted together and placed on the footings.

Four structures rock structures using 2-3-foot rocks low in the stream profile would be placed, 2 upstream and 2 downstream, from the new culvert to prevent headcutting. While the creek adjusts from taking out the old culvert to the natural bottom substrate with the new culvert, the grade control structures prevent headcutting.

Forest Road 22-800 culvert removal over Badger Creek, channel construction, removal of 10 culverts on 22-800 and providing adequate drainage: It was determined through the roads analysis (located in the project file on the district) for the area that Forest Road 22-800, 1.8 mi., T13S, R22E, Sec. 17, contributes sediment and the culvert in Badger Creek is undersized. This Environmental Assessment proposes to close Forest Road 22-800 to level I status (road bed will remain, proper drainage constructed) and remove the culvert in Badger Creek. After the culvert is removed, channel dimension, pattern and profile to Badger Creek would be constructed. Ten culverts would be removed along the road's length and proper drainage established. Road drainage structures would consist of water bars placed approximately 85 to 90 degree angle constructed 1 foot deep, and cross drains placed at a diagonal (45 degrees, constructed 6 inches deep).

Where the old culvert is removed from Badger Creek, a channel would be constructed using data collected for the channel design to reclaim the natural channel process. Silt fencing would be placed to reduce sedimentation to the stream.

Three structures would be placed approximately 25 feet above and below the area of the road crossing. Two would be placed upstream (approximately 10 feet apart) and 1 downstream, from the area where the culvert is removed in Badger Creek. While the creek adjusts the old culvert to the newly designed stream channel, the grade control structures would prevent headcutting.

Bridge maintenance on Forest Road 22 placed in 2000: In 2000, the culvert on Forest Road 22, T13S, R22E, Sec. 8, was replaced with a bridge. Since then, in the low flow the creek flows subsurface under the bridge. The voids below the substrate are larger than the fine sediments that move through the stream can fill. This is preventing fish passage during low flows. The project proposal is to remove approximately 1 foot of substrate under the bridge for approximately 30 feet, place in concrete slurry to fill in the void, and replace the substrate to its natural condition. Silt fencing would be placed to reduce sedimentation to the stream.

Forest Road 22-754: Forest Road 22-754, T13S, R22E, Sec. 18, crosses a meadow and Badger Creek. The road is approximately 1/4-mile long. The crossing consists of ruts and a 12-in culvert that is flattened and nonfunctional. Proposal is to remove the culvert and establish proper drainage, remove the ruts, and reestablishing flow through the creek. Currently the road is decommissioned, fenced and gated. The gate is not locked as there is a corral inside the gate close to Forest Road 22 used accessible by the permittee. Although the entry to the road is fenced and gated, visitors access the area through the gate for dispersed camping. Future planning in the area would be to keep visitors from using the road while having access for the permittee.

For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas. Refer to the map on p. 18.

Decision To Be Made

In making his decision, the District Ranger will evaluate the alternatives against the purpose and need. Specific questions the District Ranger will consider include:

- How well does the selected alternative improve fish habitat and fish access to the upper portions of Badger Creek?
- Would the project result in improving water quality and fish habitat reducing sediment?
- Would the project allow for movement of water of 100-year floods through the watershed?
- What impact does closing Forest Road 22-800 have on public, private, or administration access needs?
- What impact does Forest Road 754 have on recreation?
- How well does the selected alternative consider public comments?

Public Involvement

Scoping and public involvement are ongoing processes used to invite public participation and to obtain input on the scope of the analysis, alternatives to be evaluated, and issues to be addressed.

The scoping process for this EA was initiated on November 8, 2001. Seven letters were sent to individuals, organizations, and other governmental agencies. The proposal has been listed in the quarterly Schedule of Proposed Actions since the Winter 2001-02 edition. Only one telephone call was received. As a result of the one comment as part of the public involvement process, the agency met with the Wheeler County Commissioners on January 9, 2002, to discuss the proposed project. The meeting is documented in the project file scoping comments. No other comments were received.

Using the comments from scoping, issues were developed.

Issues

Forest Service separated the issues into two groups: key and non-significant issues. Key issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council for Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, "...identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)...".

The Forest Service identified five issues raised during scoping. These issues include:

Dispersed Recreation: Forest Road 22-800 would no longer be accessible to vehicles. Measurement would be access to other dispersed recreation areas in the vicinity.

Invasive and non-native plants: There would be an increase in the potential spreading weeds from project implementation and equipment during construction. Measurement would be implementing

mitigation measures to decrease the probability of spreading weeds and decreasing sedimentation into Badger Creek.

Sedimentation: There would be a short-term increase in the potential of sedimentation in the stream from removing culverts, and constructing culvert footings. Measurement would be implementing mitigation measures to decrease the probability of sedimentation into Badger Creek.

Construction of bypass road during construction of culvert on Forest Road 22: There would be potential for visitors to drive through Badger Creek if Forest Road 22 was closed during construction. In 2000, Forest Road 22 was closed during construction of the bridge construction located downstream of the proposed project. Visitors ignored the closure and caused damage to streambanks and fish habitat by driving through Badger Creek to get around the project. Measurement would be implementing a means to keep the road open during construction.

Closure of Forest Road 22-800 vs. non-closure: There was concern that the proposed project would decommission this road such that it would not be accessible for future use. This issue is not discussed further in this document as it is proposed to leave the surface of the road for future use. The road would be put in Level I (closed with road surface remaining) status.

COMPARISON OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This section describes and compares the alternatives considered for the Badger Creek Culverts and Road Closure Project. It includes a description and map of each action alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

A map of project area is located on page 19 of this EA.

Alternatives

Alternative 1

This is the No Action alternative. Current management plans would continue to guide management of the project area. No culvert replacement, culvert removal, or roadwork would be implemented to accomplish project goals. No ground disturbance would occur. Inadequate fish passage, erosion, and sedimentation in water quality would continue. The culverts on Forest Road 22 and 22-800 are not adequately sized to accommodate a 100-year flood event. Erosion and sedimentation would continue to occur from inadequately sized culverts on FR 22 and 22-800. There would be less short-term disturbance of soils; however, long term, soils could erode as a result of high flows topping over the undersized culvert on FR 22-800 on Badger Creek.

Alternative 2

This is proposed action.

Forest Road 22 culvert replacement:

The culvert on Forest Road 22, T13S, R22E, Sec. 17, is under a 4-5-foot high fill. The project proposal would replace the existing culvert with a culvert that is sized for bank full, fish passage for all life stages and the 100-year flood. The proposal is to remove the old culvert and replaced it with an

aluminum box culvert with a natural bottom substrate, 43 feet long, 12 feet wide, with 34-inch clearance from the top of the culvert to the top of the footing. Approximately 315 cubic yards of material would be removed from the old culvert. The fill removed would be used to close Forest Road 22-800.

