COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-179664

The Honorable Bob Packwood
United States Senate

Dear Senator Packwood:

Pursuant to your request of September 6, 1973, as modified in our November 7, 1973, briefing and subsequent discussions with your office, we have reviewed the benefit-cost computations and environmental aspects of the Corps of Engineers' Applegate Lake project which was authorized in the Flood Control Act of 1962 (Public Law 87-874).

As agreed, we limited our review to an evaluation of the data supporting the benefits reported to the Congress in January 1973 and to certain information developed by the Corps' Portland District during our review. We also interviewed officials of the Corps' headquarters, Portland District, and North Pacific Division, Department of the Army; Bureau of Reclamation's Pacific Northwest regional office, Boise, Idaho, and Bureau of Sport Fisheries and Wildlife regional office, Portland, Oregon, Department of the Interior; Forest Service's Rogue River National Forest Office, Department of Agriculture; National Marine Fisheries Service's Columbia Fisheries Program Office, Portland, Oregon, Department of Commerce; Oregon State Game Commission; and the Oregon State Fish Commission.

During our November 7, 1973, briefing, we told you that the reported benefits should be adjusted to correct overstatements and understatements and that support was lacking for some of the benefits claimed. Our work subsequent to the briefing revealed that additional adjustments should be made. These adjustments, generally agreed to by the Corps, could increase net annual benefits to an estimated $817,000, exclusive of area redevelopment benefits. However, as discussed in the enclosure, as much as $707,600 of the annual benefits are not fully supported by available documentation. Even if a substantial part of the benefits prove to be unsupportable, the project's benefits will still exceed costs, and therefore the project will be considered economically feasible.

Preventing flood damage to future flood plain developments accounts for about 45 percent of the total project benefits. The growth rate used to compute such benefits represents the expected annual growth in the value of damageable property less an allowance for increased price levels. Although we could not conclude that the growth rate used was unreasonable, we did note that the method used to compute the growth

rate was not consistent with a draft Corps instruction and a recent district analysis for a nearby project. In addition, benefit amounts are highly sensitive to relatively small changes in the growth rates. We wish to point out that, if the growth rate, which is the most significant factor used in computing the project's benefits, is not reasonably accurate--that is, if it is too high--its impact on the project's benefits, and therefore its economic feasibility, could be significant.

The two major environmental issues--the project's adverse impact on the Siskiyou Mountain salamander and the potential for mercury pollution in the reservoir--cannot be resolved until needed research studies are completed. District officials said they would take no irreversible actions before these issues were resolved but indicated they would not delay activities, such as advanced design and land acquisition, because of rising costs. They said that these activities could be initiated without disturbing the salamander's habitat. Corps actions concerning the salamander may also be influenced by the Department of the Interior's intention to officially list it as either a threatened or an endangered species pursuant to the Endangered Species Act of 1973 (Public Law 93-205).

The results of our review are discussed more fully in the enclosure. Although the matters presented in this report have been discussed with officials of the Corps of Engineers, as you requested, we have not obtained the comments of the Department of the Army.

We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

Comptroller General
of the United States

Enclosure

ENCLOSURE

RESULTS OF GAO'S REVIEW OF BENEFITS AND COSTS FOR CORPS OF ENGINEERS APPLEGATE LAKE PROJECT, OREGON

At a briefing on November 7, 1973, we furnished Senator Packwood with information on the background and current status of the project and on the annual benefits and costs which the Corps reported to the Congress in January 1973. We pointed out that there was an overstatement of $443,000 in the reported net annual benefits of $823,000[1] and that, for the most part, the Corps' Portland district agreed with our views on the overstated items.

Also we told Senator Packwood that we questioned claimed annual benefits totaling $1,330,000 because (1) adequate documentation was not available to support the factors the Corps used in its analyses and computations or to show how the benefits were derived and (2) the Corps had not adequately considered information which seemed to contradict the assumptions it made in the benefit computations. We pointed out that, more than likely, parts of the benefits questioned could be claimed and that, conceivably, all of them might be justified. We concluded, however, that, until further source data and supporting documentation was provided, we could not reach an opinion on the reasonableness of the benefits.

