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REGIONAL ENVIRONMENT-ENERGY DATA BOOK

Northwest Region

MASTER

OFFICE OF THE ASSISTANT SECRETARY
FOR ENVIRONMENT

OFFICE OF TECHNOLOGY IMPACTS

DIVISION OF REGIONAL ASSESSMENTS

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REGIONAL ENVIRONMENT-ENERGY DATA BOOK

NORTHWEST REGION

PROJECT STAFF

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MASTER

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ABSTRACT

This document provides a compilation of regional data relating to the energy, environmental, socioeconomic, and institutional characteristics of the Northwest. Its intended uses are to provide data for policy analysis and generic impact assessments; assist the labs in developing relevant data to be used in analyses and studies; provide a reference book that can be used by local groups and institutions; and identify the gaps in regional data bases so that the Department of Energy (DOE) may be better able to allocate resources for data and program development.

The document is divided into four chapters. Chapter I includes current and historic data on energy supply, demand, and production; sector fuel demands, fuel consumption, transmission, and transportation; location of energy production and conversion; and energy prices by sector and state. Chapter II shows a variety of natural and preternatural characteristics including water quality and quantity; air quality and air quality control areas; natural and induced climatic conditions; waste disposal; land and coast conditions, use, and management; managed and endangered species; demographic and socioeconomic conditions; and health and mortality data. Included in Chapter III are a variety of organizational, legislative, and regulatory data. Chapter IV provides energy equivalents, metric conversions, an index, and a glossary.

FOREWORD

Following the formation of the Department of Energy (DOE), Dr. James L. Liverman, the Department's Acting Assistant Secretary for Environment, established an Office of Technology Impacts (OTI). This office is under the direction of Dr. Peter A. House and serves as a focal point for the development and evaluation of environmental policies, plans, and programs. In FY 1978, OTI set up a Regional Characterization program to collect and publish available data relating to the energy, environmental, socioeconomic, and institutional characteristics of the various regions and functional subdivisions of the country. This issue of the Regional Energy-Environment Data Books represents an initial attempt to organize such data in a uniform format and is the forerunner of a more exhaustive set of Regional Characterization Documents to be developed in FY 1979.

The foundations of this program rest on a large but fragmented data base that is now being brought together for the following purposes:

- Provide DOE with regional information for conducting generic impact studies
- Further define resources available at the six national laboratories
- Provide a source book for the regions that can be used by local groups and institutions
- Permit and encourage data development within the regional offices
- Help laboratories develop relevant environmental and energy data for conducting case studies and preparing Regional Issue Identification Reports
- Identify the gaps in regional data bases so that DOE may be better able to allocate resources for data and program development.

This is the first time that a comprehensive set of data books has been assembled on a state-by-state and county basis. Six national laboratories (Argonne National Laboratory, Brookhaven National Laboratory, Los Alamos Scientific Laboratory, Lawrence Berkeley Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory) have participated in its

preparation with the primary responsibility for coordination and development going to the Los Alamos Scientific Laboratory. The program was organized by dividing the country into six regions demarcated by state boundaries, and assigning each region to a specific laboratory. No new data were developed; government sources were emphasized for the sake of consistency and reliability. National data were shared among the laboratories, but regional gaps were inevitable. These gaps will be used to provide DOE with a basis for allocating resources to the laboratories for future data development and regional characterization activities.

DOE ACKNOWLEDGMENTS

The primary credit for the development and publication of this data book must go, in general, to the program managers at the six national laboratories and, in particular, to Joyce Freiwald of Los Alamos Scientific Laboratory for her diligence and able leadership as lead laboratory coordinator. Paul Cho and John Wilson, both of OTI, served as project co-managers for the Office of Environment, DOE, and deftly guided the program through Department channels to its successful conclusion. Joe Coleman, Ted Williams, Roger Shull, Frank Leone, and Bill Coblentz acted as DOE consultants and deserve much appreciation for their advice and encouraging support. Special thanks goes to John D. Buffington and Steve Fullerton of the Council on Environmental Quality, for their informative support.

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ENERGY: REGIONAL OVERVIEW

DESCRIPTION

> The residents of the Pacific Northwest have long been the recipients of the cheapest electricity in the United States. This era of low-cost power is drawing to a close and the region must make some critical choices on how to meet the electricity demands (and other energy needs) of the future.(1)

Alaska has the greatest potential as a supplier for the Northwest Region's needed energy resources. It contains all Regional reserves of oil and natural gas, and most of the coal. Washington contains some coal and most of the Region's known uranium reserves. Alaska is predicted to contain significant uranium resources, but it has not been extensively explored. All four states have one important energy source: hydropower. Alaska has the largest share of untapped hydroelectric potential. The three Pacific Northwest states have already developed most of their sites that have hydroelectric potential.(2)

The allocation of low-cost federal hydropower is a major point of controversy in Regional energy planning because it provides two-thirds of the Region's resources, the majority of which goes to public utilities by virtue of the Preference Clause. The Preference Clause, established by the Bonneville Power Act of 1937, gives power supply priority to public utilities. Basing its decision upon utility forecasts, the Bonneville Power Administration (BPA) notified the public utilities that sufficient amounts of electric power will not be available to meet load growth after 1983.(3)

In the past, private (investor-owned) utilities had been able to purchase cheap federal hydroelectric power from BPA. The limited resources of hydroelectric power have recently caused restrictions upon private utility

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(1) Information Source: Reference 1, "Alternative Scenarios Facing the Region," Background Paper 8.
(2) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21, p. A2.
(3) Information Source: Reference 1, "Alternative Scenarios Facing the Region," Background Paper 8.

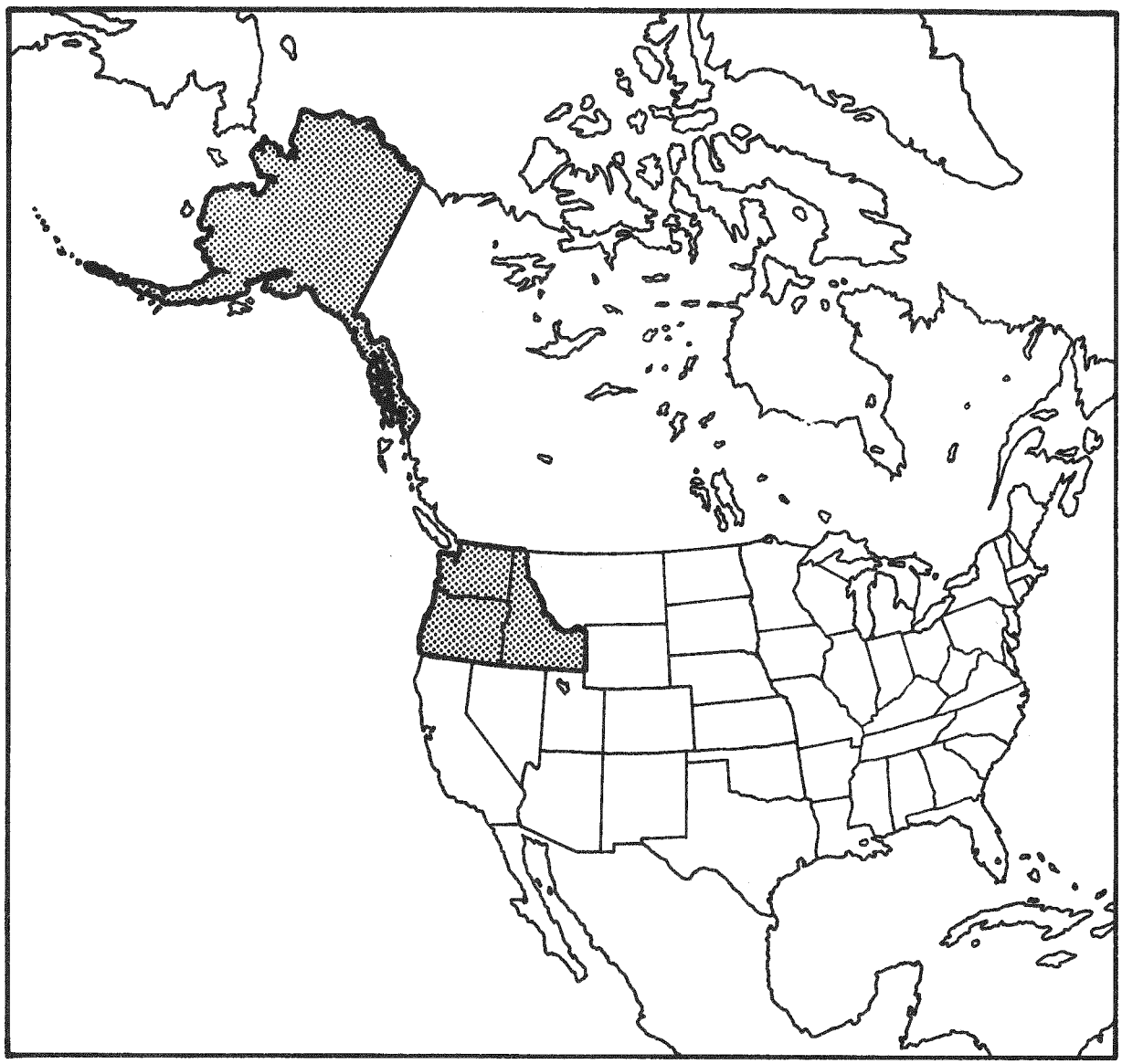

FIGURE I-A-1. The Northwest Region in Relation and Scale to the United States

expansion. Expansion by private utilities has been dependent upon new thermal resources (coal and nuclear). Reliance upon thermal power has forced private utility rates to increase, creating rate disparities between private and public utilities. Users being served by private utilities may find their rates to be as much as two to three times higher than those for adjacent public utilities.(1)