A bypass road would be needed to allow for traffic to pass during implementation. When the culvert was replaced with a bridge on Forest Road 22 in 2000, the District closed the road during implementation. Local vehicle traffic drove through Badger Creek during the road closure and caused damage to fish habitat. There is not an alternate road to access the forest in close proximity to the project area.

The bypass road would be 128 feet long and 12 feet wide on the east side of the existing culvert in Badger Creek. Geotextile would be placed in the area off the main road and along the bypass. Pit run gravel from Varmint Material Source would be used for the approach of the bridge. Gabion basket footings 3 feet tall, 3 feet wide and 6 feet long would be placed for the bridge to span the creek. The temporary metal bridge with metal decking used for the bypass road would be 14 feet by 30 feet. After the project, the temporary bypass road and bridge would be removed. Any material placed for the bypass road would be removed to reclaim the area. Approximately 270 cubic yards of pit run from the bypass road would be used for the road surface on top of the new culvert. Any excess pit run gravel would be returned to Varmint Material Source.

For the rockwork, 10,000 gallons of water would be drafted from Badger Creek. Location of the drafting would be in a pool with a filter on the siphon. Flow would be maintained at $\frac{1}{2}$ the base flow at all times or a minimum of 1 cfs flow. At no time would the stream be dried up. Should the flow be below 1 cfs, water would be obtained outside of the project area. A screen would be placed on the siphon to keep gravels and fish from being sucked into the truck.

The old culvert would remain in place for flow while the footings are excavated for the new culvert. Silt fencing would be placed to reduce sedimentation to the stream. The old culvert would then be removed and the new culvert bolted together and placed on the footings.

Four structures rock structures using 2-3-foot rocks low in the stream profile would be placed, 2 upstream and 2 downstream, from the new culvert to prevent headcutting. While the creek adjusts from taking out the old culvert to the natural bottom substrate with the new culvert, the grade control structures prevent headcutting.

Forest Road 22-800 culvert removal over Badger Creek, channel construction, removal of 10 culverts on 22-800 and providing adequate drainage: It was determined through the roads analysis (located in the project file on the district) for the area that Forest Road 22-800, 1.8 mi., T13S, R22E, Sec. 17, contributes sediment and the culvert in Badger Creek is undersized. This Environmental Assessment proposes to close Forest Road 22-800 to level I status (road bed will remain, proper drainage constructed) and remove the culvert in Badger Creek. After the culvert is removed, channel dimension, pattern and profile to Badger Creek would be constructed. Ten culverts would be removed along the road's length and proper drainage established. Road drainage structures would consist of water bars placed approximately 85 to 90 degree angle constructed 1 foot deep, and cross drains placed at a diagonal (45 degrees, constructed 6 inches deep).

Where the old culvert is removed from Badger Creek, a channel would be constructed using data collected for the channel design to reclaim the natural channel process. Silt fencing would be placed to reduce sedimentation to the stream.

Three structures would be placed approximately 25 feet above and below the area of the road crossing. Two would be placed upstream (approximately 10 feet apart) and 1 downstream, from the area where the culvert is removed in Badger Creek. While the creek adjusts the old culvert to the newly designed stream channel, the grade control structures would prevent headcutting.

Bridge maintenance on Forest Road 22 placed in 2000: In 2000, the culvert on Forest Road 22, T13S, R22E, Sec. 8, was replaced with a bridge. Since then, in the low flow the creek flows subsurface under the bridge. The voids below the substrate are larger than the fine sediments that move through the stream can fill. This is preventing fish passage during low flows. The project proposal is to remove approximately 1 foot of substrate under the bridge for approximately 30 feet, place in concrete slurry to fill in the void, and replace the substrate to its natural condition. Silt fencing would be placed to reduce sedimentation to the stream.

Forest Road 22-754: Forest Road 22-754, T13S, R22E, Sec. 18, crosses a meadow and Badger Creek. The road is approximately 1/4-mile long. The crossing consists of ruts and a 12-in culvert that is flattened and nonfunctional. Proposal is to remove the culvert and establish proper drainage, remove the ruts, and reestablishing flow through the creek. Currently the road is decommissioned, fenced and gated. The gate is not locked as there is a corral inside the gate close to Forest Road 22 used accessible by the permittee. Although the entry to the road is fenced and gated, visitors access the area through the gate for dispersed camping. Future planning in the area would be to keep visitors from using the road while having access for the permittee.

For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas. Refer to the map on p. 19.

Alternative 3

Alternative 3 would have the same design and projects as Alternative 2 except Forest Road 22-800 would not be placed into Level 1 status (closed with road surface remaining) and the culvert that crosses Badger Creek would remain in place. The access for fish passage above would be approximately 150 feet instead of 1½ miles as in Alternative 2. There would be less short term disturbance of soils; however, long term, soils could erode as a result of high flows topping over the undersized culvert on Forest Road 22-800 on Badger Creek.

For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas. Refer to the map on page 19.

Mitigation Measures Common to All Alternatives _

The alternatives were designed to reduce sedimentation by constructing a temporary bypass road during construction and using sediment fencing; working within the in-stream timing for stream construction projects and coordinating with the Oregon Department of Fish and Wildlife; and cleaning equipment and plant sites to avoid or reduce the spread of invasive and non-native plants,

Comparison of Alternatives _____

This section provides a summary of the effects of implementing each alternative. Information in Table 1 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 1. Comparison of Alternatives for Badger Creek Project and Road Closure.

	Alternative 1	Alternative 2	Alternative 3
<i>Dispersed Recreation</i>	Dispersed recreation continues; sedimentation continues with FR22-800 open; filtering vegetation at the dispersed sites in the meadows would not expand due to compaction from vehicles and campers	Vehicle access closed to FR22-800; dispersed recreation opportunities exist for horse packers and back packers	Dispersed recreation continues; sedimentation continues with FR22-800 open; filtering vegetation at the dispersed sites in the meadows would not expand due to compaction from vehicles and campers
<i>Invasive and non-native plants</i>	No change in noxious weeds would occur. Weeds would continue to be introduced by vehicles, livestock, wildlife, windborne seed and other sources.	Contract provisions are implemented for “certified weed-free” equipment and material, the project would have low risk of noxious weed introduction or spread; a variety of non-native grasses already occupy the site. Seeding disturbed soils with native or non-native grasses would further reduce risk for noxious weeds	Contract provisions are implemented for “certified weed-free” equipment and material, the project would have low risk of noxious weed introduction or spread; a variety of non-native grasses already occupy the site. Seeding disturbed soils with native or non-native grasses would further reduce risk for noxious weeds
<i>Sedimentation:</i>	Continues sedimentation during high water events and from FR 22-800 through inadequate culvert and drainage; undersized culvert elevates risk of failure of crossing during high water event	Reduces sedimentation during high water events and from FR 22 with properly sized culverts, removal of FR 22-800 crossing, and proper drainage on FR 22-800 and at the crossing on FR 22-754; temporary increase in sedimentation during construction and reduced to preconstruction levels within 5 days of end of construction; for each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas.	Reduces sedimentation during high water events from FR 22 and 22-754, but sedimentation continues at FR 22-800 culvert and improper drainage on the road; temporary increase in sedimentation during construction and reduced within 5 days of end of construction
<i>Construction of bypass road during construction of culvert on Forest Road 22</i>	No bypass road would be needed.	Temporary bypass road needed for visitors to the forest during construction so that they don’t drive through Badger Creek	Temporary bypass road needed for visitors to the forest during construction so that they don’t drive through Badger Creek
<i>Closure of Forest Road 22-800 vs. non-closure</i>	No closure; FR 22-800 available for future use	FR 22-800 put in Level I status (road surface would remain, drainage constructed, culvert on Badger Creek removed); available for future use; reduces sedimentation to stream; reestablish stream channel in culvert area	No closure; FR 22-800 available for future use