We advised Senator Packwood that we could not reach an opinion on the project's unresolved environmental matters until the completion of needed studies which is expected to take 1 to 3 years.

RECENT CORPS EFFORTS

Since the briefing, we have evaluated the results of recent Corps efforts, including studies it made during November and December 1973, and the position papers the Corps furnished the Senator.

The Corps' studies showed that additional benefits should be claimed for flood control and provided support for both the flood control and the fishery benefit amounts previously in question. The position papers did not, in our opinion, support the amounts in question under recreation, water quality, and irrigation, and contained some inaccuracies which district officials said would be corrected in subsequent revisions.

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[1] Includes $208,600 for area redevelopment benefits which, according to Corps policy, are not to be included in determining a project's economic feasibility.

ENCLOSURE

SUMMARY OF ANNUAL BENEFITS AND COSTS

	Reported to the Congress in January 1973	Adjusted values per GAO review (note a)	Values not fully supported
	(thousands)		
Annual benefits:			
Flood control	$1,172.0	$1,583.0	$ (b)
Fish and wildlife	494.0	523.0	-
Lake recreation	449.0	357.0	357.0
Water quality	383.0	383.0	330.0
Irrigation	39.0	[c]20.6	[c]20.6
Other uses	5.4	5.4	-
Area redevelopment	(d)	(d)	-
Total benefits	2,542.4	2,872.0	707.6
Less annual costs	1,928.0	[e]2,055.0	(e)
Net benefits	$ 614.4	$ 817.0	$707.6

[a]Generally agreed to by the Corps.

[b]Although we could not conclude that these benefits were unreasonable, we noted inconsistencies in the Corps' determination of the expected growth rate used to measure future flood control benefits.

[c]In January 1974 the Corps reduced the benefits which were based on the Applegate project providing storage for an irrigation project that might be developed in the future. Until such a project is a reasonable certainty, it does not seem appropriate to assign irrigation benefits to the Applegate project.

[d]In its 1973 report to the Congress, the Corps included $208,600 annual benefits for area redevelopment. Although Corps policy permits the inclusion of area redevelopment benefits in project plans for informational purposes, it precludes their use in determining a project's economic justification. Accordingly, we did not review the benefits reported for this category and excluded them in determining the project's net benefits.

[e]Part of the adjusted annual costs are directly associated with provision of recreation and water quality benefits. If some of the benefits prove to be unsupportable, the associated costs may be reduced.

Flood control

The district made three modifications to its January 1973 flood control annual benefit amount of $1,172,000. It (1) gathered more information and updated expected flood damages, (2) updated benefit computations to include anticipated flood plain growth during the project's construction period, and (3) reduced flood plain growth rate forecasts over the project life. The net effect was to increase flood control benefits by about $411,000, to $1,583,000 annually.

In revising the expected flood damages, the district physically surveyed the buildings in the 500-year flood plain and assigned values to the buildings and their contents on the basis of expected levels of inundation. The district estimated the damage per acre for agricultural lands on the basis of past floods, determined repair costs for roads and bridges on the basis of the estimated damages, and estimated flood damage reduction categories. This reanalysis increased benefits by about $324,000 annually.

Although it is district policy to consider growth in the flood plain during the project's construction period, the district had not done this. However, after our briefing, the Corps updated its benefit computations for growth in the flood plain during the expected 8-year construction period. This factor increased benefits by about $508,000 annually.

The district also reduced the expected growth rate in the flood plain for the Applegate project from 4.1 percent to 3.7 percent to account for the effects of partial flood plain zoning in Jackson and Josephine Counties. This action reduced benefits by $421,000 annually. Although we could not conclude that the growth rate used was unreasonable, we did note inconsistencies in the method used to compute it. (See p. 6.)

