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Report to the Ranking Minority Member, Subcommittee on Interior and Related Agencies, Committee on Appropriations, House of Representatives

November 2001

LAND MANAGEMENT AGENCIES

Restoring Fish Passage Through Culverts on Forest Service and BLM Lands in Oregon and Washington Could Take Decades

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United States General Accounting Office
Washington, DC 20548

November 23, 2001

The Honorable Norm Dicks
Ranking Minority Member
Subcommittee on Interior
and Related Agencies
Committee on Appropriations
House of Representatives

Dear Mr. Dicks:

The Bureau of Land Management, within the Department of the Interior, and the Forest Service, within the U.S. Department of Agriculture, manage over 41 million acres of federal lands in Oregon and Washington, including 122,000 miles of roads that use culverts—pipes or arches made of concrete or metal—to allow water to flow from one side of the road to the other. Many of the streams that pass through these culverts are essential habitat for fish and other aquatic species. When culvert openings are too high above the streams for fish to jump into or culverts are positioned at a grade too steep for fish to ascend, they pose barriers to fish attempting to access their natural rearing and spawning habitat. Passage through culverts is particularly important to anadromous fish, such as Coho and Chinook salmon (some of which are threatened or endangered), which are spawned in freshwater streams, but must travel to the ocean to mature, then travel back to the streams to spawn. The two agencies are concerned about the condition of the culverts on fish bearing streams on their Oregon and Washington lands because many, either because of deterioration or design, do not provide passage for all life stages (juvenile to adult) as required by current standards.

In this context, you asked us to determine (1) the number of culverts that may impede fish passage on Bureau of Land Management and Forest Service lands in Oregon and Washington, (2) the factors affecting the agencies' ability to restore passage through culverts acting as barriers to fish (hereafter referred to as barrier culverts), and (3) the results of the agencies' efforts to restore fish passage.

Results in Brief

Over 10,000 culverts exist on fish-bearing streams in Oregon and Washington according to Bureau of Land Management and the Forest Service estimates, but neither agency knows the total number that impede fish passage. Ongoing agency inventory and assessment efforts have

already identified nearly 2,600 barrier culverts, but agency officials estimate that more than twice that number may exist. The Forest Service plans to complete its assessment by the end of calendar year 2001. The Bureau of Land Management has not set a specific completion date for assessing all culverts, but intends to continue assessing culverts as part of its ongoing land management planning efforts. According to officials, both agencies intend to use the assessments to assist them in planning and setting priorities for eliminating barrier culverts. Based on current assessments, the agencies estimate that efforts to restore fish passage may ultimately cost over $375 million and take decades.

Although the agencies recognize the importance of restoring fish passage, several factors are inhibiting agencies' efforts. Most significantly, the agencies have not made sufficient funds available to do all the culvert project work necessary. In allocating road maintenance funds, the agencies assign a relatively low priority to such fish passage projects because road safety is a higher priority than resource protection. As a result, the agencies allocate most maintenance funding to address their large road maintenance backlogs rather than to undertake culvert projects. In addition, the often lengthy process of obtaining federal and state environmental clearances and permits to perform culvert work, as well as the short seasonal "window of opportunity" to do the work, affects the agencies' ability to restore fish passages quickly. Furthermore, the shortage of experienced engineering staff limits the number of projects that the agencies can design and complete. Currently, each barrier removal project generally takes 1 to 2 years from start to finish.

The Forest Service and the Bureau of Land Management completed 141 culvert projects from fiscal year 1998 through August 1, 2001, to remove barriers to anadromous fish and to open an estimated 171 miles of fish habitat. Neither agency, however, knows the extent to which culvert projects ultimately result in improved fish passage because neither agency requires systematic post-project monitoring to measure the outcomes of their efforts. The agencies say they do not perform post-project monitoring because of limited funding and staff availability and, according to agency officials, because they assume culverts built using current standards on lands under their jurisdiction should allow fish passage. State and local entities using these same standards, however, require systematic post-project monitoring to ensure that they used the most effective methods for improving fish passage under various conditions. Oregon's monitoring results, for example, indicate that retrofitting culverts with devices that slow the flow of water can effectively restore fish passage. Without monitoring, neither the Forest Service nor the Bureau of Land

Management can ensure that the federal moneys expended to improve fish passage are actually achieving the intended purpose. This report recommends that both agencies develop guidance for systematically assessing completed barrier removal projects to determine whether they are improving fish passage as intended. The agencies agreed with our recommendation for systematic monitoring.

Background

The Bureau of Land Management (BLM) and the Forest Service manage most of the nation's 655 million acres of federal land. BLM is responsible for about 264 million acres of public lands, managed by 12 state offices that are responsible for supervising the operations of 175 field offices nationwide. The Forest Service is responsible for about 192 million acres of public lands, managed by 9 regional offices that are responsible for supervising the operations of 155 national forests.

BLM and the Forest Service manage about 93 percent of the 44 million acres of federally owned land in Oregon and Washington. BLM's Oregon State Office manages about 17 million acres of land in the two states, including over 28,000 miles of roads. The state office directs the operations of 10 district offices—9 in Oregon and 1 in Washington—each responsible for managing BLM's public land resources within its geographic jurisdiction. Six of the Oregon districts contain Oregon and California Grant Lands, distributed in a checkerboard pattern within each district, and interspersed within and around the federal lands is state and private lands. The Forest Service's Region 6 manages about 25 million acres of land in the two states, including nearly 94,000 miles of roads. Region 6 directs the operations of 19 national forests—13 in Oregon and 6 in Washington. BLM's district offices and the Forest Service's national forest offices perform similar land management functions, including restoration of fish and wildlife habitat and designing, constructing, and maintaining roads.[1]

BLM and Forest Service land management activities regarding fish habitat in Oregon and Washington are governed by three regional agreements: the Northwest Forest Plan, signed in 1994 for activities on the west side of the Cascade mountain range, and PACFISH and INFISH, signed in 1995, for

[1] Unless otherwise stated, this report focuses on the activities of BLM's Oregon State Office and districts and the Forest Service's Pacific Northwest Region 6 and corresponding forests.

activities on the east side of the range.[2] Both agencies are required to direct their land management activities toward achieving the objectives of the three agreements. The Northwest Forest Plan's Aquatic Conservation Strategy includes the objective of maintaining and restoring "connectivity within and between watersheds," which must provide "unobstructed routes to areas critical for fulfilling the life history requirements" of aquatic species.[3] In addition, the Northwest Forest Plan's road management guidelines state that the agencies shall "provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams."[4] PACFISH includes the objective of achieving "a high level of habitat diversity and complexity…to meet the life-history requirements of the anadromous fish community inhabiting a watershed." The PACFISH road management guidelines duplicate the Northwest Forest Plan guidance. INFISH provides similar management objectives and guidance for resident native fish outside of anadromous fish habitat.