AFFECTED ENVIRONMENT

Geology

The shaping of the landforms in the watershed are a reflection of the past climate and geologic history of the area. The climate 60 million years ago to the present has evolved from a warm moist tropical regime to the temperate four distinct seasons of today. The tectonic movement, uplift of the Blue Mountain anticline and mass wasting processes have combined to create the moderately dissected and hummocky terrain, which is the predominant landform. Landslides played a major role in the shaping of the watershed creating large areas of hummocky terrain, seeps, ponds and springs. Present day erosion processes are primarily in the form of sheets and rills with minor mass wasting in the form of small landslides, rock topple and slope creep. The watershed is a recharge collection area for regional and local aquifers.

The soil, which has formed on all the formations, combined with the ash, provides the majority of the natural stream sediment due to processes like sheet and rill erosion. The ash enhances the fertile environment of the residual soils.

Based on an air photo interpretation, the watershed has a series of dormant and active landslide terrain features composed of scarps and debris lobes. The dormant landslide terrain stretches from the saddle at Scott's Camp, along the east side of Badger Creek. The slopes above, below and on Road 2200-800 have a number of seeps and springs, indicating the presence of the landslide terrain.

Roads

The aquatic ratings for the roads analysis for the Badger Creek project area (located in the project file on the Ranger District) indicated Road 22 has a high rating for fish, moderate rating for geologic hazard and a moderate rating for fine sediment, floodplain, flow and wetlands. The road is gravel, parallels Badger Creek, crosses numerous dry meadows, Hoffman Creek, Bug Creek and four intermittent tributaries. The road is located in landslide terrain in the valley bottom.

Forest Road 22-800 has a high rating for geologic hazard and a moderate rating for fine sediment, floodplain, flow, fish and wetlands. The road is located mid-slope and crosses Badger Creek and Bug Creek. It crosses Badger Creek, Bug Creek, two Class III streams and has an additional 5 to 6 relief culverts. The upper cross drainage structures are at risk for plugging and causing fill failures and/or potential debris flows if not maintained. The 2 lower culverts are currently restricting flow and present fish barrier passage concerns. It is completely within dormant landslide terrain.

The construction of roads across landslide debris has the potential to compact the debris, creating a dam-like feature, which could collect water upslope, increasing pore water pressure to the point of failure. Similar terrain and geology on the northern slopes of the Ochoco Mountains, to the west, have exhibited mass wasting events during 1996 and 1997 wet winters. These roads are older roads; constructed with higher cut and fill slopes and the relief drainage structures appear to be placed further apart.

Forest Road 22-754 is a decommissioned road that crosses a meadow and Badger Creek. The road is approximately 1/4-mile long. The crossing consists of ruts and a 12-in culvert that is flattened and nonfunctional. Although the entry to the road is fenced and gated, visitors access the area through the gate for dispersed camping.

ENVIRONMENTAL CONSEQUENCES

Competing and Unwanted Vegetation ---

Ground disturbance associated with this project would increase risk of noxious weed introduction and spread. Noxious weeds are present in the immediate vicinity of the proposed project area, but could spread from introduction through equipment or fill material containing noxious weed seed or plant parts.

Alternative 1

Weeds would continue to be introduced by vehicles, livestock, wildlife, windborne seed and other sources.

Alternative 2 and 3

Contract provisions would be implemented for “certified weed-free” equipment and material, the project would have low risk of noxious weed introduction or spread. A variety of non-native grasses already occupy the site. Seeding disturbed soils with native or non-native grasses would further reduce risk for noxious weeds.

Disturbance to soil would occur within the existing culvert sites during implementation of the project. New disturbance could occur when the temporary bypass road is constructed during the project timeline. Reseeding to establish desired vegetation would minimize the spread of noxious weeds in this area. Post treatment weed monitoring would need to be implemented to detect infestations while they are very small.

Ground disturbance associated with this project would increase risk of noxious weed introduction and spread. Noxious weeds are not present in the immediate vicinity of the proposed project area, but could be introduced through equipment or fill material containing noxious weed seed or plant parts.

Weeds would continue to be introduced by vehicles, livestock, wildlife, windborne seed and other sources.

For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas.

Heritage Resources ---

Alternative 1

Under the No Action alternative, current management plans would continue. Existing culverts would not be replaced. There would be a greater potential for high flow or flood events to cause surface damage and down cutting in areas where flows are restricted. Heritage sites located in the flood plain would be at increased risk for damage. There is a heritage site on Forest Road 22-845, close to Forest Road 22 and 22-845 junction.

Alternative 2 and 3

Under the proposed action, undersized culverts would be replaced with properly sized openings. This would reduce the potential for erosion and surface damage to occur to heritage sites located along the stream terraces and in the flood plain.

Proposed project activities would mainly occur along and within the existing road prisms. Parking and supplies would not occur on Road 2200-845 (currently closed to vehicle use). Known site locations would be avoided and not affected by the proposed improvements and activities including:

1. Improving the bridge site on Road 22 (T. 12 S., R. 22 E, NW of NW ¼ section 08)
2. Removing culverts along Rd 22 (T. 12 S., R. 22 E., north NW ¼)
3. Closing and removing culverts on Rd 2200-800; and
4. Removing culvert on Rd 2200-754.

The proposed Badger Creek stream improvement project and associated road closures would not have an effect on known heritage resources. The heritage site located on Forest Road 22-845 would be protected. Any newly discovered sites would be protected and, or mitigated on a case by case basis.

Management Indicator Species (MIS) _____

The Forest Plan identified MIS to help determine the effects of management activities on fish and wildlife habitat. Brook and rainbow trout were picked as indicators of riparian and aquatic habitat. Pileated woodpecker was picked as an indicator for species that require mature forest and old growth habitat. Primary cavity excavators and the common flicker were selected to represent species that utilize snags and old growth juniper habitat, respectively.

Brook and Rainbow Trout:

In the past, these fish have been stocked by the Oregon Department of Fish and Wildlife. They are no longer stocked in streams in the Badger Creek watershed. Effects to brook and rainbow trout habitat would be the same as the effects described for redband trout because redband trout and have similar habitat requirements.