Fish and wildlife

After our briefing, the district made a new study of the reservoir's ability to release water of the desired temperature for downstream fish spawning and rearing. An earlier study (1969) had indicated that the low-temperature objectives downstream could not be consistently met. Federal and State fish agency officials said that failing to meet these objectives could eliminate some benefits and reduce others. District personnel said that the earlier study was invalid because it had used incorrect input data.

In addition to revising incorrect input data, the new study used updated water temperature objectives the fish agency officials provided. The new temperature objectives were higher for April to June and lower for July to September than those used earlier. The results of the new study showed that the higher temperature objectives in the spring would

allow the colder water in the reservoir to be saved for summer and fall release and that in that way temperatures could be adequately controlled throughout the year.

The Federal and State fish agency officials agreed the study results indicated satisfactory temperature control could be achieved in all but extremely hot and dry years. They said such extreme years were so infrequent that their impact, if any, on predicted fishery benefits could be ignored. The new study and other factors seem to reasonably support all fishery benefits previously in question.

Lake recreation

Lake recreation benefits of $357,000 were not fully supported because the Forest Service could not give us any documentation for its 1966-67 projection of recreation attendance. Forest Service officials said the necessary supporting data could not be reconstructed and conditions had changed, which made a new study necessary if a documented attendance projection was required.

In position paper 10, the district recently tried to verify the Forest Service's projected annual use of 730,000 recreation-days. The district used a Corps estimating procedure and data available on visitor characteristics at seven other district reservoirs and modified them to allow for the visitor characteristics at the Applegate project. The district projected an ultimate annual use of 780,000 recreation-days. We noted that the district apparently had not considered some important aspects of the Applegate project and that some of its calculations were wrong. For these reasons, we question the reliability of the district's modifications.

Among the errors in and omissions from the district's calculations were:

--The number of swimming acres were overstated.

--Facilities were not time phased according to the plan for development.

In addition, the number of camping and picnicking sites had been reduced from 1,150 to 831 (28 percent), according to a Forest Service letter to the Corps dated December 4, 1973. Correcting the errors and updating the facility plan would reduce the Corps' projected ultimate annual use from 780,000 recreation-days to 546,000 recreation-days.

We questioned the accuracy of some of the factors the Corps used in its recreation analysis and noted that small changes in these factors could produce large changes in projected use.

An example of a Corps modification in doubt involves the percent of annual use in the peak month (July). The Corps reduced the district's projected average use of 23.3 percent to 20 percent because Applegate would benefit from the warmer climate and longer recreation season in southwestern Oregon. Apparently the Corps did not consider the fact that many recreation sites would be remote from the water's edge for at least 9 months a year because of reservoir drawdown. It appears that the most desirable use season at about 60 percent of the camping and picnicking sites would be only 3 months long, which is generally less than for the projects on which the district had based its average use. This could indicate that the district's average use projection should be modified upward, rather than downward, which would tend to lower the attendance projections.

Similar questions were raised concerning the modifications to the district averages for percent of weekend use, density, and the activity day-recreation day conversion factor. In each case there were factors which might justify modifications of different directions or magnitudes.

We found that the reliability of the Corps' attendance projection depended highly on the accuracy of the modified values used, since relatively small changes in these values could produce large changes in the projection. For example, using the district's averages rather than modified values gives an ultimate annual use of 417,000 recreation-days rather than the 546,000 recreation-days discussed above.

Because the procedure used by the Corps did not appear to be a reliable way to test the reasonableness of the original Forest Service projection, it does not provide a sound basis for supporting the benefits.

Water quality

Water quality (downstream recreation) benefits of $330,000 are in question because of inadequate support, but, as with lake recreation benefits, a substantial part of the benefits may be supportable after further study. These benefits are based on increased recreation use and on water quality at downstream recreation sites resulting from increased and sustained streamflows in the Applegate River.