Maintaining fish passage and habitat is particularly important for anadromous fish, which as juveniles migrate up and down stream channels seasonally, then travel from their freshwater spawning grounds to the ocean where they mature, and finally return to their spawning grounds to complete their life cycle. Under the authority of the Endangered Species Act, the National Marine Fisheries Service currently lists four species of salmon—including Coho, Chinook, Chum, and Sockeye—as well as steelhead and sea-run trout as either threatened or endangered anadromous fish in the northwest region. According to agency officials, BLM and Forest Service lands in Oregon and Washington include watersheds that represent some of the best remaining habitat for salmon and other aquatic life, often serving as refuge areas for the recovery of listed species. As such, unobstructed passage into and within these watersheds is critical.

[2] PACFISH is the common title for the Decision Notice/Decision Record, Environmental Assessment, and Finding of No Significant Impact for interim management of anadromous fish producing watersheds on federal lands in eastern Oregon and Washington, Idaho, and portions of California. The Inland Native Fish Strategy (INFISH) is PACFISH's counterpart for resident native fish outside of anadromous fish habitat.

[3] A watershed is an area of land that acts as a drainage basin contributing water, organic matter, nutrients, and sediments to a stream or lake.

[4] Fish-bearing streams support fish during all or a portion of a typical year.

Culverts—generally pipes or arches made of concrete or metal—are commonly used by BLM and the Forest Service to permit water to flow beneath roads where they cross streams, thereby preventing road erosion and allowing the water to follow its natural course. Culverts come in a variety of shapes and sizes, designed to fit the circumstances at each stream crossing, such as the width of the stream or the slope of the terrain. Historically, agency engineers designed culverts for water drainage and passage of adult fish. However, as a culvert ages, the pipe itself and conditions at the inlet and outlet can degrade such that even strong swimming adult fish cannot pass through the culvert. The agencies remove, repair, or replace culverts to restore fish passage, as shown in figure 1.

Figure 1: Culvert Before and After Replacement

Source: BLM's Eugene District Office.

To meet the objectives of the Northwest Forest Plan and PACFISH, as well as Oregon and Washington state standards, current culvert repair or replacement efforts must result in a culvert that allows the passage of all life stages of fish, from juvenile to adult.

Extent to Which Barrier Culverts Block Fish Passage Is Unknown

As of August 1, 2001, the agencies' fish passage assessments identified almost 2,600 barrier culverts—over 400 on BLM lands and nearly 2,200 on Forest Service lands—and agency officials estimate that, in total, up to 5,500 fish barrier culverts may exist. BLM's 10 district offices are collecting culvert information as part of their ongoing watershed analysis activities and have not established a date for completing all culvert assessments. The Forest Service, using a regionwide fish passage assessment protocol, plans to complete data collection for all of its 19

forests by the end of calendar year 2001. The culvert information the agencies are collecting will help them coordinate and prioritize culvert repair, replacement, and removal efforts. Based on their current knowledge of culvert conditions, the agencies project that to restore fish passage at all barrier culverts could cost over $375 million and take decades to finish.

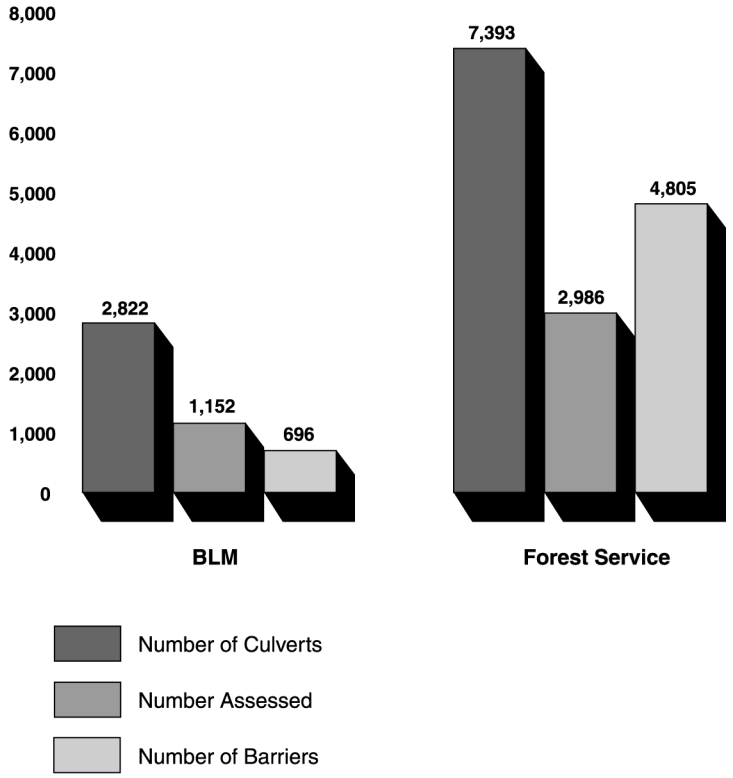
Agencies' Assessments to Determine Maintenance Status of Culverts Are Ongoing

BLM's district offices are assessing fish passage through culverts as part of the ongoing land management activity of a watershed analysis. A watershed analysis—a systematic procedure to characterize the aquatic (in-stream), riparian (near stream) and terrestrial (remaining land area) features within a watershed— is a requirement of the Northwest Forest Plan and provides the foundation for implementing stream and river enhancement projects, timber sales, and road building and decommissioning projects. According to an agency official, the extent to which a watershed analysis has been completed varies by district. The five western Oregon districts entirely within the Northwest Forest Plan's jurisdiction, which contain 98 percent of BLM's culverts on fish-bearing streams, have completed watershed analyses for 87 to 100 percent of their lands. The range for the remaining five districts is 0 to 18 percent. Each BLM district office maintains its own records regarding barrier culverts on its lands. As of August 1, 2001, BLM's district offices had assessed 1,152 culverts for fish passage and identified 414 barrier culverts. BLM plans to continue its ongoing watershed analysis process, and estimates, based on assessments to date, that an additional 282 barrier culverts may be identified, for a total of 696 culverts blocking fish passage.

The Forest Service initiated a regionwide assessment of culverts on fish-bearing streams in fiscal year 1999 to determine the scope of fish passage problems and to create a database of culvert information that will allow it to prioritize projects to address barrier culverts on a regionwide basis. The region first developed written guidance and provided implementation training to staff at each forest office. In fiscal year 2000, 13 of the 19 forests conducted the assessments and reported the results to the region's fish passage assessment database. In fiscal year 2001, the remaining six forest offices initiated their assessments and follow-up and verification of the first year's results is ongoing. As of August 2001, the forest offices had assessed 2,986 culverts for fish passage and identified 2,160—or about 72 percent—as barrier culverts. The region plans to complete its assessment by December 2001, and based on its findings thus far, estimates that an additional 2,645 barrier culverts may be identified, for a total of 4,805 culverts blocking fish passage.