A third major electric consumer group in Washington are the Direct Service Industries (primarily aluminum companies). Their long-term contracts have provided them a share of the cheap federal power from BPA, but those contracts are due to expire in the 1980's. At that time the industries will be faced with the higher costs of thermal power generation.(2)

Termination or curtailment of natural gas supplies (similar to the termination of crude oil supplies) from Canada to the three lower states in the Region will further increase the Region's energy vulnerability. Increased demand has brought on an era of higher-cost conventional energy source development, which in turn has created concern over economic and environmental costs. In order to supplement conventional sources, new emphasis has been placed upon research, development and application of unconventional alternative sources.(3)

The Region is in a critical stage of energy assessment involving related socio-economic and environmental impacts from reallocation of hydropower, increasing imports, and major new energy developments. The disparity of energy resources among states in the Region further complicates decision-making. Physical distance and differential in energy needs between Alaska and the lower states in the Northwest have hindered energy planning and physical transfers. Each area has specific environmental, social and economic factors that must be considered separately in energy planning. Major

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(1) Information Source: Reference 1, "Alternative Scenarios Facing the Region," Background Paper 8.
(2) Information Source: Reference 1, Ibid.
(3) Information Source: Reference 3, Energy Futures Northwest, p. 48.

shifts in the Region's energy use pattern are expected as the generation of energy changes from hydroelectric to thermal.

Electric power has been an inexpensive source of energy in the states of Idaho, Oregon and Washington, with hydroelectric generation supplying most electrical energy needs. However, forecasted load growth and the limited number of potential new hydroelectric sites will result in a heavier reliance upon thermal generation in the future. The transition from hydroelectric to thermal power generation will cause significant changes in the Northwest. The future path of electric power supply will be largely determined by demand, basic energy prices, public policy, and environmental consequences of thermal power generation.(1)

RESERVES

Alaska leads the Region in energy reserves. It contains all of the Region's reserves of oil and natural gas, and most of the coal. Washington has some coal and most of the Region's known uranium, although Alaska has not been extensively explored for uranium. Refer to Figure I-A-2.

All four states are blessed with one important renewable energy resource: hydropower. Alaska has the largest share of untapped hydroelectric potential. Idaho, Oregon and Washington have already developed most of their sites having substantial hydroelectric potential.

The Region also contains less conventional energy sources: geothermal, wind, solar, and biomass. These sources have a large energy potential; however, to date they have not been significantly utilized.

Geothermal energy is available in each of the states. It is being used for heating in Klamath Falls, Oregon and Boise, Idaho. In addition, there are several pilot and demonstration projects in the Region.

Wind power has a high potential for all of the Northwest (except mountainous areas). Areas with a lower solar radiation incidence along the coastline have the highest potential for wind power generation.

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(1) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

Solar electric potential also is high in the Region. Commercial and residential buildings are beginning to find this source feasible for passive radiation and hot-water heating. Sunshine, however, primarily drives natural energy systems such as the hydrologic cycle and drop-producing photosynthesis.

The Region's forest wastes are presently being utilized by industry, while agricultural biomass has potential for energy production separately or with agricultural production in the Region.(1)

ENERGY PRODUCTION

Production of energy for the consumer has always been a challenge. The Northwest is rich in certain energy forms and scarce in others. Thus, with growing demand the production of energy has had to be supplemented by new sources or imports to the Region. Refer to Figure I-A-3.

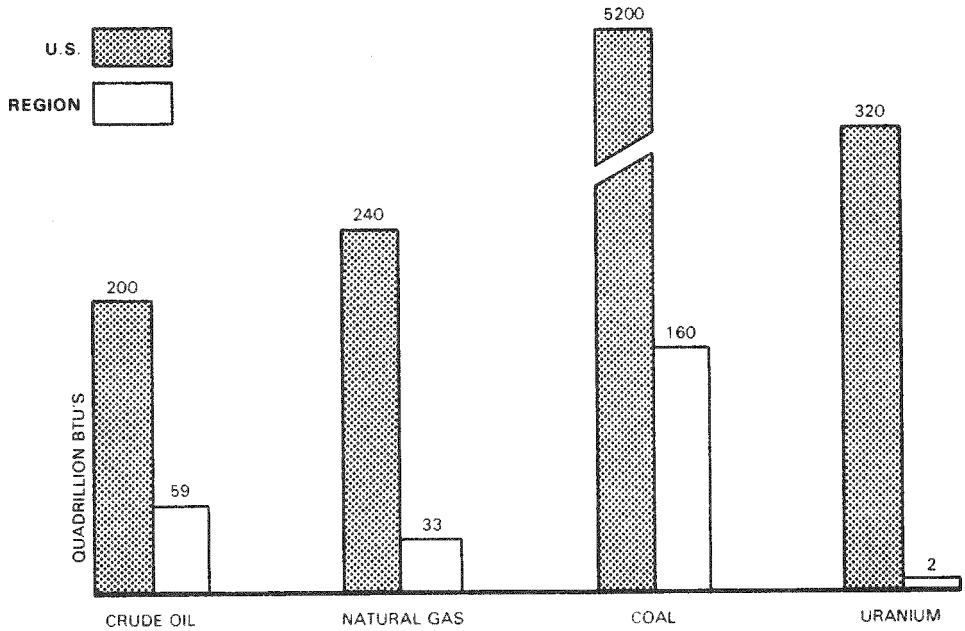


FIGURE I-A-2. Energy Reserves

Data Source: Reference 4, Energy Northwest, Figure 12.

(1) Information Source: Reference 4, Energy Northwest, pp. 22-24.

Petroleum

Petroleum production in the United States peaked in 1970 at 3.5 billion barrels (bbl) and then declined, falling to about 3 billion bbl in 1975. This decline ended a steady annual growth that averaged nearly 3%/yr between 1950 and 1970. Refer to Figure I-A-5.

The Regional trend in petroleum production (all from Alaska) mirrors that of the United States: a 1970 peak of nearly 84 million bbl, then a drop to less than 70 million bbl by 1975. The Alaska pipeline is expected to boost Regional petroleum production to about 600 million bbl by 1980. However, Alaska produced less than 2.5% of the country's total petroleum supply in 1970, and just over 2% of the 1975 supply.(1) Figure I-A-4.

Natural Gas

As with petroleum, natural gas production is falling off. U.S. production peaked in 1973 at 22.6 trillion cubic feet (TCF), then declined nearly 5% in 1974, ending nearly 23 yr of increasing production.

Alaska is the only natural gas producer in the Region. Its contribution to total United States production has continued to rise, although inability to move the fuel to demand centers has slowed its rate of growth.(2)

Coal

National coal production has increased steadily since 1961 with the exception of one year. Production fell in 1971, probably in response to two federal acts: The Coal Mine Health and Safety Act of 1969, and the Clean Air Act of 1970. Other than 1971, however, coal production has typically grown 3%/yr.

Because of Washington's large mine-mouth coal-fired electric plant at Centralia, the State of Washington produced five times as much coal as

(1) Information Source: Reference 4, Energy Northwest, pp. 25 and 26.
(2) Information Source: Reference 4, Ibid, p. 26.