The reasonableness of the downstream recreation part of the reported water quality benefits is, in our opinion, not adequately demonstrated by the district's position paper 8. It appears that this paper was prepared without sufficient, updated input from the county park departments involved. For this reason, assumptions about the maximum attendance at the downstream parks with and without the project and the resultant increase in downstream recreation are in doubt.

For example, the Josephine County parks director told us that the fish hatchery site had a current attendance of 1,000 to 1,500 an acre on its developed portions and might eventually be expanded to handle that level of use on its entire acreage, even without the Applegate project. This could mean an ultimate attendance at that site of 200,000 to 300,000 without the project, rather than the 50,000 the Corps had assumed. If such were the case, it would reduce the projected increase in attendance related to the project.

The additional recreational value of the more stable waterflows to those visiting the downstream parks is also questionable. The original field survey, included with position paper 10, estimated a 20-percent increase ($0.50 to $0.60) in the value of a recreation experience with regulated streamflows. In its benefit computations, however, the district had assumed a 100-percent increase ($0.50 to $1). The Corps did not provide any data to support the larger increase. However, the district recently made an analysis to test the increase's reasonableness.

We reviewed the analysis and found that the procedure the district used was intended for valuing reservoir recreation rather than downstream recreation. District personnel agreed that the procedure was not fully applicable to downstream recreation and said that it was meant only to give a general indication of the increased value of the recreation. Although the procedure did give a general indication that the value of the recreation would increase, we feel that it did not reliably support the size of the increase the district used in the benefit computations.

With both the level of increase in downstream recreation use and the additional value of the recreation in doubt, we believe that the reported water quality benefits are not fully supported.

Projection of flood plain growth

The growth rate[1] applied to damageable property in the flood plain, which accounted for about 45 percent of the total project benefits, was the most significant factor used in Applegate's benefit computations. In addition, we noted that project benefits were highly sensitive to relatively small changes in the growth rate. Although we could not conclude that the growth rate used was unreasonable, we did note inconsistencies in its formulation. The appropriateness of the growth rate depends on two factors--selection of the proper indicator to measure

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[1]The growth rate used to compute flood control benefits is the expected annual growth in the value of damageable property in the flood plain, less an allowance for increased price levels over the project's life.

expected growth and use of appropriate procedures for measuring the growth rate for the indicator selected. Although available information indicates that the Portland district properly determined the growth rate for the indicator used, we noted that the district had selected an indicator different from the one recommended in a draft Corps instruction and used in a recent district analysis for a nearby project.

Corps projections

According to Portland district officials, the district could not document the 4.1-percent annual growth rate used in computing the reported flood control benefits. The district developed several position papers in trying to show the reasonableness of the rate it used.

After our November 7, 1973, briefing, the district reduced the growth projection to 3.7 percent to account for the effects in the Applegate Valley of flood plain zoning ordinances adopted by Jackson and Josephine Counties. The district's revised growth rate was based on:

Jackson County

A 3-percent growth in the 10-year flood plain where zoning was expected to be effective.

A 5-percent growth outside that area.

Josephine County

A 3-percent growth in the 10-year flood plain where zoning was expected to be effective.

A 4-percent growth in the area outside the 10-year flood plain up to the limit of the 1964 flood plain where zoning was expected to be somewhat effective.

A 5-percent growth outside the 1964 flood plain.

The 3.7-percent projected rate is the average of the growth rates weighted by the probability of damage within the land area covered by each percentage rate.

The district considered 3 percent the minimum possible growth; this minimum was based on the increase in value per acre for farmlands and buildings in Josephine County, assuming exclusive agricultural use. The 4-percent growth rate was based on the 3-percent annual agricultural growth and a 1-percent annual population growth. The 5-percent growth

rate was based on a 3-percent annual growth in real per capita personal income and an annual population growth of 2 percent. Thus the 3- and 4-percent growth rates were based either wholly or primarily on growth in agricultural damages and the 5-percent rate was based on estimated growth in residential property damages.