Pileated Woodpecker and Primary Cavity Excavators

The proposed project would not directly alter pileated woodpecker or primary cavity excavator habitat. The nearest designated pileated woodpecker feeding area is ½ mile from the project area. Equipment may disturb white-headed and pileated woodpeckers during implementation. However, pileated woodpecker and other primary cavity excavators should not be negatively impacted by implementing the proposed project because the timing of project implementation (after July 15) would occur outside of the early nesting season and after young are expected to have fledged.

Alternatives 1 and 3

Current trends in condition of wildlife habitat would remain. Potential impacts to snag habitat would continue to occur.

Alternative 2

There would be potential for reduced effects to snag habitat due to management after Forest Road 22-800 is closed. Hazard tree removal would not be required on the closed road and there would be reduced potential for loss of snag habitat through woodcutting.

Recreation

There are four dispersed recreation sites on Forest Road 22-800. Two of them are located in meadows. There will be dispersed camping opportunities on Forest Road 22-850, 22-810, and 22-802 within 1 mile of Forest Road 22-800. Most dispersed camping occurs in the area in the fall during hunting season.

Alternatives 1 and 3

Motorized dispersed recreation would continue on Forest Road 22-800. Sedimentation would still occur in the watershed to Badger Creek from campsites located in the meadows. Filtering vegetation at the dispersed sites in the meadows would not have the opportunity for expansion due to compaction from vehicles and campers. Opportunities for horse packing and back packing camping would be available on Forest Road 22-800.

Alternative 2

Forest Road 22-800 would be closed and not accessible to motor vehicles. However, dispersed recreation camping would be available to those packing or hiking. Hunters would have more area to hunt that is not roaded in Alternative 2.

Soils

Existing Conditions: The culverts of the proposed project are located largely in ashy alluvial sediments with side slope fill material used for the culvert approaches. This material has been eroding due to the undersized culvert and its effects on flows in the vicinity of the culvert.

Soils along Forest Road 22-800, on western and northwestern aspects, are largely ash and colluvium over clayey subsoils (Landtype T3 and Landtype L26).

Alternative 1

No culvert replacement, removal or roadwork would occur other than routine road maintenance. Bank erosion in the vicinity of the culverts would still be a long-term problem. The undersized culverts along Forest Road 22-800 would still potentially plug and produce additional sediment.

Alternative 2

There would be a short-term increase in sediment as a result of the removal and replacement of the Road 22 culvert and as a result of the removal of the main Road 22-800 culvert and subsequent recontouring. Also, the removal of the 10 culverts on Forest Road 22-800 would produce some additional sediment. The temporary bypass road would produce some additional short-term sediment.

There would be a long-term reduction in sediment due to the decrease in bank erosion near the culvert location on Road 22 and near the replaced culvert on the 22-800.

There will be better stream function and less concentrated runoff upstream and adjacent to the replaced culvert, the removed culvert and along the 22-800 road.

In the long term, the past impacts of road construction and undersized culverts would be somewhat alleviated, especially through providing for better stream function, fish passage and less sediment from bank erosion.

Drainage would be improved along the Forest Road 22-800 thereby decreasing water concentration and potential erosion.

Alternative 3

Alternative 3 would have the same affects as Alternative 2 except that Forest Road 22-800 would not be closed, the culvert over Badger Creek would not be removed, and drainage on FR 22-800 would not be improved. There would be less short-term disturbance of soils; however, long term, soils could erode as a result of high flows topping over the undersized culvert on FR 22-800 on Badger Creek.

Threatened, Endangered and Sensitive Species __

Aquatic Species

Bull trout (*Salvelinus confluentus*) and Mid-Columbia River steelhead trout (*Onchorhynchus mykiss* spp.) are the only federally listed threatened or endangered aquatic species known or suspected to occur on the Ochoco National Forest. Bull trout were not addressed further because there is no habitat in the project area. Steelhead trout are present in the project area.

There are five sensitive aquatic species that are known or suspected to occur on the Ochoco National Forest: redband trout (*Onchorhynchus mykiss* spp.), Malheur mottled sculpin (*Cottus bairdi*), West Slope cutthroat trout (*Onchorhynchus clarki*), Columbia spotted frog (*Rana luteiventris*), and Mid-Columbia River spring chinook salmon (*Onchorhynchus tshawytscha*). Mid-Columbia spring chinook salmon, Mid-Columbia spring chinook salmon Essential Fish Habitat (EFH), West Slope cutthroat trout, and Malheur mottled sculpin are not addressed further because there is no habitat in the project area. Redband trout and Columbia spotted frog are discussed further because there is habitat and they are present in the project area.

Redband trout and steelhead trout occupy perennial streams. Columbia spotted frogs breed in very shallow water beside ponds or streams, in flooded meadows, or in water pooled at the edge of a pond. The combination of habitat modification, low summer flows, high summer stream temperatures, lack of suitable riparian vegetation (due to livestock and farming activities), and increase in sediment (due to roads and off-road travel within RHCAs) has an effect on the fish habitat and populations of redband trout, steelhead trout and Columbia spotted frogs in the Badger Creek watershed.

The Ochoco National Forest has prioritized culverts that need to be replaced. The headwaters of Badger Creek are located on the National Forest. Steelhead trout are known to occur in Bug Creek and in Badger Creek on the Forest. Badger Creek aquatic passage is a high priority culvert replacement as Mid-Columbia River steelhead trout occupy the creek and come upstream from the John Day Basin.

Alternative 1

The culverts on Forest Road 22 and 22-800 do not provide for passage of all life stages for fish to the upper portions of Badger Creek due to improper sizing and placement. Columbia spotted frog habitat would be impacted from off-road travel in meadow areas and in the locations of the culverts on Forest Roads 22, 22-800, and 22-754. Inadequate fish passage, erosion, and sedimentation in water quality

would continue. The culverts on Forest Roads 22, 22-800, and 22-754 are not adequately sized to accommodate a 100-year flood event and to pass bedload.

Sediment entering the stream as a result of erosion reduces light and oxygen to fish eggs in riffles and frog eggs along the vegetative banks of the streams that would directly affect survival rates of Mid-Columbia River steelhead trout, redband trout, and Columbia spotted frogs. Erosion in the meadow areas would directly affect survival of Columbia spotted frog populations.

Alternative 2

The culvert replacement on Forest Road 22 and culvert removal on Forest Road 22-800 would provide for fish passage for all life stages. Riparian vegetation at the Forest Road 22-800, and 22-754 crossings would reestablish as the stream banks would be contoured after culvert removal. Water quality would improve as proper drainage would be constructed on Forest Road 22-800. The proposed project would adequately accommodate a 100-year flood event.

Reduction in sedimentation from existing culverts and passage of bed load within the stream system improves water quality, passage, and increases riparian and meadow vegetation for Mid-Columbia steelhead trout, redband trout, and Columbia spotted frogs.