On the basis of information collected as of August 1, 2001, the two agencies estimate a total of 10,215 culverts on fish-bearing streams under their jurisdictions—2,822 culverts on BLM lands and 7,393 culverts on Forest Service lands—as shown in figure 2.

Figure 2: Total Culverts Assessed and Barriers Estimated on BLM and Forest Service Lands as of August 1, 2001



Source: BLM's Oregon State Office and the Forest Service's Region 6.

Detailed information on district and forest office culvert assessment efforts is provided in appendix I.

Assessment Results Will Help Prioritize Reduction of Barrier Backlog

Additional ground work is necessary before both agencies have complete information on the extent of barrier culverts on their Oregon and Washington lands, and as such, neither agency has established a process for prioritizing passage restoration projects on a regionwide basis. However, the agencies are using the fish passage information they have

collected to help them coordinate and prioritize culvert repair, replacement, and removal efforts on a more limited scale.

For example, officials at BLM's Coos Bay district stated that through the ongoing culvert assessment process, they annually reprioritize culvert projects for each resource area within the district and for each watershed within each resource area, thus ensuring that the most critical barriers are addressed first. In addition, according to BLM state office officials, some culverts identified by district offices as fish passage barriers are included in their deferred maintenance and capital improvement project backlog and evaluated for funding among other road and facility projects. State office officials stated that while culvert passage restoration projects have not ranked high due to the critical nature of other backlog projects, they expect barrier culvert projects to move up the list for funding as the backlog is reduced.

National forest offices use their culvert fish passage assessment information to assist them in prioritizing culvert maintenance activities and for broader road management planning purposes. For example, in fiscal year 2001, regional officials directed each forest office to identify its top five culvert passage restoration projects when submitting its final assessment report. The region considered these projects for funding; however, according to a regional office official, it is not known how many of these projects were actually completed. In addition, Olympic National Forest officials stated that they have developed a draft road management strategy that uses the fish passage assessment results as input to assist them in further prioritizing of road projects identified by the strategy.

Although BLM and the Forest Service are currently addressing barrier culverts based on the assessment information they have collected, agency officials estimate, based on their results to date, that it may cost over $375 million and take decades to restore fish passage at all barrier culverts. BLM officials estimate a total cost of approximately $46 million to eliminate their backlog of about 700 barrier culverts, while Forest Service officials estimate a total cost of about $331 million to eliminate their backlog of approximately 4,800 barrier culverts. At the current rate of replacement, BLM officials estimate that it will take 25 years to restore fish passage through all barrier culverts, and Forest Service officials estimate that they will need more than 100 years to eliminate all barrier culverts. Furthermore, these estimates do not reflect any growth in the backlog due to future deterioration of culverts that currently function properly.

Several Factors Affect Agencies' Ability to Eliminate Barrier Culverts Quickly

According to BLM and Forest Service officials, several factors restrict their ability to quickly address the long list of problem culverts. Of most significance, the agencies assign a relatively low priority to such culvert projects when allocating road maintenance funds because ensuring road safety is the top priority for road maintenance, repair, and construction funds. Both agencies emphasize reducing the backlog of road maintenance rather than specifically correcting barrier culverts. Because neither agency requests funds specifically for barrier culvert projects, district and forest offices must fund these restoration projects within their existing budgets, and these projects must compete with other road maintenance projects for the limited funds. Therefore, to restore fish passage, the agencies largely rely on other internal or external funding sources not dedicated to barrier removal nor guaranteed to be available from year-to-year. Other factors affecting the agencies' efforts to restore fish passage include the complex and lengthy federal and state project approval process to obtain environmental clearances and the limited number of agency engineers experienced in designing culverts that meet current fish passage requirements. Furthermore, to minimize disturbance to fish and wildlife habitat, states impose a short seasonal "window of opportunity" within which restoration work on barrier culverts can occur. As a result, each barrier removal project generally takes 1 to 2 years from start to finish.

Barrier Culvert Projects Compete With Other Road Maintenance Priorities for Limited Funding

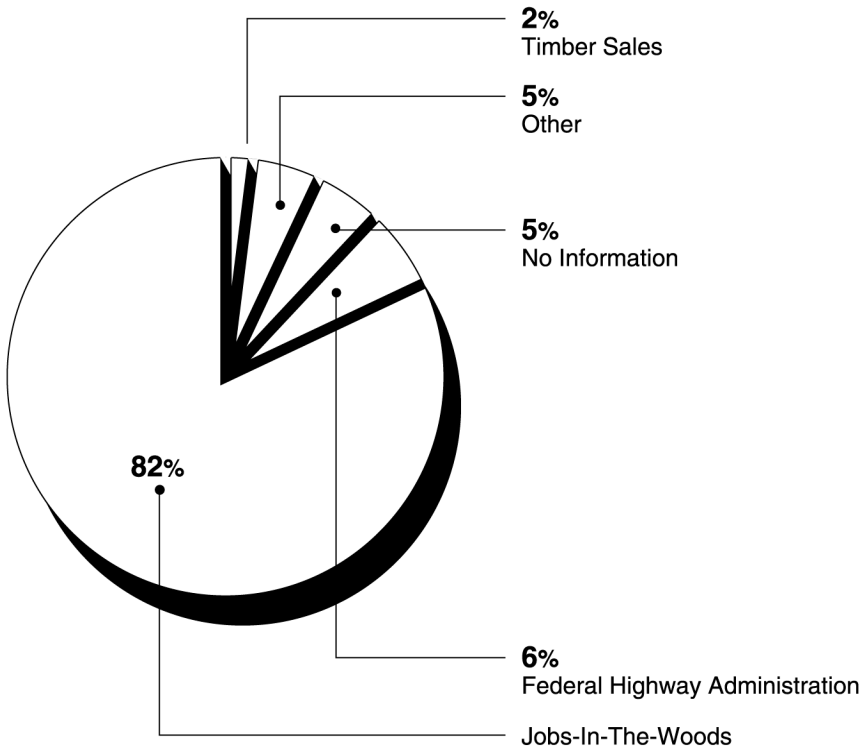
Both BLM and the Forest Service regard culverts as a component of their road system—similar to bridges, railings, signs, and gates—each requiring maintenance, including repair, replacement, and removal to ensure safe operation. As such, each agency requests funding for road maintenance as a total program of work rather than requesting funding specifically for culvert maintenance, or more specifically, to restore fish passage at barrier culverts. Furthermore, according to agency guidance, ensuring road safety is the top priority for road maintenance activities rather than removing barrier culverts.