Inconsistent growth applications

The method used to compute the growth rate was not consistent with Corps instructions and a recent district analysis for another project. A Corps instruction (Engineer Regulation 1120-2-113) requires that prevention of future flood damages to additional development be categorized by the type of development, including agricultural, residential, commercial, industrial, and utilities. In 1971 the district developed annual growth rates by category (agricultural, community, and industrial) for the Days Creek project on the Umpqua River (about 60 air miles from Applegate). For Applegate, however, the district did not determine separate growth rates for each category of damageable property, but the district did indicate that most damages would fall under the agricultural category.

In addition, the district used a different agricultural growth rate indicator for Applegate than the one suggested by a Corps draft instruction and used for the Days Creek project. The draft instruction stated that the principal physical units of agricultural measurement were acres of land under production, types of crops, and changes in yield per acre. For Days Creek, the district used changes in yield per acre for projecting agricultural growth. The Days Creek report stated:

> "In the long run, the value of the investments and production would best correspond to increases in yield of a fixed amount of land. To estimate future agricultural values and flood damages, it is assumed that the trends in yield of essentially the same mix of farm output will be a conservative indicator."

The district projected Applegate's agricultural growth on the basis of increases in the per acre value of farmlands and buildings.

Use of the yield rate indicator for Days Creek was based on a Federal and State forecast for the Columbia-North Pacific region and resulted in an agricultural growth rate projection from 1.5 to 1.9 percent annually. Using the farmlands and buildings indicator for Applegate was based on historical trends for Josephine County and resulted in a growth-rate projection of 3 percent annually for agricultural damages.

Corps headquarters and district officials said their growth rate evaluations were sufficiently detailed for this analysis. Also district officials stated that the value of farmlands and buildings per acre provided a better measure of future agricultural growth than the yield rate because the yield rate did not fully consider the increased capital investment required for farming. Corps headquarters officials stated the yield rate per acre was commonly used but that they believed the value of farmlands and buildings could be used in this case.

Benefits' sensitivity to growth rates

Project benefits are sensitive to relatively small changes in growth rates. Preventing damages to future flood plain development accounted for about 80 percent of the $1,583,000 in flood control benefits and about 45 percent of the $2,872,000 in total project benefits. The graph on p. 10 shows the relationship between annual benefits and costs for various growth rates for the Applegate Lake project. The break-even growth rate (the point where average annual benefits equal average annual costs) is 2.43 percent if the otherwise-unsupported benefits prove to be supportable by later studies. Corps studies would be necessary to determine to what extent the use of the yield per acre growth rate indicator for the agricultural portion of the growth rate and determination of specific growth rates for each category of damageable property in the flood plain would affect the 3.7-percent growth rate forecast by the district.