The proposed project would be implemented following the instream timing as recommended by the Oregon Department of Fish and Wildlife. Should an extension of the time in the stream be needed, it would be with coordination with the Oregon Department of Fish and Wildlife.

Alternative 3

The culvert replacement on Forest Road 22 and 22-754 would provide for fish passage and improvement of spotted frog habitat.

The culvert replacement provides for fish passage for all life stages for 150 feet up to the culvert on FR22-800. Year round fish passage above FR 22-800 would not be facilitated. Improper drainage from FR 22-800 would not be improved. Water quality would improve as the culvert on FR22 would allow for bed load movement. The undersized culvert on FR22-800 would continue to impact water quality and stream function.

Reduction in sedimentation from existing culverts and passage of bed load within the stream system improves water quality, passage, and increases riparian and meadow vegetation for Mid-Columbia steelhead trout, redband trout, and Columbia spotted frogs.

Plants

No threatened or endangered plant species are known or expected to occur in the geographic area that includes the Ochoco National Forest. Ground disturbance associated with this project could affect sensitive plants or habitat. Of the 26 sensitive plant species known or expected to occur on the Ochoco NF and Crooked River National Grassland, 17 species do not have potential habitat in the proposed project area. Nine other species have either been documented or have potential habitat in the project vicinity. However, the area that would be disturbed during project activities has had prior disturbance from road construction and other activities. These sites have low probability of occurrence for the remaining nine species.

Alternative 1

No ground disturbance would occur. This alternative would result in no impact to sensitive plants.

Alternative 2 and 3

The area has already been impacted by past disturbance from road construction and installation of the bridge and culvert. Some individual sensitive plants or habitat may be affected by construction of the temporary bypass road during construction, but this is not expected to lead towards federal listing.

Wildlife

Northern bald eagle (*Haliaeetus leucocephalus*) and Canada lynx (*Lynx canadensis*) are the only federally listed threatened or endangered terrestrial species known or suspected to occur on the Ochoco National Forest. Canada lynx were not addressed further because there is no mapped lynx habitat or key linkage areas on the Ochoco National Forest. Northern bald eagles are known to occur on the Ochoco National Forest but no nests are known in the immediate vicinity of the project area.

There are eight sensitive terrestrial species that are known or suspected to occur on the Ochoco National Forest: American peregrine falcon, bufflehead, tricolor blackbird, upland sandpiper, California wolverine, western sage grouse, and pygmy rabbit. The bufflehead, tricolored blackbird, western sage grouse, upland sandpiper, pygmy rabbit, and gray flycatcher are not addressed further because there is no habitat in the project area. American peregrine falcon and California wolverine are discussed below because there is habitat and there is potential for these species to utilize the project area.

Alternative 1

Current trends in the condition of wildlife habitat would remain. Impacts to meadow and wetland communities from motor vehicle access to dispersed camping sites would continue.

Alternative 2

Riparian vegetation would expand from existing plants in the area and from planting in areas where culverts were removed, conditions in meadow and wetland communities would improve. Human disturbance would be reduced. Improved condition and abundance of riparian habitats would increase the potential for riparian dependent birds and would improve foraging opportunities for peregrine falcons and wolverine.

Peregrine falcons nest on ledges on cliff faces and forage over a variety of habitats. Cliffs are present within the vicinity of the project area and the riparian area may serve as foraging habitat. The project would not alter riparian habitat but may improve conditions in meadows and wet areas along Forest Road 22-800 after closure.

California wolverine den in rocky areas in remote locations and forage in a variety of habitats. The project would not alter foraging opportunities but may reduce disturbance if Forest Road 22-800 is closed.

Alternative 3

Riparian vegetation would be reestablished in areas where culverts were removed. An increase in the condition and abundance of riparian habitat could increase the potential for riparian dependent birds but the difference would be negligible.

Water Quality, Temperature and Sediment _____

Stream turbidity and temperature are primary indicators of water quality in forested ecosystems. There is normally a close correlation between turbidity and suspended sediment in a given stream. The analysis focused on production of sediment.

Effects to water quality are also discussed in relation to temperature. The primary indicators for water quality are also important indicators of fish habitat.

Temperature would likely improve to cooler temperatures within the project area. Channel dimension, pattern and profile would be restored in the area of the culvert removal on Forest Road 22-800 and 22-754. The culvert on Forest Road 22 would be properly sized to adequately pass bed load, fish, and improve riparian habitat. As streamside vegetation improves in these streamside areas and in the meadows, vegetation would filter sediment before it reaches and stream and shade would improve reducing stream temperatures.

A discharge measurement was taken on 29 October 1998 approximately 3/4 mile below the stream crossing where the culvert would be replaced. The flow was 0.66 cfs on that date. Correlating this flow with the continuous flow records from Ochoco Creek at the ranger station, the base flow for Badger Creek in 1998 is estimated to have been about 0.33 cfs. It is estimated in normal years, at the discharge measurement site, flows fall below 1 cfs between the middle and end of July. The Forest’s Water Conservation Plan (Ochoco NF, 1996) requires that ½ the base flow or a minimum of 1 cfs be maintained at all times.

Water temperature data has been collected in Badger Creek at the Forest boundary since the late 1980s. Data was collected below Hoffman Creek, which is just below the project site, in 1995 and 1996. A summary of the water temperature data closest to the site is shown in Table 2.

Table 2 – Water Temperature Data

Station	Year	7 day avg max	Days > 64°F	1 st day > 64°F	Last day > 64°F
Badger blw Hof.	1995	68.83°F	25	30 Jun 1995	7 Aug 1995
Badger blw Hof.	1996	72.86°F	65	30 Jun 1996	10 Sep 1996

Alternative 1

No ground disturbance would occur. Higher temperatures, erosion, and sedimentation in water quality would continue from culverts on Forest Road 22, 22-800, and 22-754. The culverts on Forest Road 22 and 22-800 are not adequately sized to accommodate a 100-year flood event.

Chronic sedimentation, impacts to riparian vegetation in the areas of the culverts on Forest Roads 22, 22-800, and 22-754, and in the meadows on Forest Road 22-800 would continue to impact habitat for Mid-Columbia River steelhead trout, redband trout, and Columbia spotted frogs.

Alternative 2 and 3

Riparian vegetation at the Forest Road 22-800 crossing would reestablish as the stream banks would be contoured after culvert removal. Water quality would improve as proper drainage would be constructed on the road surface on Forest Road 22-800. The proposed project in Alternative 2 would adequately accommodate a 100-year flood event. Alternative 3 would continue to have the culvert in Badger Creek on Forest Road 22-800 and the road would continue to be open to vehicle traffic causing sedimentation.

Replacing the culvert on Badger Creek above Hoffman Creek and pulling the culverts on Forest Roads 22-800 and 22-754 would not affect the magnitude or timing of flows. Properly sizing the culvert on Badger Creek above Hoffman Creek and pulling culverts on Forest Roads 22-800 and 22-754 would improve vegetation in the riparian vegetation and streambank conditions should a large event occur. Stable streambanks and proper channel dimension allow the system to withstand flood conditions.