Individual forest and district offices must fund culvert projects within their road maintenance allocations, compete with other units for deferred maintenance funds, or use other funding sources. BLM's state office and the Forest Service's regional office each allocate annual road maintenance funds to districts and forests primarily based on the miles of roads each contains and distribute additional funds to those units for maintenance projects on a competitive basis. BLM's fiscal year 2001 annual road maintenance funding totaled about $6 million, while according to officials, about $32 million is required to meet annual maintenance needs, including culverts. The Forest Service's fiscal year 2001 annual road maintenance

funding totaled about $32 million, while according to officials, about $129 million is required to meet their annual maintenance needs, including culverts. Due to their large backlogs of deferred maintenance, officials of both agencies stated that deferred maintenance funds have not been distributed to district or forest offices for fish passage restoration projects.

In the absence of sufficient road maintenance funding, the district and forest offices largely rely on other internal or external funding sources not specifically dedicated to barrier removal nor guaranteed to be available from year-to-year to restore anadromous fish passage at barrier culverts. As shown in figure 3, BLM's district offices reported that since fiscal year 1998, they relied almost entirely on Jobs-In-The-Woods program funding, which seeks to support displaced timber industry workers within BLM's Oregon and California Grant Lands. BLM distributes this funding to the western districts in Oregon containing the Oregon and California Grant Lands to fund contracts with local workers to do stream restoration projects, including barrier culvert repair and replacement. While BLM officials view the Jobs-In-The-Woods program as an ongoing source of funding for culvert projects, this funding source is not dedicated to barrier removal and BLM may use these funds for a variety of other resource programs or projects. Other BLM barrier culvert project funding sources include timber sales and the Federal Highway Administration's Emergency Relief for Federally-owned Roads to replace storm-damaged culverts.

Figure 3: Sources of Funding for BLM Culvert Projects, Fiscal Years 1998 Through August 1, 2001

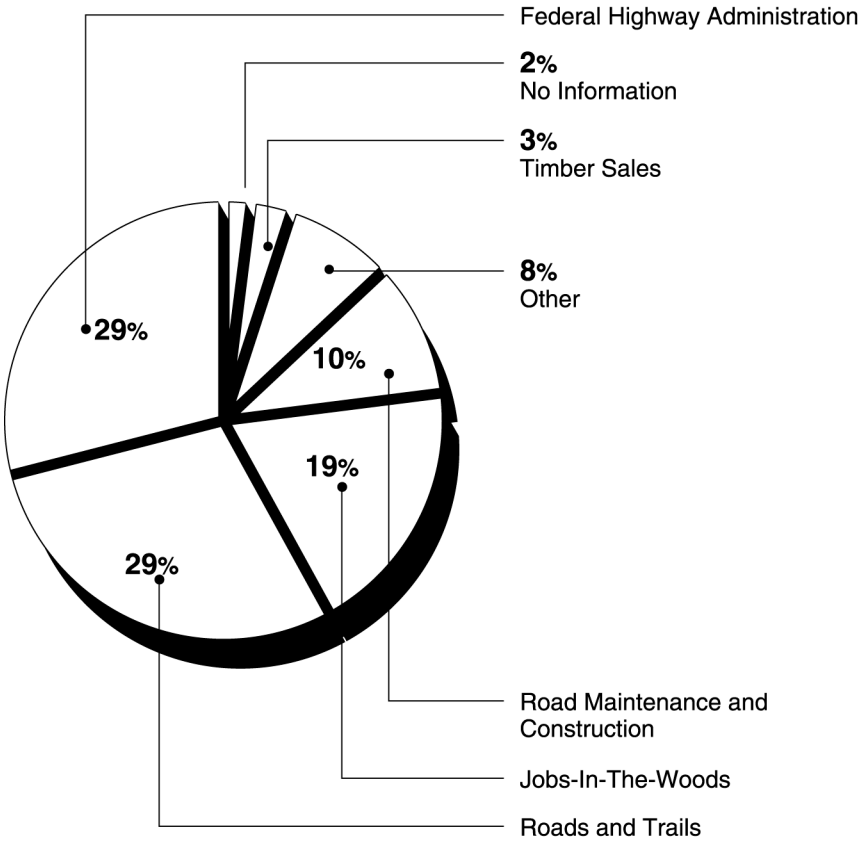


Source: BLM's Oregon State Office.

As shown in figure 4, national forest offices reported that since fiscal year 1998 they have primarily relied on the Federal Highway Administration's funding and the National Forest Roads and Trails funds for projects to restore anadromous fish passage at barrier culverts. Due to severe flooding in recent years and widespread damage to culverts, forest offices obtained Federal Highway Administration funds to replace damaged culverts and concurrently ensure these culverts meet current fish passage standards. While such funds enabled the forest offices to address barrier culverts, the forest offices cannot rely on future flood events to ensure a steady stream of funding for such projects. National Forest Roads and Trails funds consist of 10 percent of the receipts of the national forests made available to supplement annual appropriations for road and trail construction and projects that improve forest health conditions. Forest offices used these funds to restore fish passage at barrier culverts and to fund their ongoing culvert fish passage assessment effort. These funds,

however, are not dedicated to fish passage projects, but rather culvert projects compete with other road projects for these funds on a regionwide basis. Other funding sources for Forest Service fish passage projects include Jobs-In-The-Woods and timber sales.[5]

Figure 4: Source of Funding for Forest Service Culvert Projects, Fiscal Years 1998 Through August 1, 2001



Source: The Forest Service's Region 6.

[5] According to Forest Service officials, Jobs-In-The-Woods funds are no longer available.

Factors Affecting Project Design, Approval, and Construction Restrict Agencies' Efforts to Eliminate Barriers

In addition to limitations on the amount of funding available for barrier culvert projects and uncertainty regarding the continuity of such funding, three other factors affect the agencies' efforts to restore fish passage. These factors are (1) the complex and lengthy federal and state project approval process, (2) the limited number of agency engineers with experience designing culverts that meet current fish passage standards, and (3) the short seasonal "window of opportunity" during which work on barrier culverts can occur. Each of these factors affects the time frame needed to complete each of the major phases of a barrier culvert project—specifically, obtaining necessary permits and clearances, designing the culvert, and constructing the culvert—and consequently impacts the number of projects that can be completed annually. Due to these factors, culvert projects to restore culvert fish passage take 1 to 2 years to complete, according to BLM and Forest Service officials.