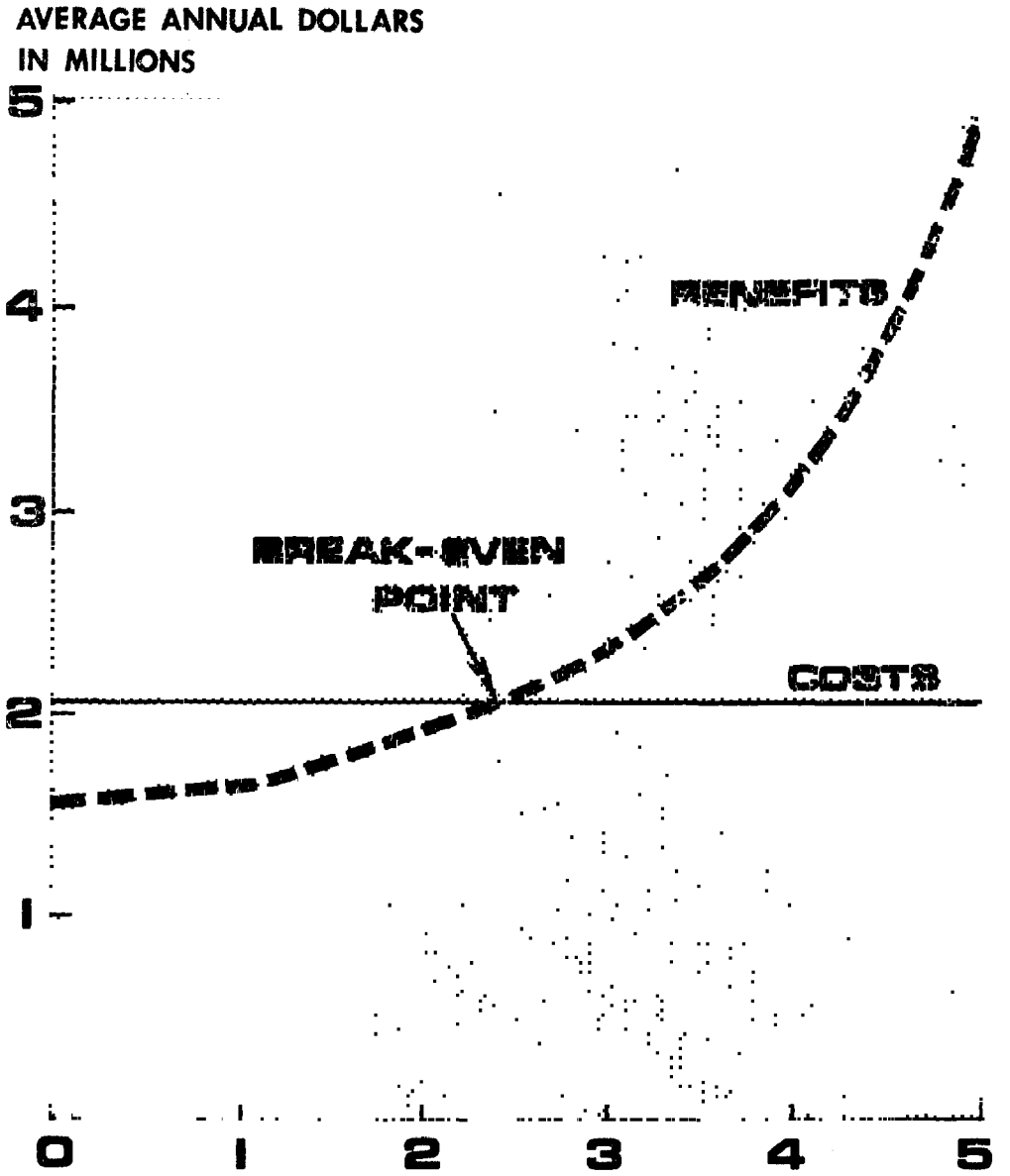
ENVIRONMENTAL ISSUES

The two major environmental issues raised over the Applegate Lake project cannot be resolved without further study. The Corps has contracted for an independent study of the rare Siskiyou Mountain salamander and hopes to receive a proposal for a mercury pollution study in the near future. Although the results of these studies may be available within 1 to 3 years, district officials said that, because of spiraling costs, they could not afford to delay spending any project funds made available during that period. They said that no irreversible actions would be taken before the issues were resolved but indicated that advanced design and land acquisition could proceed without detriment to the salamander's habitat.

The situation regarding the salamander will not be resolved until the results of the Corps' study have been obtained and a decision made as to whether the Department of the Interior should officially list it as either a threatened or an endangered species pursuant to the Endangered Species Act of 1973 (Public Law 93-205). An Interior official said that Interior probably would so list the salamander by the

APPLEGATE LAKE PROJECT

TOTAL BENEFITS USING VARIOUS GROWTH RATES



NOTE: TOTAL BENEFITS INCLUDE INADEQUATELY SUPPORTED BENEFITS VALUED AT THEIR STATED VALUE

end of fiscal year 1974. This official also told us that Interior instructions were being developed to implement the provisions of the act. These instructions will delineate the procedures for conserving threatened or endangered species.