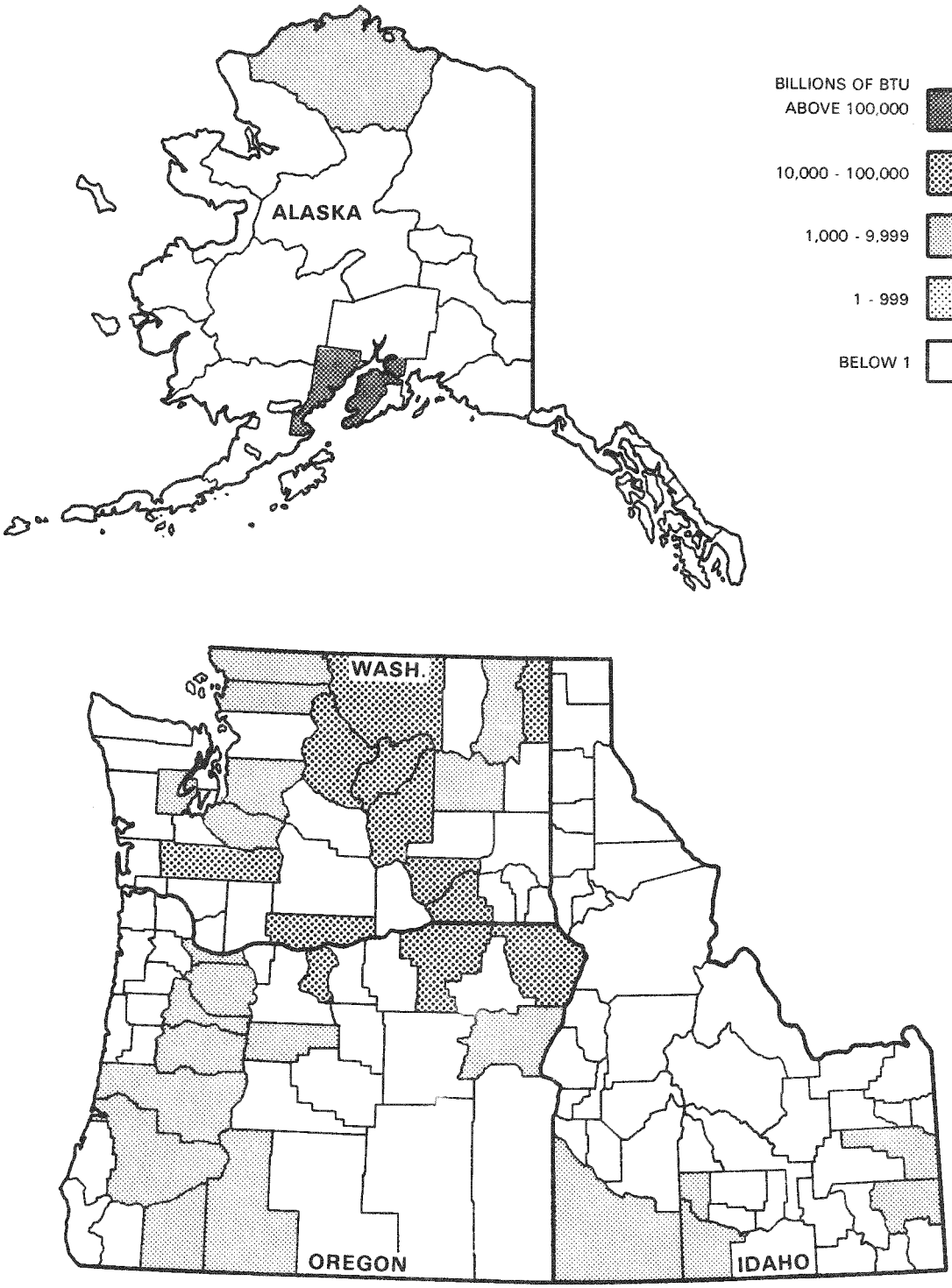


FIGURE I-A-3. Total Fuel and Hydroelectric Production by County

Data Source: Ref. 5, Energetics of the USA, p. 53.

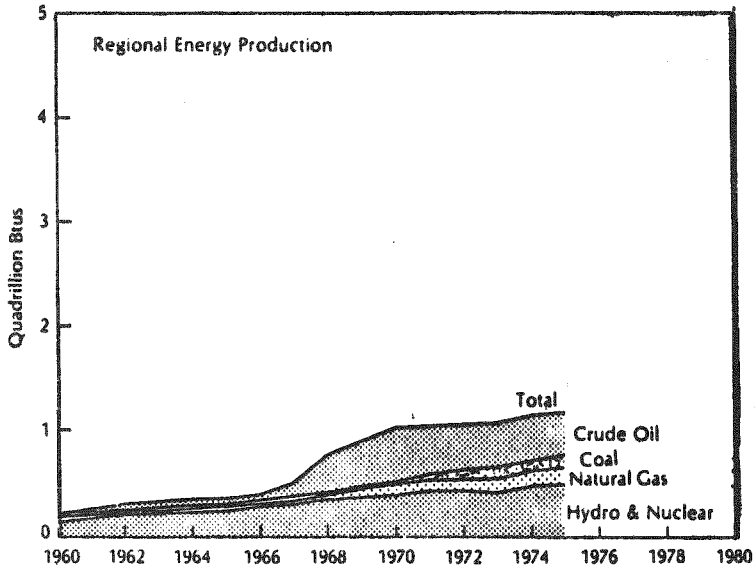


FIGURE I-A-4. Regional Energy Production in Quadrillion Btu

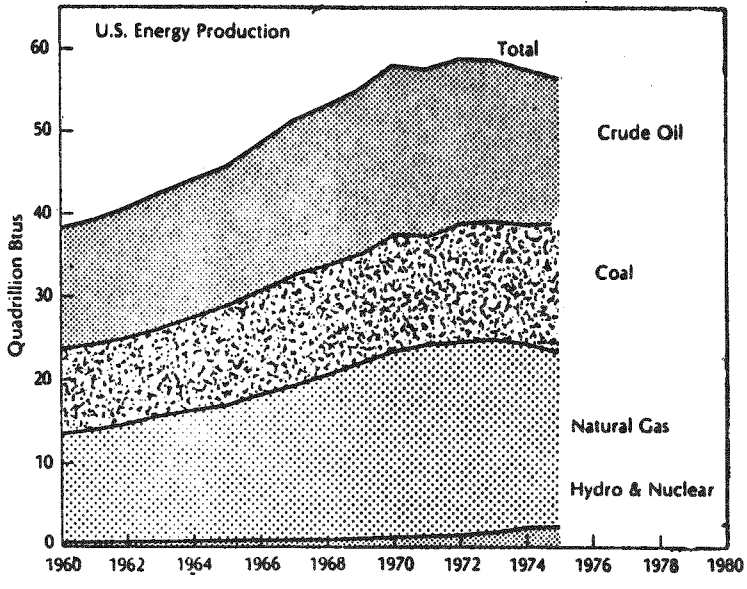
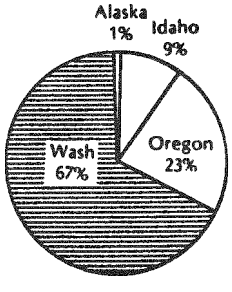
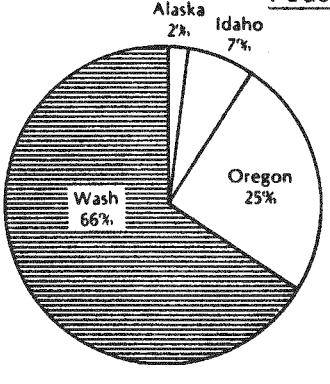


FIGURE I-A-6. Total U.S. Energy Production in Quadrillion Btu



1965 Regional Total 72,928 Million kWh
(6.9% of Total U.S. Generation)



1975 Regional Total—140,585 Million kWh
(7.3% of Total U.S. Generation)

FIGURE I-A-5. Regional Electric Generation by State

Data Source: Ref. 4, Energy Northwest, Figures 14, 15 and 16.

Alaska in 1975. In several areas, Alaska's abundant natural gas supply is substituted for coal in electric generation because of difficulties in mining and transporting Alaskan coal.(1)

Electric Generation

Electric production in the United States has grown at an average rate of 6.5 %/yr since 1961. Total 1961 production was 792 billion kilowatt-hours (kWh). That more than doubled to nearly two trillion kWh in 1975 (see Figure I-A-6).

Regional electric growth paralleled national growth during that time, rising from 55 billion kWh in 1961 to 140 billion kWh in 1975.

Washington accounts for more than 66% of the Region's total electric production. Oregon produces nearly 25% of the Region's electric energy. Idaho produces just over 7% and Alaska produces less than 2%. Most of Alaska's electricity comes from fossil-fueled plants, while hydropower is the leading source in the other states. In figuring these percentages, states receive equal shares of hydroelectric capacity from dams on rivers dividing those states, such as the Columbia River between Oregon and Washington.

Although hydropower now supplies the Region's major portion of electric energy (92% in 1975), conventional and nuclear steam-generating facilities will increase their portion of electric production because no new large hydroelectric sites are being developed.(2)

ENERGY IMPORTS AND EXPORTS

With the exception of electricity, the Region depends heavily upon imported energy sources. In 1975, for example, net imports accounted for about two-thirds of the energy consumed in the Region. Petroleum, natural gas and coal are imported from such areas as Canada, South America, Southeast Asia and the Middle East. Refer to Figure I-A-7.

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(1) Information Source: Reference 4, Energy Northwest, p. 26.
(2) Information Source: Reference 4, Ibid.