First, BLM and Forest Service officials stated that the number of fish passage projects the agencies can undertake and the speed with which they can be completed depend largely on how long it takes to obtain the various federal and state clearances necessary to implement a culvert project. Under the National Environmental Policy Act, an assessment of each project's impact on the environment must be completed before construction can commence. If the assessment indicates that an endangered species may be adversely affected by the project, Section 7 of the Endangered Species Act of 1973 requires the agency to consult with the appropriate authority—generally the National Marine Fisheries Service for anadromous fish and the Fish and Wildlife Service for other species—to reach agreement on how to mitigate the disturbance. BLM and the Forest Service have entered into an agreement with the consulting agencies to expedite the process through streamlined procedures. However, according to agency representatives, factors such as staffing shortages and turnover, as well as differing interpretations of the streamlining guidance, have prevented the revised consultation process from producing the efficiencies desired by the agencies, and it is currently under review. In addition to consultation:

- the U.S. Army Corps of Engineers requires a permit for fill or excavation in waterways and wetlands;
- Oregon requires a "removal and fill" permit for in-stream construction; and
- Washington requires a hydraulic project permit to engage in construction activities within streams.

According to information provided by district and forest offices for 56 completed culvert projects, the clearance and permit process is the most

time-consuming phase of a culvert project, ranging from a low of 4 weeks to a high of 113 weeks, for an average of about 31 weeks.

Second, BLM's and the Forest Service's efforts to eliminate barrier culverts are restricted, according to agency officials, by the limited number of engineers available to design them, and more specifically, the few with experience in designing culverts that meet current fish passage requirements. As a result, district and forest officials speculate that additional hiring or contracting with engineering firms for culvert design work may be necessary if greater emphasis is placed on reducing the barrier culvert backlog. Agency officials also emphasized the need for more fish biologists, hydrologists, and other professionals with fish passage design skills. According to time frame information provided by district and forest offices for 56 completed culvert projects, the design process is the second most time-consuming phase of a project, ranging from a low of 4 weeks to a high of 78 weeks to complete, for an average of about 19 weeks.

Finally, BLM and Forest Service officials stated that their efforts to eliminate barrier culverts are limited by a short seasonal "window of opportunity" of about 3 months during which fish passage restoration work—that is, construction work within streams— can occur. Oregon and Washington have established these time frames to minimize the impacts to important fish, wildlife, and habitat resources. The summer to fall in-stream work time frames, when construction is most feasible due to low water flow, most commonly run from July to September, but could be as narrow as July 15 to August 15, or just 1 month. According to time frame information provided by district and forest offices for 56 completed culvert projects, construction is the least time-consuming phase of a project, ranging from a low of 4 weeks to a high of 61 weeks to complete, for an average of about 10 weeks.

According to BLM and Forest Service officials, the minimum time necessary to complete a barrier culvert project, if all phases of the project are completed in the shortest possible time frame, is about 1 year. However, due to the factors discussed above, projects are more likely to take over a year to complete. The consequences of a delay caused by any one of the factors have a cascading effect on the project completion date. For example, according to agency officials, they generally begin a project by initiating the clearance and permit process and collecting some preliminary engineering information. However, if project clearances are not obtained or imminent by March when project funding decisions are made, construction may be put off to the next year, rather than committing

funds to a project that may not be ready for implementation within the seasonal time frames. Similarly, project clearances may be completed timely, but the project may be delayed if an engineer with fish passage design experience is not available. And, if all phases of a project, including construction contracts, are not in place in time to complete construction within the state-mandated stream construction time frames, the project must be put off until the next season. According to the information provided by district and forest offices for 56 projects, the total time to complete a project ranged from a low of 16 weeks to a high of 186 weeks, for an average of 60 weeks.

Ultimate Effectiveness of Agency Efforts to Restore Fish Passage Is Largely Unknown Because Completed Projects Are Not Systematically Monitored

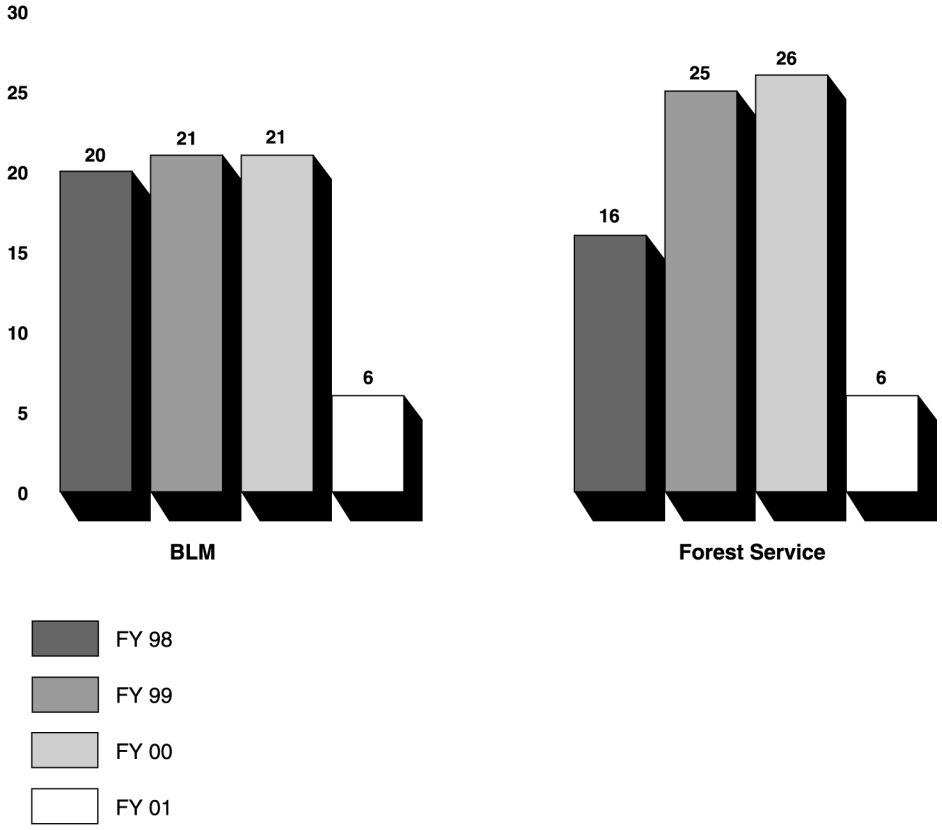
BLM and the Forest Service completed 141 projects to restore fish passage for anadromous fish at barrier culverts from fiscal year 1998 through July 2001 and opened access to an estimated 171 miles of fish habitat. However, because neither agency requires systematic monitoring of these completed projects, the actual extent of improved fish passage is largely unverified. According to agency officials, current culvert fish passage design standards are based on scientific research that considers such factors as the swimming ability of fish at various life stages and the velocity of water. Therefore, the officials assume that fish can migrate into the newly accessible habitat through culverts built to these standards. Furthermore, agency officials cite a lack of funds and available staff as reasons for not requiring systematic post-project monitoring.

While district and forest offices may monitor projects on a limited or ad hoc basis, whether both juvenile and adult fish can actually pass through the restored culvert or actually inhabit the upstream areas is not systematically determined. However, the Oregon and Washington state fish passage restoration programs, as well as other local efforts, require systematic post-project monitoring to determine the most effective methods for improving fish passage under various conditions. Without such monitoring, neither the Forest Service nor BLM can ensure that the federal moneys expended for improving fish passage are actually achieving the intended purpose.