Long term flow and sediment data have not been collected on Badger Creek. Using Trout Creek located in a steelhead drainage in the Deschutes Basin as a comparison, normal turbidity and suspended sediment levels on Badger Creek are probably a little higher than those found on Trout Creek. The amount of cutbank is higher in some of the meadow systems in Badger Creek above the project site and is on a cattle allotment instead of a sheep allotment like Trout Creek. Cattle tend to inhabit riparian areas more than sheep

Sampling during the installation of the bridge on Badger Creek in 1999 indicated turbidity impacts were short term and probably were only visible during and shortly after the instream disturbance. There was no apparent difference in turbidity between the station above and below the bridge site during the rest of the period of construction. The contractor indicated that the creek was quite turbid for about an hour after the creek was put back in the channel.

For the proposed project, the culvert on Forest Road 22 and excess fill would be removed leaving a bankfull width channel inside the new culvert. Implementation of the project would result in more sediment than the 1999 project where the culvert was replaced with a bridge on Forest Road 22, but the effect should be small and of short duration. Geo-textile sediment fence would be placed below the site when the old culvert is removed and the in channel work accomplished to reduce sediment delivery.

The proposed temporary bypass on the east side of the stream crossing would cause less short term sedimentation than having the public driving through the stream through the road closure as experienced during the installation of the bridge on Badger Creek in 1999.

The water temperatures in Badger Creek, in the reach where the culvert is being replaced, exceed the State water quality threshold. Replacing the culvert on Badger Creek above Hoffman Creek and pulling the culverts on the 22-800 and 22-754 roads should not increase or decrease water temperatures in Badger Creek.

For each site, riparian shrub planting would occur to re-establish riparian vegetation in disturbed areas.

Stream turbidity will be monitored above and below the culvert replacement site to verify that Forest mitigation measures are effective.

Consultation and Coordination ---

The Forest Service consulted the following individuals, Federal, state and local agencies, and non-Forest Service persons during the development of this environmental assessment:

ID TEAM MEMBERS:

Jim David	Soil Scientist
Barb Franano	Fishery Biologist, Team Leader
Carrie Gordon	Geologist
Terry Holtzapple	Archeologist
Rodd Kubitza	Transportation Engineer
Mark Lesko	Botanist
Jim Seymour	Hydrologist
Barb Smith	Recreation
Dede Steele	Wildlife Biologist

FEDERAL, STATE, TRIBAL AND LOCAL AGENCIES:

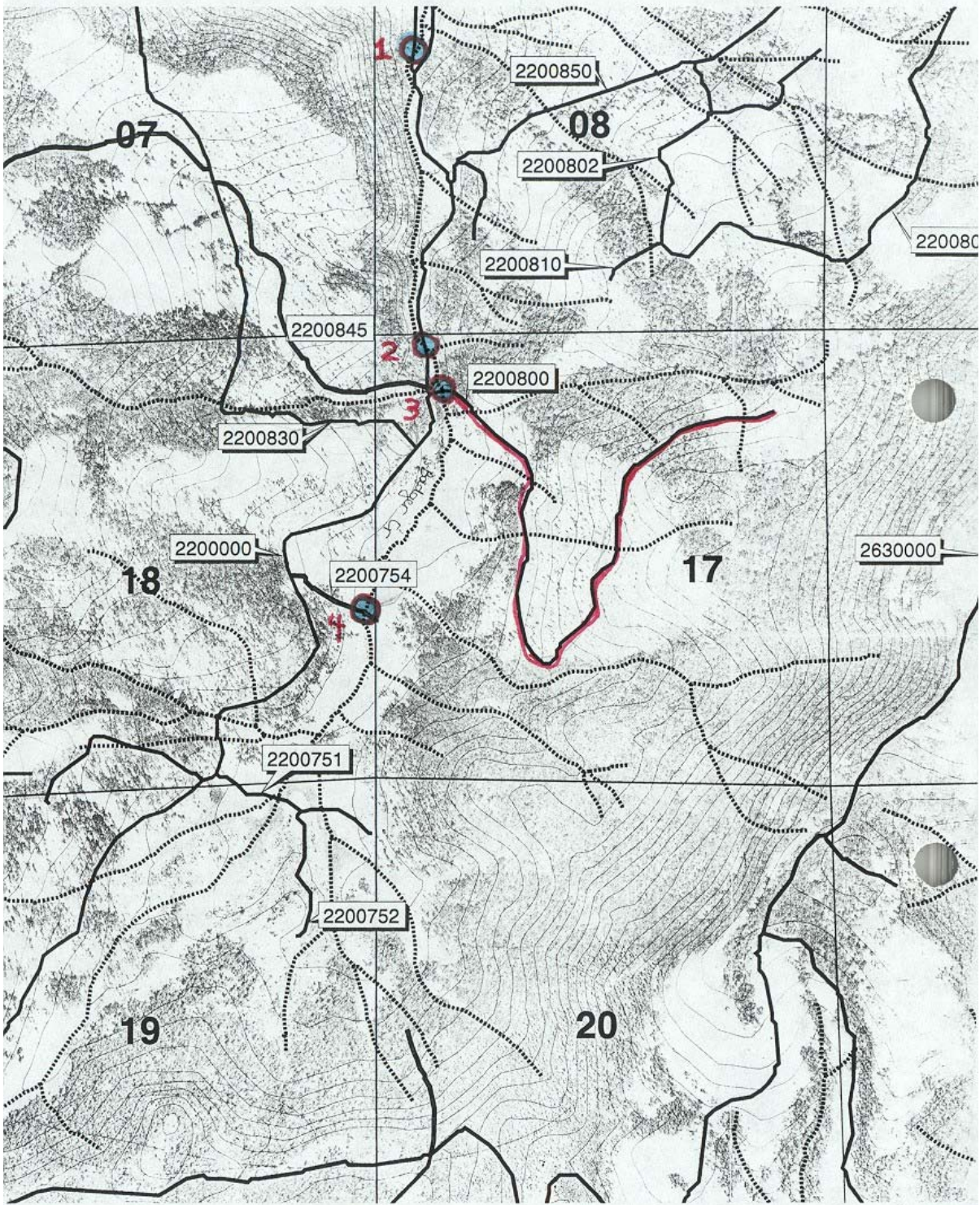
Wheeler County Court
Oregon Department of Fish and Wildlife, John Day Field Office
Prineville-Crook County Chamber of Commerce
Warm Springs Tribe CTWSR
Umatilla Tribe

OTHERS:

Hashknife Ranch
Private property owners at Indian Creek
Central Oregonian
League of Wilderness Defenders
Oregon Trout