Petroleum

Of the four states in this Region, only Alaska produces crude oil; Washington and Oregon refineries must import crude oil supplies, while Idaho must import all finished petroleum products, since it has no refineries.

Most of the Region's petroleum imports have come from Canada, but the Canadian government has announced plans to end all exports to the United States by 1981. Northwest refinery activity was to be curtailed by the end of 1976; however, small amounts of condensate and crude (about 25,000 bbl/day) continue to flow to these refineries in exchange for a like quantity of crude delivered to Canada from the Midwest.

Imports were also received from Iran (18.1 million bbl), Indonesia (12.9 million bbl), the United Arab Emirates (6 million bbl), Venezuela (2.8 million bbl), Saudi Arabia (1.2 million bbl) and Ecuador (1.1 million bbl).

Washington and Oregon refineries supply many of the Region's finished petroleum products, although a significant portion is imported from foreign sources (7.7 million bbl in 1975) and by pipeline from refining centers in Montana and Utah.

In 1975, Alaska consumed about 21 million bbl (121 x 10^{12} Btu) of petroleum products. These products originated from Alaskan refineries and from California, Puget Sound, and foreign sources. California supplied an estimated 7.1 million bbl, foreign sources about 800,000 bbl, and Puget Sound sources about 2.9 million bbl. In addition, Alaska exported to California about 10.5 million bbl of residual fuel oil and unfinished oils.(1)

Natural Gas

Alaska, again, is the only state in this Region capable of meeting its own natural gas requirements. Alaska exported about 53 million cubic feet (MMCF) of liquefied natural gas from its Kenai gas fields to Japan in 1975.

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(1) Information Source: Reference 4, Energy Northwest, p. 27.

Alaska's natural gas exports are continuing and will be expanded with construction of a natural gas pipeline connecting the Prudhoe Bay gas fields to the "lower 48" states.

Idaho, Oregon and Washington, however, have no natural gas supplies and must import all they use. One interstate natural gas company, Northwest Pipeline Corporation, supplies all of those states' natural gas from fields in Canada and the American Rocky Mountain and Southwestern states.(1)

Coal

Alaska and Washington are the only coal-producing states in the Region; some of the Region's coal demand in 1975 was met by Utah (641,000 tons), Wyoming (370,000 tons), and the Southwest (5,000 tons). Alaska may become a major coal exporter if its transportation systems are fully developed, if its coal becomes more economical, and if environmental concerns are resolved.

Of the 4.7 million tons of coal consumed in Idaho, Oregon and Washington during 1975, 3.7 million tons were mined near Centralia, Washington for use in a coal-fired power plant.(2)

Electricity

Alaska generates all of its own electrical energy: hydroelectric generation supplies much of southeast Alaska; natural gas turbines, plus smaller amounts of hydro and diesel generation, supply the southcentral railbelt; coal and diesel are used in the Fairbanks area; and diesel generation is generally used in small rural villages.

The Pacific Northwest has abundant hydroelectric resources and in most years has been self-sufficient in electrical energy; however, some electricity has been both imported and exported from the area.

The largest electrical transmission system in the Pacific Northwest is operated by BPA, which markets power generated from federal hydroelectric

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(1) Information Source: Reference 4, Energy Northwest, p. 28.
(2) Information Source: Reference 4, Ibid.

projects. BPA also provides transmission services (wheeling) for some utilities that generate their own electricity. The BPA transmits power not only within the area but also to Canada, western Montana, and California. Exchanges of power are common between these areas when one area has excess energy. Usually, the largest exchanges occur between the Pacific Northwest and California. In a normal water year BPA moves power to California in the spring and summer, when the hydroelectric system has the capacity to generate more energy than is needed locally because of the melting of mountain snow packs. Power is then returned by California in the fall and winter, when the water supplies are lowest in the Columbia River System. The two-way exchange of energy is complementary, since California demand peaks in the summer and demand in the Pacific Northwest peaks in the winter. Typically, more electricity is exported than is imported. In 1975, exports exceeded imports by 19,943 million kWh, or about 68 trillion Btu.(1)

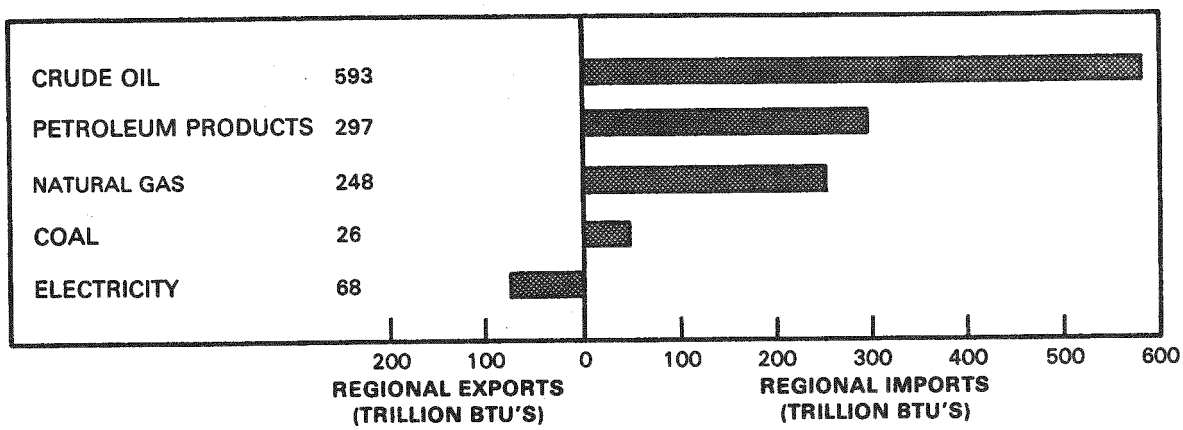

FIGURE I-A-7. Energy Imports and Exports - 1975

Data Source: Reference 4, Energy Northwest, Figure 17.

(1) Information Source: Reference 4, Energy Northwest, p. 28.

ENERGY FACILITIES

Energy facilities extract energy resources from the earth, convert them into useful forms, and transport them throughout the Region and the United States.

Petroleum

Northwest petroleum facilities include wells (producing only in Alaska), refineries, and pipeline or tanker transportation for crude and refined oil products.

Movement of Alaskan crude within the state will be primarily by three pipelines. Two are now operating near south Alaska's Cook Inlet. Another, the Trans-Alaska pipeline, between the North Slope oil field and the Port of Valdez, located on Prince Williams Sound, is expected to carry 1.6 million bbl of crude oil a day when all 12 pumping stations are completed in 1980. Design capacity of the pipeline is 2 million bbl/day. Oil is transported from Valdez by tanker.

Washington's Puget Sound area is supplied by tankers and by Canadian pipeline from Edmonton, Alberta, via a tank farm and terminal at Burnaby, B.C. The United States' portion of this pipeline can carry 300,000 bbl of crude oil a day, but Washington refineries actually received only 179,000 bbl/day in 1975 (by April 1977 the crude received had dropped to essentially zero). Tanker imports to Puget Sound refineries averaged 109,000 bbl/day in 1975. Oregon's only refinery imports about 7,000 bbl/day of oil fuelstock by tanker from California.

Alaska, Oregon and Washington contain the Region's ten refineries for converting crude oil into finished petroleum products (gasoline, residual and distillate oil, and asphalt). Total current capacity of these facilities is 449,000 bbl/day.

Finished petroleum products are transported into and around the Region by pipeline, tanker, barge, railroad and truck.[1]

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(1) Information Source: Reference 4, Energy Northwest, pp. 29 and 30.

Natural Gas

Alaska is the only state in the Region to produce natural gas, and does so primarily in the Cook Inlet area, although other large gas fields have been found on the North Slope. Alaska Public Service Corporation and the Kenai Utility Service Corporation have natural gas pipelines in the State.

Idaho, Oregon and Washington import natural gas from British Columbia, Alberta, and the American Rocky Mountain and southwest states. The three-state area is served by pipelines operated by the Northwest Pipeline Corporation and distributed by six gas utilities. Northwest Pipeline System's main line can carry as much as 1.45 billion cubic feet (BCF) per day.

The seven utilities handling natural gas in the Region are: Alaska Gas and Service Company, serving southcentral Alaska; California-Pacific Utilities Company, serving Oregon; Cascade Natural Gas Corporation and Northwest Natural Gas Company, serving Oregon and Washington; Intermountain Gas Company, serving Idaho; Washington Natural Gas Company, serving Washington; and Washington Water Power Company, serving Idaho and Washington.

There are seven natural gas storage facilities in the Region: A liquefication, storage and transportation terminal at Kenai, Alaska; a liquefying facility and storage tank in southwest Idaho; a liquefying facility and storage tank at Newport, and a storage facility near Portland, Oregon; two underground facilities near Chehalis; and a liquified natural gas facility at Plymouth, Washington.(1)

Electric Generation

In 1975 the Region had a generating capacity of more than 25.5 million kilowatts (kW) of electricity. Hydroelectric facilities accounted for more than 81% (20.8 million kW) of that capacity, with the rest available from coal, wood and nuclear-fueled steam plants, gas turbines, and internal combustion generators.