Forest Service and BLM Do Not Require Post-Project Monitoring

As shown in figure 5, BLM reported 68 projects completed to restore fish passage for anadromous fish at barrier culverts from fiscal year 1998 through August 1, 2001, opening access to an estimated 95 miles of fish habitat. During the same time frame, the Forest Service reported 73 projects completed to restore fish passage for anadromous fish at barrier culverts and opened access to an estimated 76 miles of fish habitat.

Figure 5: Completed BLM and Forest Service Culvert Projects by Fiscal Year



Note: Fiscal year 2001 includes only projects completed as of August 1, 2001.

Source: BLM's Oregon State Office and the Forest Service's Region 6.

The actual extent of improved fish passage is largely unknown, however, because neither agency requires systematic post-project monitoring of completed projects. Forest and district offices undertake a wide range of activities in and around streams to restore aquatic habitat. These activities include eliminating fish passage barrier culverts, as well as other activities such as stabilizing eroding stream banks, planting vegetation, and placing desirable woody debris and boulders into the streams. While each forest and district office is required to conduct monitoring of selected restoration activities, neither agency specifically requires barrier culvert projects be monitored. Therefore, restoration projects selected by district and forest offices for monitoring may or may not include barrier culvert passage projects. Consequently, the agencies do not systematically determine whether fish can actually pass through repaired or replaced

culverts. Furthermore, while the miles of habitat theoretically made accessible to fish is estimated, the extent to which fish actually inhabit that stream area is not routinely determined.

BLM and Forest Service officials stated that monitoring all culvert fish passage projects would be a costly and time-consuming effort for their already limited staff. Therefore, district and forest staff stated that culvert project follow-up is generally ad hoc in nature. For example, subsequent to project completion, the designing engineer will likely look to see if water appears to be flowing through the culvert as designed, or the fish biologist that helped plan a project may walk up the stream side looking for egg beds to ascertain the presence of fish. However, according to agency officials, a formalized, comprehensive measurement of results, for example, requiring engineers to measure water flows through all completed culverts or biologists to count egg beds in every area of a newly opened habitat is not feasible at current funding and staffing levels. One forest official stated that ideally, every project should have monitoring funds included with the project funds to verify effectiveness, but funding realities have not made this possible.

According to BLM and Forest Service officials, in the absence of systematic monitoring, they assume that culverts built to current standards will allow fish migration into the newly accessible habitat. Current culvert design standards are based on scientific research that considers important factors such as the swimming capabilities of fish at various life stages and the velocity of water to guide engineers in building culverts that will allow passage of juvenile to adult fish. BLM primarily follows the standards published by the Oregon State Department of Fish and Wildlife, and the Forest Service follows those same Oregon standards or the Washington Department of Fish and Wildlife's standards, depending on the project's location. Where appropriate, the current standards endorse the use of open bottom culverts that simulate natural stream bottoms and slopes and culvert widths that adhere to the stream's natural width, mimicking the stream's natural features to the greatest extent possible.

However, even culvert projects built to current standards may not necessarily result in improved fish passage. District and forest officials characterized culvert fish passage design as an evolving area of study. For example, according to federal and state officials, retrofitting culverts by adding staggered or perforated panels inside to slow down water velocities is a complex design process only applicable in limited circumstances. Another area of concern, according to Forest Service

officials, is the length of culverts because questions remain as to how far fish will swim inside a dark culvert. Furthermore, during our field visits to completed culvert project sites, we observed culverts that, according to agency officials, continued to be barriers to fish passage, including a retrofitted culvert that did not sufficiently slow water flow, a replaced pipe that did not allow juvenile fish passage, and a culvert that allowed water to flow under it rather than through it.

Post-Project Monitoring Could Help Identify the Most Effective Fish Passage Restoration Methods

Systematic post-project monitoring is a requirement of the Oregon and Washington state fish passage restoration efforts on state lands, as well as cooperative local programs on other lands within the states and has helped these programs to identify ways to enhance the effectiveness of fish passage projects. According to an Oregon Department of Fish and Wildlife official, in fiscal year 1999 the state implemented a protocol for systematically monitoring and documenting the results of culvert retrofit projects to improve fish passage. The protocol, jointly developed by Oregon's Department of Fish and Wildlife and Department of Transportation, requires monitoring the movement of water in and around retrofitted culverts to determine if fish passage is improved. In the first year of implementation, the agencies systematically monitored selected culverts retrofitted in 1998 within certain state regions, including visual inspections and water velocity measurements taken at different times to assess how well the retrofit designs slowed water velocity. The monitoring results indicated the retrofit designs, while needing some adjustments, improved fish passage by slowing water and reducing culvert entry jump heights for fish. According to the state official, the agencies are currently developing fish passage monitoring protocols for culverts that have been replaced rather than retrofitted.

The Washington Department of Fish and Wildlife, in partnership with the state Department of Transportation, developed and implemented a three-level culvert and fish use evaluation procedure for all culvert retrofit or replacement projects funded by the state's Fish Passage Barrier Removal Program. Agreeing that the best management practice is to avoid "walking away" from a fish passage project once construction is complete, the agencies are systematically assessing culvert projects for design, durability and efficiency; determining if fish use the newly available habitat; and troubleshooting problems identified. The three-level evaluation involves the following steps:

- First, fish use before and after project completion is determined, and each completed project is evaluated for durability, efficiency, and design flaws,

which are corrected during the year following project completion. The culvert is removed from the monitoring list if fish passage is verified and no additional monitoring is required.

- Second, for culverts where fish passage is not occurring, additional monitoring for fish presence is implemented, and if necessary, other methods to support fish recovery, including supplementation such as planting of hatchery fish, fishing restrictions, or stream habitat improvement projects, are implemented.
- Third, selected culverts are studied to determine the overall impact on fish populations.

Evaluation results as of April 2001 indicated most habitats reclaimed through culvert projects were immediately populated by fish; however, varied responses on some streams require additional monitoring and possibly further enhancement efforts to promote fish recovery.

In addition to the state monitoring efforts, local fish passage restoration plans may also require systematic monitoring of project results to ensure they are successful. For example, Oregon's Rogue River Basin Fish Access Team, composed of local stakeholders, watershed councils, and state and federal agencies (including BLM and the Forest Service), has established a basinwide strategic plan to cooperatively prioritize fish passage barriers, secure funding for projects, implement passage enhancement projects, and monitor the success of projects. Specifically, to participate in the program, a monitoring plan must be completed for each project before the project begins. The monitoring plan must determine whether the project was implemented as planned, was effective in solving fish passage problems, and contributed to the expanding fish distribution across the Rogue River basin. Potential techniques suggested to determine effectiveness include spawning and snorkeling (underwater observation) surveys.