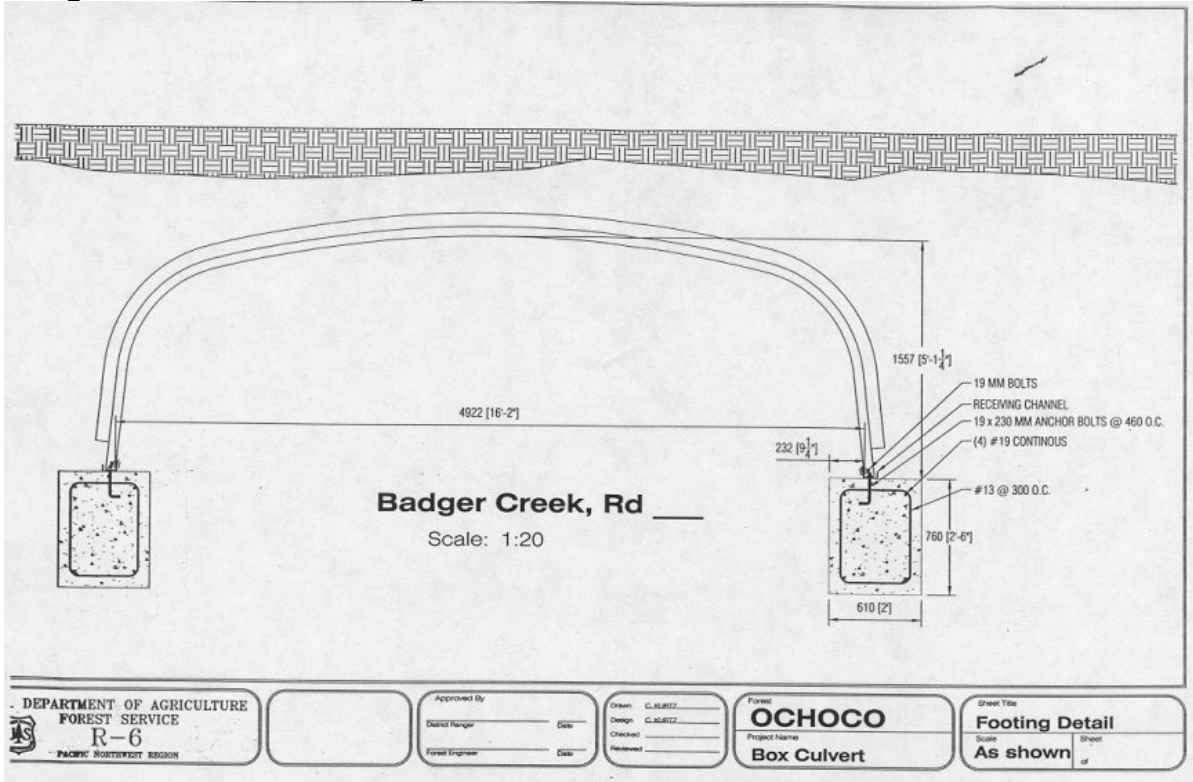
BADGER CREEK CULVERT AND ROAD CLOSURE PROJECT AREA

Alternative 2 includes sites 1 through 4; Alternative 3 includes sites 1,2, and 4; T13S, R22E, S17, 18, 8

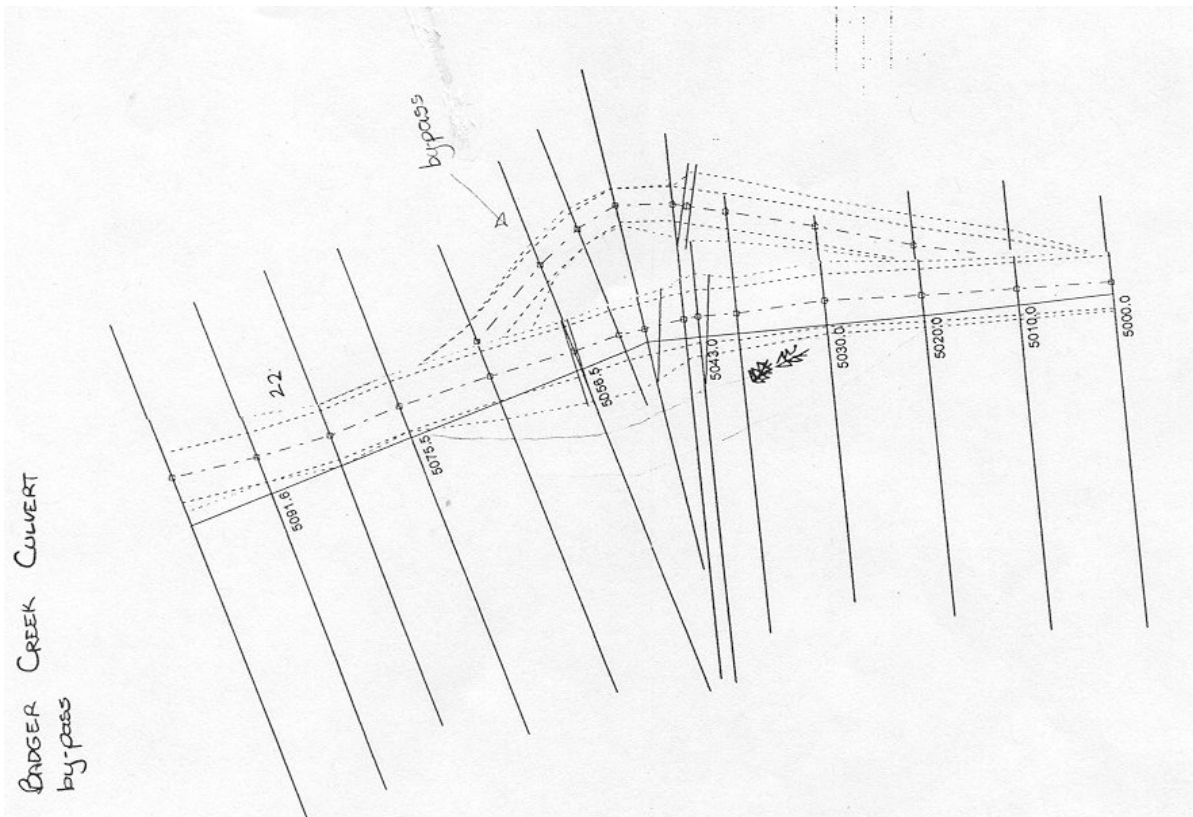


Alternative 2 includes sites numbered 1, 2, 3 and 4. Alternative 3 includes sites numbered 1, 2 and 4.