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(1) Information Source: Reference 4, Energy Northwest, p. 31.

Washington is the Region's leading electric supplier; its 58 dams and 14 steam plants account for more than 66% of the Region's electric capacity. Oregon's 49 dams and 9 steam plants added more than 21% to the Region's capacity, while Idaho's 40 dams and 6 steam plants added about 5%. In figuring these capacities, states receive equal shares of hydroelectric capacity from dams on rivers dividing those states, such as the Columbia River between Oregon and Washington.

In addition to the generation facilities, there are a number of high-voltage lines used to move electricity within the Region. Alaska Power Administration, the federal agency overseeing transmission and wholesale marketing of power from Alaska's federal dams, has transmission systems serving Anchorage and Juneau. The BPA transmits most of the electricity in Oregon and Washington, while investor-owned utilities transmit most of Idaho's electricity.(1)

ENERGY CONSUMPTION

Petroleum

Petroleum is consumed primarily as three basic end products: 1) distillate oil (lighter fuel oils and diesel fuel), 2) residual oil (heavier fuel oils for space heating and electric generation), and 3) gasoline. These represent about 75% of the final products from a barrel of crude oil. The rest goes for petrochemical feedstocks, lubricants, wax, road oil and other products. Refer to Figure I-A-8.

In 1975 Washington consumed 16.7 million bbl of distillate oil, Oregon 13.2 million bbl, Idaho 7.4 million bbl, and Alaska 7.0 million bbl. Until recently, all states except Washington have slowly consumed more each year since 1960; consumption in Washington has remained basically stable. Regional distillate oil consumption peaked at 48.8 million bbl in 1973, then fell to 44.3 million bbl in 1975. The Region accounted for just over 4% of total U.S. distillate oil consumption in 1975. Refer to Figure I-A-9.

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(1) Information Source: Reference 4, Energy Northwest, p. 32.

Regional residual oil consumption totaled 14.7 million bbl in 1975, with Washington consuming 8.6 million bbl, Oregon 4.4 million, Alaska 1.1 million, and Idaho just over 700,000 bbl. The Region accounted for 1.6% of all U.S. residual oil consumption.

Nationwide gasoline use hit a peak of 104.5 billion gallons (gal) in 1973, fell amost 3% in 1974, then rose to 104.3 billion gal in 1975. That 1974 dip ended a steady 4.8% annual growth from 1962.

The Region used 3.6 billion gal of gasoline in 1974. More than 47% of that was used in Washington. Oregon used nearly 34% of the Region's total, Idaho more than 13%, and Alaska just over 5%.(1)

Natural Gas

Natural Gas consumption is divided among five sectors: 1) residential, 2) commercial, 3) industrial, 4) electric and 5) other.

In 1975 the Region used 383 BCF of natural gas, about 2% of the nation's total. Industry used nearly 52% of the Region's natural gas, residential used 23%, commercial 18%, electrical power about 5%, and other uses accounted for 2%. Refer to Figure I-A-11.

Washington led the Region in natural gas consumption in 1975, using nearly 160 BCF, about 41% of the Region's total. Industry in Washington accounted for more than 58% of the total state consumption.

Oregon used 102 BCF natural gas in 1975, accounting for about 25% of the Region's total. Again, industry was the state's largest natural gas consumer, accounting for about 56% of total use.

Alaska consumed 67 BCF natural gas in 1975, accounting for just over one-sixth of the Region's total. About 33% of that went to industry, 29% to electric power generation, 16% to residential, 13% to commercial, and 9% to other uses.(2) Refer to Figure I-A-10.

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(1) Information Source: Reference 4, Energy Northwest, p. 33.
(2) Information Source: Reference 4, Ibid, pp. 34 and 35.

Idaho was the Region's smallest natural gas consumer in 1975, using less than 57 BCF, about one-sixth of the Region's total. Industry received more than 50%, residential and commercial used nearly 46%, while transportation uses accounted for just over 1%.(1)

Coal

In Alaska, electric power production accounts for a large part of the state's coal consumption. The state accounts for almost 12.5% of the coal used in the Region. Washington accounts for more than 75% of the Region's coal consumption, mostly for electric power production. The major reason for Washington's high level of coal consumption is the coal-fired electric power plant at Centralia, which burned almost four million tons of coal in 1975.(2) Refer to Figures I-A-12 and 13.

Electricity

Electricity consumption in the Region generally is divided into five classes: 1) domestic, 2) irrigation, 3) commercial, 4) industrial, and 5) other. The availability of low-cost hydropower has had far-reaching effects upon consumption. The Region has the highest per capita residential electric energy use in the nation. Refer to Figure I-A-15.

National electricity consumption increased more than 6%/yr between 1961 and 1975. Idaho, Oregon and Washington had nearly average growth rates, but electricity consumption in Alaska has grown at nearly twice that rate. Nevertheless, Alaska is still far behind the rest of the Region in kWh consumption.

Washington accounted for more than half of the Region's electricity use in 1975, with nearly 63.3 billion kWh consumed. Nearly 50% of that was used by industry, followed by domestic, commercial, and irrigation uses.

Oregon accounted for more than one-quarter of Regional electricity consumption in 1975, using 33.4 billion kWh. Again, industry was the largest electricity consumer at 39%, followed by domestic, commercial, and irrigation uses. Refer to Figure I-A-14.

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(1) Information Source: Reference 4, Energy Northwest, p. 35.
(2) Information Source: Reference 4, Ibid.

Petroleum

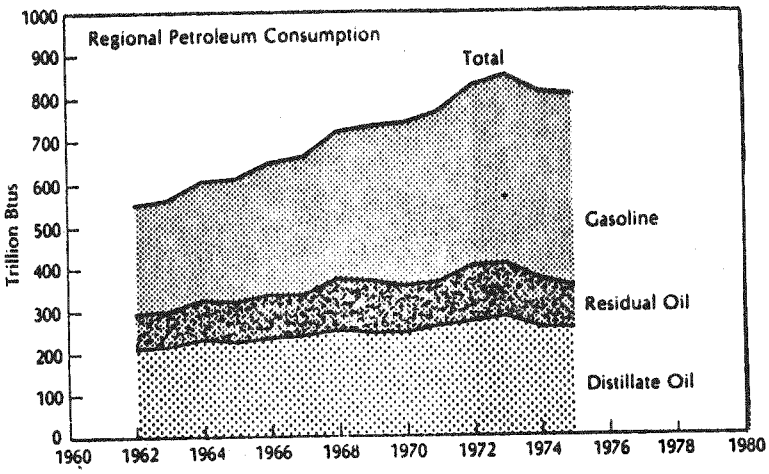
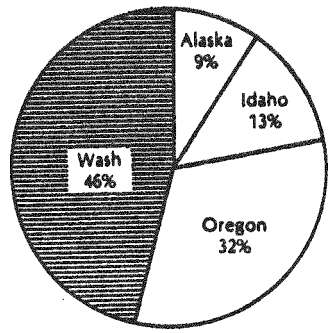
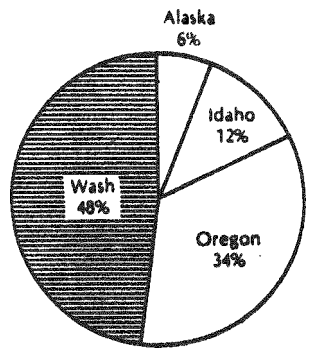


FIGURE I-A-8. Regional Petroleum Consumption



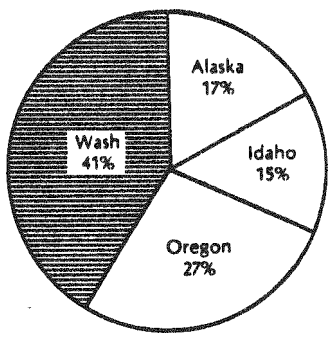
1975 Total—145,539 Thousand bbl.
(3.1% of Total U.S. Consumption)



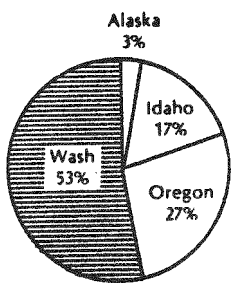
1965 Total—110,505 Thousand bbl.
(3.6% of Total U.S. Consumption)