As their actions demonstrate, Oregon, Washington, and other entities consider systematic monitoring to be an important tool to determine the most effective methods for improving fish passage under various conditions. The systematic monitoring allows the entities to incorporate this knowledge into future restoration planning and implementation. Their varied approaches reflect the range of methods available for monitoring—that is, monitoring improvements to water flow at selected culverts of a specific design type, verifying the actual presence of fish in a newly opened habitat, or developing monitoring plans for specific projects. While each monitoring approach requires a commitment of agency staff and funding to implement, they all provide valuable information for targeting future expenditures on culvert passage restoration methods that most

benefit fish. Oregon and Washington's monitoring efforts have helped them to assess the success of various culvert passage restoration methods and identified methods that require adjustments or further study to determine their effectiveness. Without such systematic monitoring programs, neither the Forest Service nor BLM can ensure that the federal moneys expended for improving fish passage are actually achieving the intended purpose.

Conclusions

BLM and the Forest Service are faced with the daunting task of addressing a large backlog of fish passage barrier culverts. Given the limited funding available for fish passage projects and the various factors that affect the agencies' ability to complete projects quickly, eliminating barrier culverts will be a long, costly effort. While both agencies are already using culvert assessment information to help them prioritize projects, that is just the beginning of the barrier elimination process. Ultimately, the culvert projects selected for implementation—whether retrofitting existing culverts, replacing culverts, or removing culverts—must achieve the objective of restoring fish passage. Systematic monitoring of completed projects would provide the agencies with information to help them identify which methods actually work best under various circumstances and evidence that their expenditures have actually improved fish passage. Although monitoring would divert funding and staff from the implementation of culvert passage improvement projects, state monitoring programs have demonstrated the value of monitoring to assess the effectiveness of barrier culvert projects and to allow these entities to incorporate this knowledge into future planning and implementation efforts.

Recommendation for Executive Action

To determine whether fish passage restoration projects are achieving their intended purpose, we recommend that the Director of BLM and the Chief of the Forest Service each develop guidance for systematically monitoring completed barrier removal projects. This guidance should establish procedures that will allow the agencies to cost-effectively measure and document improvements to fish passage.

Agency Comments

We provided the Department of the Interior and the Forest Service with a draft of this report for comment prior to issuance. The agencies generally agreed with the content of the report and concurred with our recommendation for systematic monitoring so long as agency officials have the discretion to determine the monitoring approaches and

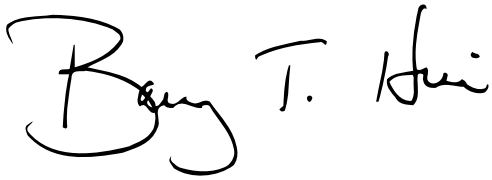
methodologies that will most benefit them in planning and implementing future fish passage projects. We recognize that the agencies will have to exercise discretion in developing this guidance, but they need to ensure that they implement a monitoring program that cost-effectively measures and documents improvements to fish passage. The agencies also provided certain technical clarifications, which we incorporated, as appropriate, in the report. Copies of the agencies' comments are included as appendixes II and III.

We conducted our review from March 2001 through October 2001 in accordance with generally accepted government auditing standards. Details of our scope and methodology are discussed in appendix IV.

We are sending copies of this report to the Director of the Bureau of Land Management and the Chief of the Forest Service. We will also provide copies to others on request.

If you or your staff have any question about this report, please call me at (202) 512-3841. Key contributors to this report are listed in appendix V.

Sincerely yours,



Barry T. Hill
Director, Natural Resources
and Environment

Appendix I: Barrier Culvert Information by Bureau of Land Management District Office and National Forest

The Bureau of Land Management (BLM) and the Forest Service are assessing culverts on their lands in Oregon and Washington to identify barriers to fish passage. Neither agency has completed this effort, but each of the 10 district and 19 forest offices provided their assessment results as of August 1, 2001. In addition, each district and forest office provided the estimated total number of culverts on fish-bearing streams, an estimated number of culverts not yet assessed that may be barriers, and an estimated cost to restore fish passage through barrier culverts.

Bureau of Land Management

BLM districts reported that they have assessed 1,152 culverts for fish passage and identified 414 barriers. In addition, the districts estimate that 282 additional barrier culverts may exist. BLM estimates that the cost to restore fish passage at all 696 of these barrier culverts could be about $46 million, as shown in table 1.

Table 1: BLM Fish Passage Barrier Culverts as of August 2001

Dollars in thousands						
BLM district	Estimated number of culverts on fish-bearing streams	Number of culverts assessed for fish passage	Number of barrier culverts identified	Number of barrier culverts estimated	Total number of barrier culverts identified and estimated	Estimated cost to restore fish passage at barrier culverts
Oregon						
Burns	2	2	0	0	0	0
Coos Bay	960	92	33	55	88	$2,561
Eugene	284	264	112	20	132	8,404
Lakeview	53	16	1	3	4	313
Medford[a]	167	154	57	10	67	7,931
Prineville	2	2	0	0	0	0
Roseburg[a]	879	500	150	30	180	19,800
Salem	466	117	60	164	224	7,425
Vale[a]	4	0	Unknown[b]	Unknown[b]	Unknown[b]	Unknown[b]
Oregon total	**2,817**	**1,147**	**413**	**282**	**695**	**$46,434**
Washington						
Spokane	5	5	1	0	1	13
Total all districts	**2,822**	**1,152**	**414**	**282**	**696**	**$46,447**

[a]Data reported by Medford, Roseburg, and Vale Districts do not include culverts on streams bearing resident fish only.

[b]Vale district did not provide estimates as of August 1, 2001.

Source: BLM.

Forest Service

Forest Service national forest offices reported that they have assessed 2,986 culverts for fish passage and identified 2,160 barriers. In addition, they estimate that an almost equal number, about 2,645, of additional barrier culverts may exist. The Forest Service estimates that the cost to restore fish passage at all 4,805 barrier culverts could be about $331 million, as shown in table 2.