Badger Creek Culvert Design on Forest Road 22



Badger Creek Culvert temporary bypass on Forest Road 22



REFERENCES

- Altman, B. 2000. Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington. American Bird Conservancy, for Oregon-Washington Partners in Flight.
- Furniss, Michael J.; Sam A. Flanagan; Bryan McFadin. July 2000. Hydrologically- Collected Roads: An Indicator of the Influence of Roads on Chronic Sedimentation, Surface Water Hydrology, and Exposure to Toxic Chemicals, in Stream Notes: Stream Systems Technology Center, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.
- Helliwell, R. 2001. Personal communication on *Carex interior*
- Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press. Seattle.
- Hopkins, William E. and Stuart Garrett. 1990. Sensitive Plant-Animal and Noxious Weeds Guide for the Deschutes, Fremont, Ochoco and Winema National Forests-Area IV. USDA Forest Service, Pacific Northwest Region. R6-DES-TP-017-90.
- Hornocker, M.G., J.P.Messick and W.E. Melquist. 1983. Spatial strategies in three species of Mustelidae. Acta. Zool. Fenn. 174:185-188.
- Johnson, C.G. and Clausnitzer, R.R. 1991. Plant Associations of the Blue and Ochoco Mountains. USDA Forest Service.
- Joint Aquatic and Terrestrial Programmatic Biological Assessment April 2001 - April 2003, for Federal Lands within the Deschutes Basin Administered by the Bureau of Land Management Prineville Office and for Federal Lands Administered by the Deschutes and Ochoco National Forests April 30, 2001.
- Kaufman, K., "Lives of North American Birds". 1996.
- Martin, S.K. 1989 - "Ecology and Habitat Requirements of Wolverine". Literature Search. 1989.
- NatureServe Explorer: An online encyclopedia of life [web application]. 2001. Version 1.6. Arlington Virginia, USA: NatureServe. Available: <http://www.natureserve.org/explorer> (Accessed: May 23, 2002).
- Ochoco National Forest. 1989. Land and resource management plan - part 1 - Ochoco National Forest, Prineville, Oregon.
- Ochoco National Forest. 1995. Stream Survey Report.
- Ochoco National Forest. 1991. Stream Survey Report.
- Ochoco National Forest Botanists. 1996. Personal communication on viability of Ochoco NF sensitive plant species.
- Oregon Department of Fish and Wildlife. 1991. Sensitive Vertebrates of Oregon.
- Oregon Department of Fish and Wildlife. 1992. Threatened and Sensitive Wildlife of Oregon's Forests and Woodlands.
- Oregon Natural Heritage Program. 2001. Rare, Threatened, and Endangered Plants and Animals of Oregon. ONHP. Portland, OR.

-
- Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources. June 2000.
- Oregon Trout. Healthy Native Stocks of Anadromous Salmonids in the Pacific Northwest and California. 1994.
- Orr, Elizabeth L., William N. Orr and Ewart M. Baldwin, 1992, "Geology of Oregon", Kendall Hunt Publishing Company, 254 p.
- Paige, C., and S. A. Ritter. 1999. Birds in a sagebrush Sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, ID.
- Paulson, Dale J. 1977. "Ochoco National Forest Soil Resource Inventory, Pacific Northwest Region", U. S. Forest Service, Ochoco National Forest.
- Schmidt, Thomas. 1996. "Water Conservation Plan for Ochoco National Forest and Crooked River National Grasslands," U.S. Forest Service, Ochoco National Forest, 8 p.
- Sharp, B.E. 1992. "Neotropical Migrants on National Forests in the Pacific Northwest". A compilation of existing information. USDA Forest Service.
- Swanson, Donald A. 1969. "Reconnaissance Geologic Map of the East Half of the Bend Quadrangle, Crook, Wheeler, Jefferson, Wasco and Deschutes Counties, Oregon", USGS, Misc. Geologic Investigations Map I-568.
- Taylor, George. 1997. OSU Extension talk, Prineville, Oregon, January 16, 1997
- Tout, Deborah. 1989. "Mineral Potential Report for the Ochoco National Forest", USDA Forest Service, unpublished, 13 p.
- USDA Forest Service. 1992a. Forest Service Manual 2670 -- threatened, endangered, and sensitive plants and animals.
- USDA, Forest Service. 1992a. Forest Service Manual 2670. Letter from John E. Lowe, Deputy Regional Forester, sensitive species list; March 9, 1992. Portland, OR.
- USDA Forest Service. 1995. Environmental Assessment. Interim strategies for managing anadromous fish-producing watershed on federal lands in eastern Oregon and Washington, Idaho, and portions of California. Feb. 1995. 70 p.
- USDA Forest Service. 1996. Water Conservation Plan memorandum. June 12, 1996.
- United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 1996. Implementation of "Matrix of Pathways and Indicators" for evaluating the effects of human activities on anadromous salmonid habitat.
- United States Congress. 1974. Federal Noxious Weed Act of 1974. 7 USC 2801.
- USDA Forest service. 1988. Managing Competing and Unwanted Vegetation Final Environmental Impact Statement. Pacific Northwest Region, Portland, Oregon.
- USDA Forest Service. 1989. Ochoco National Forest Land and Resource Management Plan.
- USDA Forest Service. 1990-1993. Region 6 Threatened, Endangered, and Sensitive Plant Sighting Forms. Unpublished records on file at Ochoco Ranger Station and Lookout Mt. Ranger District Office, Ochoco National Forest.

-
- USDA Forest Service. 1991 and 1999. Regional Forester's (R-6) Sensitive Species List.
- USDA Forest Service. 1995 and 1998. Environmental Assessments, Decision Notices and Forest Plan Amendments for the Integrated Noxious Weed Management Program. Ochoco National Forest and Crooked River National Grassland, Ochoco National Forest, Prineville, Oregon.
- USDA/USDI Forest Service/Bureau of Land Management. 1997. Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement. Vol. 1, Ch 2, p. 104.
- USDA Forest Service. 1992. Forest Service Manual 2670-- Threatened, Endangered, and Sensitive plants and animals.
- U.S. Fish and Wildlife Service. 1986. Pacific Bald Eagle Recovery Plan. USFWS, Portland, OR. 163 p.
- U.S. Geological Survey: Bird Conservation [web application]. Available: <http://www.mbr-pwrc.usgs.gov/Infocenter> (Accessed: May 23, 2002).
- Verts, B.J. and L.N. Carraway. "Land Mammals of Oregon". 1998. University of California Press.
- Walker, George W., editor. 1990. "Geology of the Blue Mountains Region of Oregon, Idaho and Washington: Cenozoic Geology of the Blue Mountains Region", USGS, Professional Paper 1437, 135 p.
- Walker, George W. and Norman S. MacLeod. 1991. "Geologic Map of Oregon", Department of Oregon Geology and Minerals Industry, 1:500,000.
- Water Resources, Appendix V, Columbia-North Pacific Region Comprehensive Framework Study, Volume 2 (Subregions 7-12). April 1970. Prepared by Columbia-North Pacific Technical Staff, Pacific Northwest River Basins Commission, Vancouver, Washington.
- Woltering, G. 1994. Listing actions for aquatic species, section 4 of the ESA. USDA Forest Service, Region 6. 4 p.
- Yates, G. 2001. Personal communication on *Carex interior*.
- Zika, P.F. 1992. Draft management guide for rare Botrychium species (moonworts and grape ferns) for the Mount Hood National Forest. Prepared by the Oregon Natural Heritage Program.