FIGURE I-A-9. Petroleum Consumption by States

Natural Gas



1975 Total—383,456 Million cu. ft.
(1.9% of Total U.S. Consumption)



1965 Total—204,984 Million cu. ft.
(1.3% of Total U.S. Consumption)

FIGURE I-A-10. A Consumption of Natural Gas by State

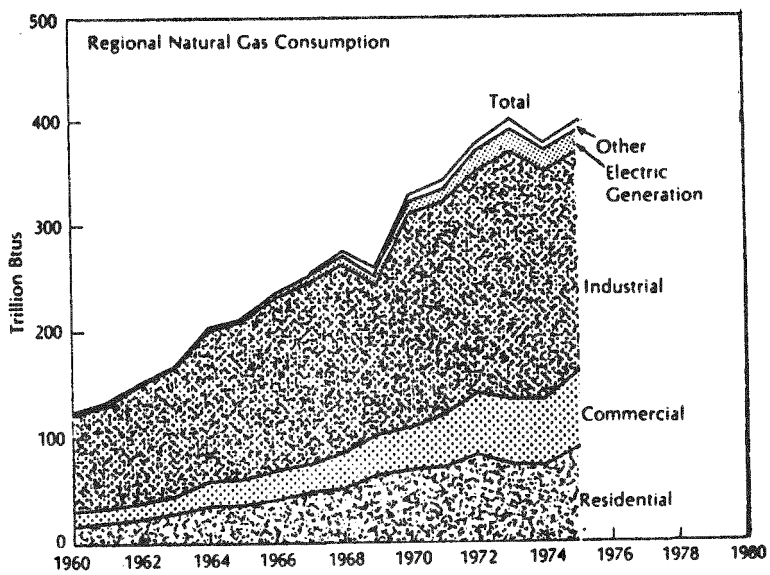


FIGURE I-A-11. Regional Natural Gas Consumption by Sector

Data Source: Ref. 4, Energy Northwest.

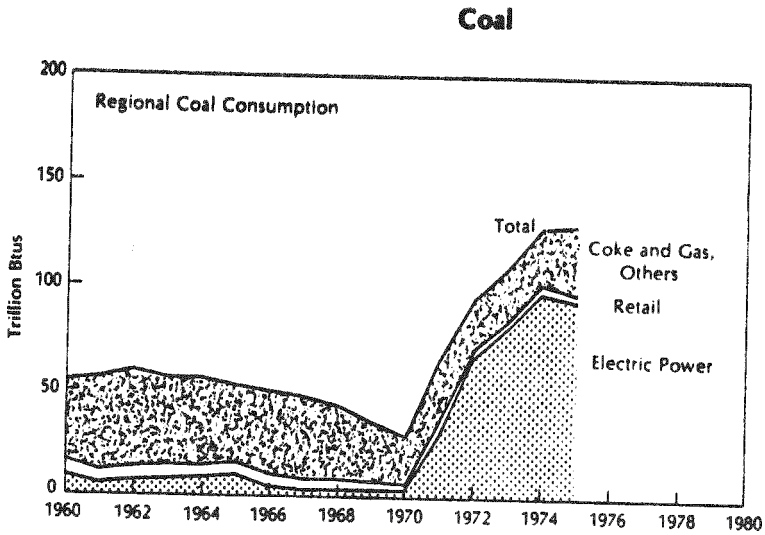
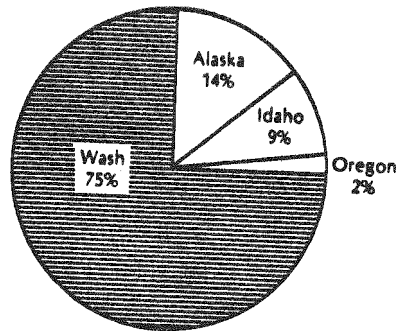
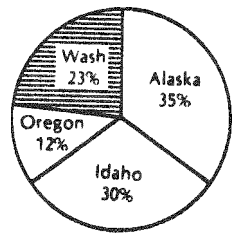


FIGURE I-A-12. Regional Coal Consumption by End Use

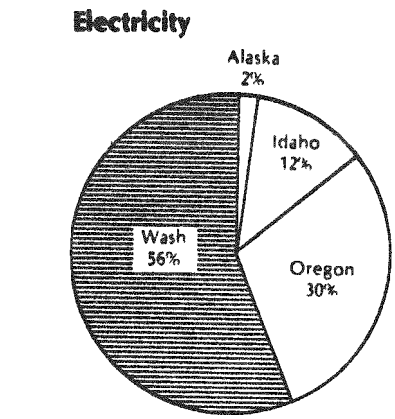


1975 Total—5,507,000 Tons
(1.3% of Total U.S. Consumption)

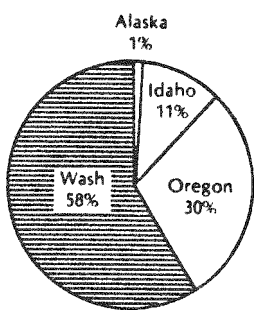


1965 Total—2,273,000 Tons
(0.4% of Total U.S. Consumption)

FIGURE I-A-13. Coal Consumption by State



1975 Total—111,650 Million kWh
(6.4% of U.S. Total Electricity Consumption)



1965 Total—64,930 Million kWh
(6.8% of Total U.S. Electricity Consumption)

FIGURE I-A-14. Electricity Consumption by State

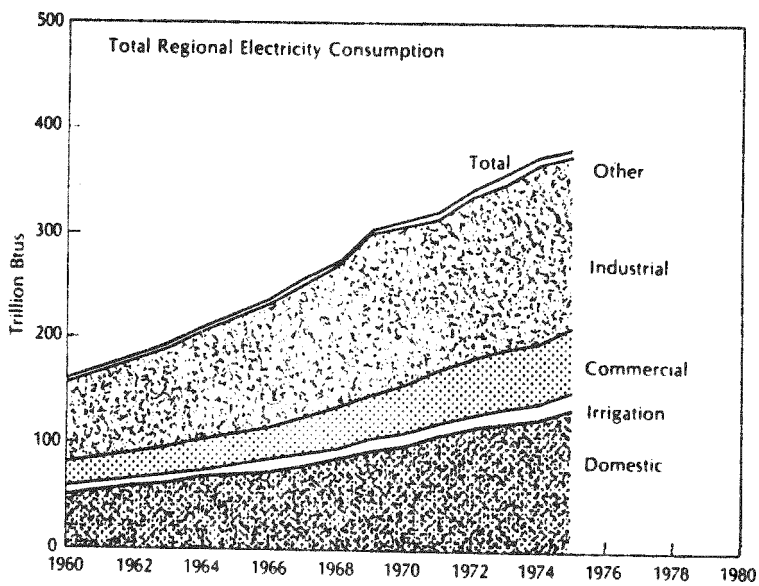
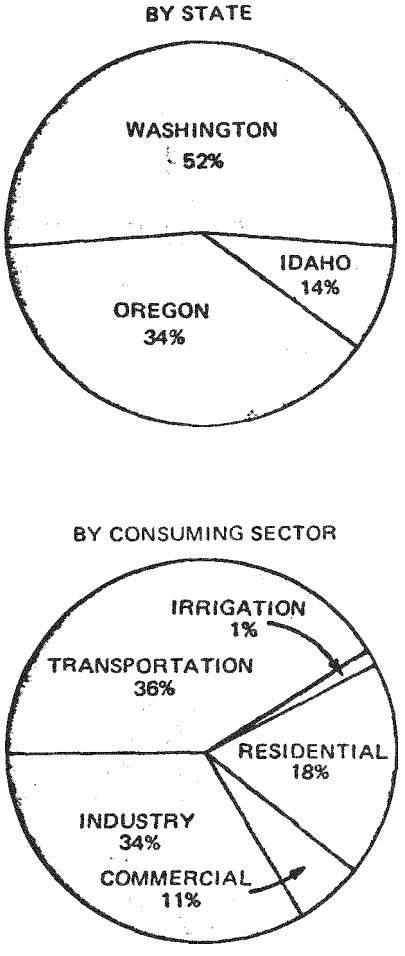


FIGURE I-A-15. Regional Consumption by Sector



NORTHWEST POPULATION DISTRIBUTION

Washington	53.3%
Oregon	34.4%
Idaho	12.3%
	100.0%

FIGURE I-A-16. Northwest Energy Consumption, 1975(a)

(a) This only includes ID, OR and WA.

Data Source: Ref. 3, Energy Futures Northwest, p. 44.

Idaho accounted for slightly less than one-eighth of Regional electricity consumption with 13.1 billion kWh. Industry consumed more than 40%, followed by domestic, irrigation, and commercial uses.

Alaska accounted for only a small fraction of regional electricity consumption in 1975, using 1.8 billion kWh. Domestic use accounted for nearly 45%, followed by commercial and industrial uses.(1) Refer to Figure I-A-16.

UNIQUE REGIONAL CONSIDERATIONS

The considerations discussed in Appendix A are hydropower expansion, hydropower for peak demands, utilization of western coal, nuclear power, large amounts of federal land ownership, the high level of dependence upon hydroelectric generation, and the separateness of Alaska.