Table 2: Forest Service Fish Passage Barrier Culverts as of August 2001

Dollars in thousands						
National forest	Estimated number of culverts on fish-bearing streams	Number of culverts assessed for fish passage	Number of barrier culverts identified	Number of barrier culverts estimated	Total number of barrier culverts identified and estimated	Estimated cost to restore fish passage at barrier culverts
Oregon						
Deschutes	200	180	134	0	134	$24,232
Fremont	600	177	138	262	400	10,000
Malheur	1,000	50	40	760	800	20,000
Mt. Hood	397	247	237	142	379	18,200
Ochoco	600	52	42	420	462	21,800
Rogue River	310	106	88	0	88	5,560
Siskiyou	198	198	132	0	132	13,000
Siuslaw	540	491	270	0	270	25,427
Umatilla	392	200	180	0	180	33,000
Umpqua	236	107	96	116	212	Unknown[a]
Wallowa-Whitman	Unknown[a]	0	0	Unknown[a]	Unknown[a]	Unknown[a]
Willamette	991	323	310	116	426	77,000
Winema	120	0	0	80	80	2,000
Oregon total	**5,584**	**2,131**	**1,667**	**1,896**	**3,563**	**$250,219**
Washington						
Colville	250	100	0	50	50	Unknown[a]
Gifford Pinchot	500	100	0	425	425	38,000
Mt. Baker-Snoqualmie	250	130	56	67	123	10,701
Okanogan	150	77	74	66	140	8,000
Olympic	142	119	119	0	119	16,422
Wenatchee	517	329	244	141	385	7,700
Washington total	**1,809**	**855**	**493**	**749**	**1,242**	**$80,823**
Total all forests	**7,393**	**2,986**	**2,160**	**2,645**	**4,805**	**$331,042**

[a]According to the Forest Service, the Umpqua, Wallow-Whitman, and Colville national forests did not provide estimates because their fish passage assessments were not complete.

Source: The Forest Service.

Appendix II: Comments From the Department of the Interior

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

NOV 8 2001

Mr. Barry Hill
Director, Natural Resources and Environment
U.S. General Accounting Office
441 G Street, NW
Washington, D.C. 20548

Dear Mr. Hill:

Thank you for the opportunity to respond to the General Accounting Office's (GAO) draft report entitled, "LAND MANAGEMENT AGENCIES: Restoring Fish Passage Through Culverts on Forest Service and BLM Lands in Oregon and Washington Could Take Decades" (GAO-02-136).

The Department of the Interior concurs with GAO's recommendation that the Director of the Bureau of Land Management (BLM) and the Chief of the Forest Service each develop guidance for systematically monitoring completed barrier removal projects. This guidance should establish procedures that will allow the agencies to cost-effectively measure and document improvements to fish passage.

If you have any further questions, please contact Joe Moreau, Fisheries Program Lead, BLM Oregon State Office, at 503/952-6418, or Rebecca Mack, Management and Program Analyst, BLM Management Systems Group, at 202/452-5047.

Sincerely,

Tom Fulton for

J. Steven Griles
Acting Assistant Secretary
Land and Minerals Management

Enclosure

Appendix III: Comments From the Forest Service

United States Department of Agriculture | Forest Service | Washington Office | 14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

File Code: 1420
Date: NOV 15 2001

Barry T. Hill
Director, Natural Resources and Environment
U. S. General Accounting Office
441 G Street N.W.
Washington, DC 20548

Dear Mr. Hill:

Thank you for the opportunity to provide a response to GAO's Draft Report, *Restoring Fish Passage Culverts on Forest Service and BLM Lands in Oregon and Washington Could Take Decades, GAO-02-136.* Enclosed are the comments to the draft report. These comments include those of a general nature pertinent to the draft report as a whole, such as setting the context within which the review team was directed to operate, as well as specific comments addressing factual errors and/or misinterpretations.

The Forest Service generally agrees with the report's content and concurs with its recommendations. We appreciate the time and effort on the part of GAO staff to examine this complex program, as well as the changes made to the first draft based on our exit conference interview.

The effectiveness monitoring listed as the primary recommendation in the report is necessary to ensure that new fish passage structures, and those recently repaired, are in fact operating as intended and passing fish at all life stages. We want to point out that monitoring to ensure that replacement structures operate as intended is a highly technical and complex task and requires substantial investment in time and trained personnel in order to arrive at accurate results. We also want to point out that there are other aquatic organisms that need to be considered when replacing road stream crossings. Designs for replacement structures or repair of existing structures should accommodate other species as well otherwise the replacement structures may become obsolete in a short period. Also, barriers to fish passage is a national issue that affects all regions of the nation. It is important to keep this in mind when discussing funding alternatives to rectify this problem.

If you have additional questions, please contact the Agency's External Audit Liaison, Linda Washington at (202) 205-1560.

Sincerely,

Donna Carmical

for CATHRINE L. BEATY
Chief Financial Officer, Deputy Chief, Office Of Finance

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Appendix IV: Scope and Methodology

To determine the number of culverts that may impede fish passage on BLM and Forest Service lands in Oregon and Washington, we interviewed officials and gathered documentation from BLM's Oregon State Office and the Forest Service's Region 6 office, both located in Portland, Oregon. Specifically, we gathered and analyzed information on the number and maintenance status of culverts located in the 10 BLM districts under Oregon State Office jurisdiction and the 19 national forests under Region 6 jurisdiction and the costs and time frames associated with the repair of barrier culverts. We conducted site visits at four BLM district offices in Oregon—Coos Bay, Eugene, Medford, and Prineville—and at nine national forest offices—Deschutes, Ochoco, Rogue River, Siskiyou, Siuslaw, Umatilla, and Williamette in Oregon; and Gifford Pinchot and Olympic in Washington. We met with district and forest office staff and collected information on their culvert inventories and assessment and prioritization efforts and observed completed and potential culvert restoration projects.

To identify the factors affecting the agencies' ability to restore passage through culverts acting as barriers to fish, we interviewed BLM and Forest Service headquarters officials, Oregon State Office and Region 6 officials, and district and forest office staff and reviewed policies, procedures, and practices for repairing, replacing, or removing barrier culverts. We gathered and analyzed funding information for 141 anadromous fish passage culvert projects completed in Oregon and Washington from fiscal year 1998 through July 2001, including the amount and source of funds expended for each project. We analyzed detailed time line information for 56 of the 141 projects that included complete start and finish dates for the three main phases of each project—federal and state clearances, design and engineering, and construction. We interviewed agency officials and gathered documentation to identify the factors that affect project time frames and to determine how these factors limit the number of culvert projects that can be completed annually.

To determine the results of the agencies' efforts to restore fish passage, we gathered and analyzed information on the number of (1) culverts repaired, replaced, or removed to improve anadromous fish passage and (2) miles of habitat restored from fiscal year 1998 through August 1, 2001, by district and forest offices under Oregon State Office and Region 6 jurisdiction. We interviewed BLM and Forest Service headquarters, state and regional office, and district and forest office officials and reviewed documentation to determine whether regulations, policies, and procedures required systematic monitoring of the effectiveness of the culvert restoration projects. To identify state efforts to monitor the outcome of fish passage projects, we interviewed Oregon and Washington state officials and

reviewed regulations, policies, and procedures and monitoring reports provided by the state agencies with fish passage restoration responsibilities.

We conducted our work from March 2001 through October 2001 in accordance with generally accepted government auditing standards.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

Linda Harmon (202) 512-8046

Acknowledgments

In addition to the above, Leo Acosta, Kathy Colgrove-Stone, and Brad Dobbins made key contributions to this report.

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