IDENTIFICATION OF PROBLEMS/ISSUES

Discussed in Appendix A are the pertinent issues facing the Region. They include conservation, electric rates, the Clean Air Act of 1970, continental self development, transmission corridors, centralized electric generation and generation mix, electric power planning, environmental and safety regulations, water use, electric energy forecasts, and oil tankers.

(1) Information Source: Reference 4, Energy Northwest, p. 35.

DATA QUALITY

FOR

CHAPTER 1 - PERSPECTIVES AND DATA ON ENERGY CONDITIONS

Outline	Resolution (Temporal, Spatial) of Data Available and Included	Finer Resolution Available to Laboratory But Not Included
B. ENERGY PRODUCTION		
1. Natural Gas	1975 state data including Alaska	No finer resolution of 1975 data available
2. Natural Gas Liquids	1975 state data including Alaska	No finer resolution of 1975 data available
3. Crude Oil & Petroleum	1975 state data including Alaska	No finer resolution of 1975 data available
4. Oil Shale	No data available including Alaska	Available information for Alaska
5. Coal	1975 state data including Alaska	No finer resolution of 1975 data available
6. Uranium	1975 state data including Alaska	No finer resolution of 1975 data available
7. Geothermal	Gradient map for Region and number of available sites including Alaska	Site specific information for developing sites
8. Solar	Solar radiation map for Region	Site specific data gathered
9. Wind	Wind velocity and exposure (no data for Alaska), experimental turbine sites	Finer resolution becoming available at lab
10. Biomass	State data No data for Alaska	No finer resolution of data available
11. Energy from the Ocean	State data including Alaska	No finer resolution of data available
12. Pumped Storage	State data No data for Alaska	Site data available
13. Electric	River and dam data Generating plant data Potential resources	Available for plants and sites

DATA QUALITY

FOR

CHAPTER 1 - PERSPECTIVES AND DATA ON ENERGY CONDITIONS

(continued)

Outline	Resolution (Temporal, Spatial) of Data Available and Included	Finer Resolution Available to Laboratory But Not Included
C. ENERGY CONSUMPTION		
1. Regional Consumption	1975 state data	Available by SMSA
2. Quantities Consumed by	1974 state data	Available by SMSA
3. Consumption per capita	1975 state data	No finer resolution available
historical	1971-74 state data	
4. Consumption by End Use	1975 state data	No finer resolution available
5. Consumption by Fuel Source	1975 state data	No finer resolution available
6. Consumption Trends	1970-75 state data	No finer resolution available, or information before 1970
7. Quantities Stored	1975 state	No finer resolution without further research
D. ENERGY BALANCE		
1. Energy Imported and Exported	1974 and 1975 state data	No finer resolution available
E. TRANSPORTATION	1975 state data	No finer resolution available
F. REGIONAL PRICES	1975 state data	No finer resolution available

NATURAL GAS

Natural gas and petroleum are the two major fuels consumed in the Pacific Northwest. Neither is produced in the region. At present, the supply of natural gas presents some problems, as much of the supply is imported from Canada (Alberta or British Columbia). Table I-B-1 summarizes the proven reserves of natural gas in the Northwest and surrounding environs.

The three-state Pacific Northwest area is served by pipelines operated by the Northwest Pipeline Corporation and distributed by six gas utilities. Northwest Pipeline system's main line can carry as much as 1.45 BCF/day. The six utilities handling natural gas in the Region are: California-Pacific Utilities, serving Oregon; Cascade Natural Gas Corporation and Northwest Natural Gas Company, serving Washington and Oregon; Intermountain Gas Company, serving Idaho; Washington Natural Gas Company, serving Washington; and Washington Water Power Company, serving Idaho and Washington. The Region contains the following natural gas storage facilities: a liquefying facility and storage tank in southwest Idaho; a storage facility near Portland, Oregon; two underground facilities near Chehalis, Washington; and a liquefied natural gas facility at Plymouth, Washington.

Figure I-B-19 illustrates the flows and consumption patterns in these states during 1975. A total of 743 BCF were imported (86% from Canada) and 404 BCF flowed through to Northern California. Net consumption within the three states was 339 BCF, or approximately 3.3×10^{14} Btu.

The current heavy dependence upon Canadian supplies has raised some concerns, because contracted amounts have not been delivered in recent years; the Canadian government policy is to export only surplus gas, and Canada's demands have been increasing.

Canadian imports are purchased under two long-term contracts with the West Coast Transmission Company Ltd. (WESCO). The main contract calls for

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Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

delivery at Sumas, Washington of 809 MMCF/day. This contract expires in 1989. Due in part to field operating difficulties, actual deliveries have been running somewhat below contracted amounts.

Natural gas supplies over the next 20 years depend upon a number of factors:

- Alaskan Natural Gas Delivery System

  Selection of the overland (Alcan) delivery system for North Slope natural gas to the lower 48 states was made in 1977. Total flow from Alaska will be approximately 2.0 BCF/day. It is currently planned that a portion (80%) will be routed eastward and a portion (~20%) will tie into the existing West Coast transmission systems.

- Canadian Development

  Exploration in British Columbia and Alberta is accelerating under revised Canadian pricing policies. The potential for extremely large gas reserves in the Alberta sandstones has recently been announced. Depending upon the outcome of the exploration and development efforts and upon Canadian export policies, continued gas supplies could be available beyond the expiration dates of current contracts.

- Alternative Alaskan Gas Supplies

  Exploration is currently underway on the North Slope offshore in the Eastern Gulf of Alaska, and is expected to begin early in 1978 in Lower Cook Inlet. Both associated and nonassociated gas are expected to be discovered and produced. Gas from these regions would be available to the lower 48 states via liquefied natural gas (LNG) carriers to the West Coast. Additional gas and oil resources have been discovered in the Flaxman Island/Point Thompson area and off the McKenzie Delta. The commercial potential of these areas has not been determined.

Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

It appears that natural gas supply to the Region is assured at least until the year 2000. The market potential for high-Btu, synthetic natural gas made from coal is not foreseen unless its costs can be reduced to below $3.18 per thousand Btu (MBtu).

Natural gas in Alaska is the major energy source for both direct heating and for electric power generation. When natural gas production began in the Cook Inlet region in the early 1960s, gas-fired turbines started providing an increasing share of electric generation, principally in the South-central region. The natural gas was available at extremely low cost ($0.16 per MMCF) and was regarded almost as a nuisance by the producers. More recently, competing demands for export (by LNG to Japan) and for agrichemicals (ammonia and urea) have resulted in greatly increased value of the gas. Although low-cost, long-term contracts continue, new gas prices are much higher ($0.65 to $0.85 per MMCF) but are less than those in the "lower 48."

Natural gas from Cook Inlet plays a major role in Alaska's energy balance for nontransportation uses. The more populated Cook Inlet region is highly dependent upon this source. In 1975, production was 255 trillion Btu. In 1975 the Cook Inlet region produced about 154 BCF of natural gas, 69 BCF of which were used within the state.

Several areas of Alaska are excellent speculative prospects for natural gas. However, the Cook Inlet region is the only current major producer.

Natural gas will become available from the North Slope in the mid-1980s. The known recoverable reserve in the North Slope Sadlerochit formation is estimated at 26 TCF, over 11% of the total known U.S. reserves. Production of the reserve will probably begin in 1983-84 at a rate of between 2.0 and 2.5 BCF/day. For comparison, the total 1975 Cook Inlet net production was about 440 MMCF/day. The energy content of the known North Slope natural gas is about 50% of that associated with the North Slope oil reserve. The fact that natural gas provides about 53% of the state's electric power

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Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

generation and almost all of that associated with the Cook Inlet region is significant. Implementation of the National Energy Plan could cause a rapid change in the use pattern, with coal being substituted for gas in electric generation.

Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

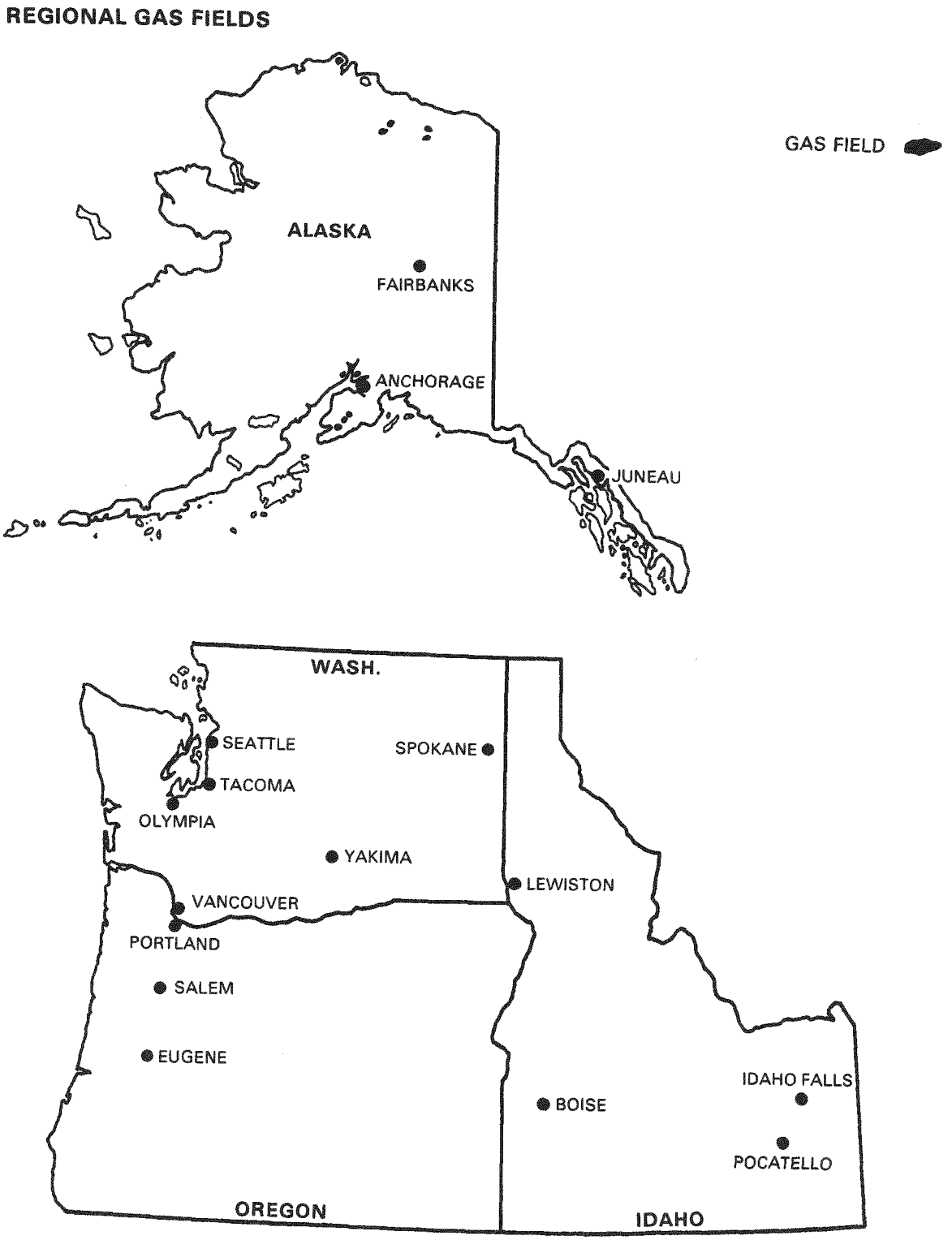

FIGURE I-B-17. Natural Gas Fields of the Northwest

Data Source: Ref. 4, Energy Northwest, Figure 11.

TABLE I-B-1.

NATURAL GAS RESERVES

Area	Natural Gas Liquids (bbl)	Natural Gas (Million ft^3)
Alaska	845,000	31,866,612
Idaho	0	0
Oregon	0	0
Washington	0	0
Region	845,000	31,866,612
U.S.		205,000,000

Data Source: Reference 6, Fuel and Energy Data.

TABLE I-B-2.

NATURAL GAS WELLS

	1977 Estimate			1978 Forecast		
Area	Total Wells 1977	Total Wildcats 1977	Total Footage (1,000 ft)	Total Wells 1978	Total Wildcats 1978	Total Footage (1,000 ft)
Alaska	66	19	690	124	39	1,182
Idaho	3	3	42	12	12	168
Oregon	2	2	11	1	1	6
Washington	1	1	2	0	0	0
Total U.S.	061	9,875	210,380	48,041	10,872	3 224,932

Data Source: Reference 7, The Oil and Gas Journal, pp. 133, 137 and 138.

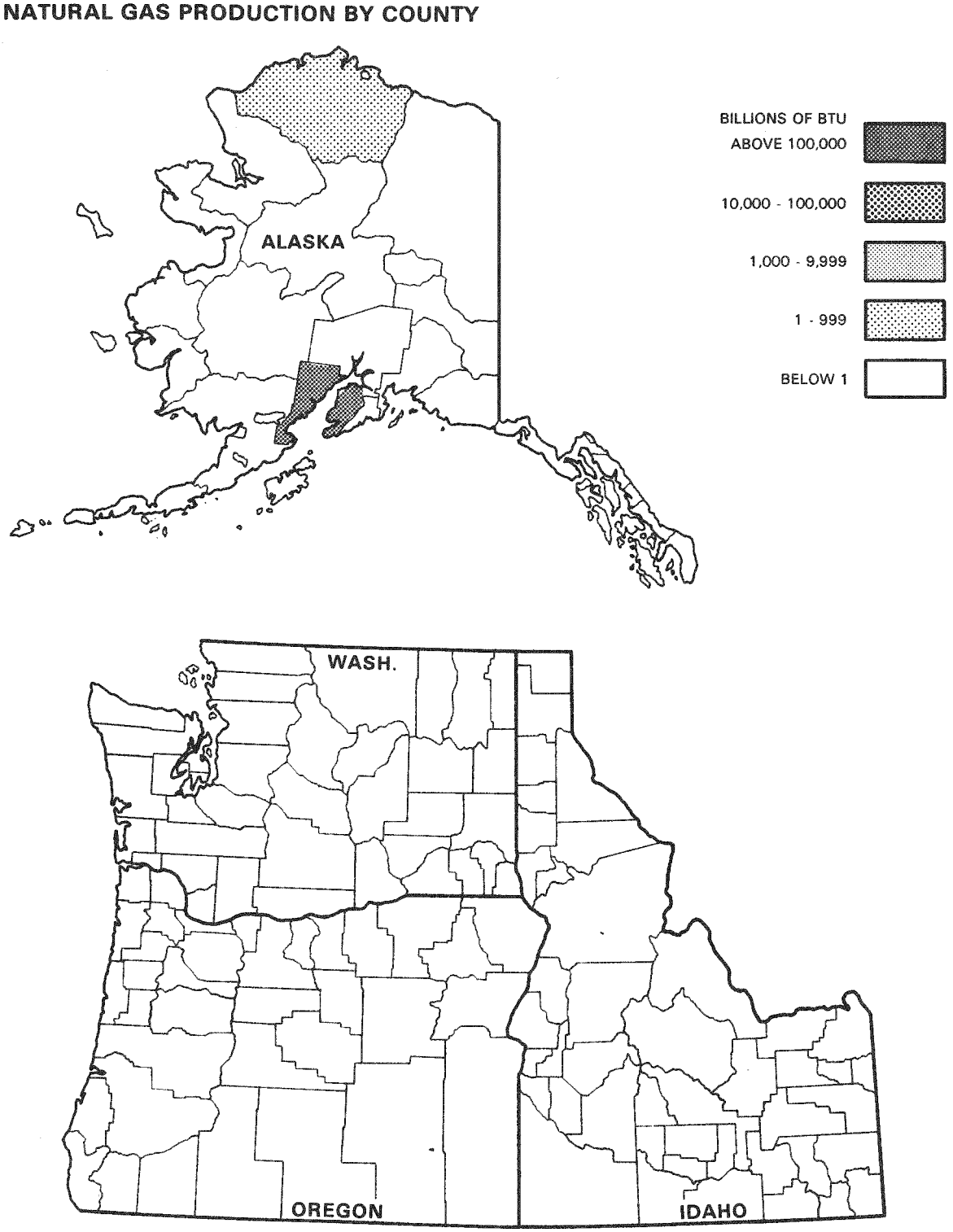

FIGURE I-B-18. Natural Gas Production by County

Data Source: Ref. 5, Energetics of the USA, p. 59.

TABLE I-B-3.

NATURAL GAS PRODUCTION BY YEAR

Year	Millions of ft^3					
	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	160,270	0	0	0	160,270	20,108,661
1974	128,935	0	0	0	128,935	21,600,522
1973	131,007	0	0	0	131,007	22,647,549
1972	125,596	0	0	0	125,596	22,531,698
1971	121,618	0	0	0	121,618	22,493,012
1970	111,576	0	0	0	111,576	21,920,642
1969	50,864	0	0	0	50,864	20,698,240
1968	17,343	0	0	0	17,343	19,322,400
1967	14,438	0	0	0	14,438	18,171,325
1966	11,267	0	0	0	11,267	17,206,628
1965	7,255	0	0	0	7,255	16,039,753
1964	6,238	0	0	0	6,238	15,462,143
1963	4,498	0	0	0	4,498	14,746,663
1962	2,184	0	0	0	2,184	13,876,622
1961	631	0	0	0	631	13,254,025

Data Source: Reference 8, Basic Petroleum Data Book (Sec. XIII, Table 9).

NATURAL GAS MOVEMENTS

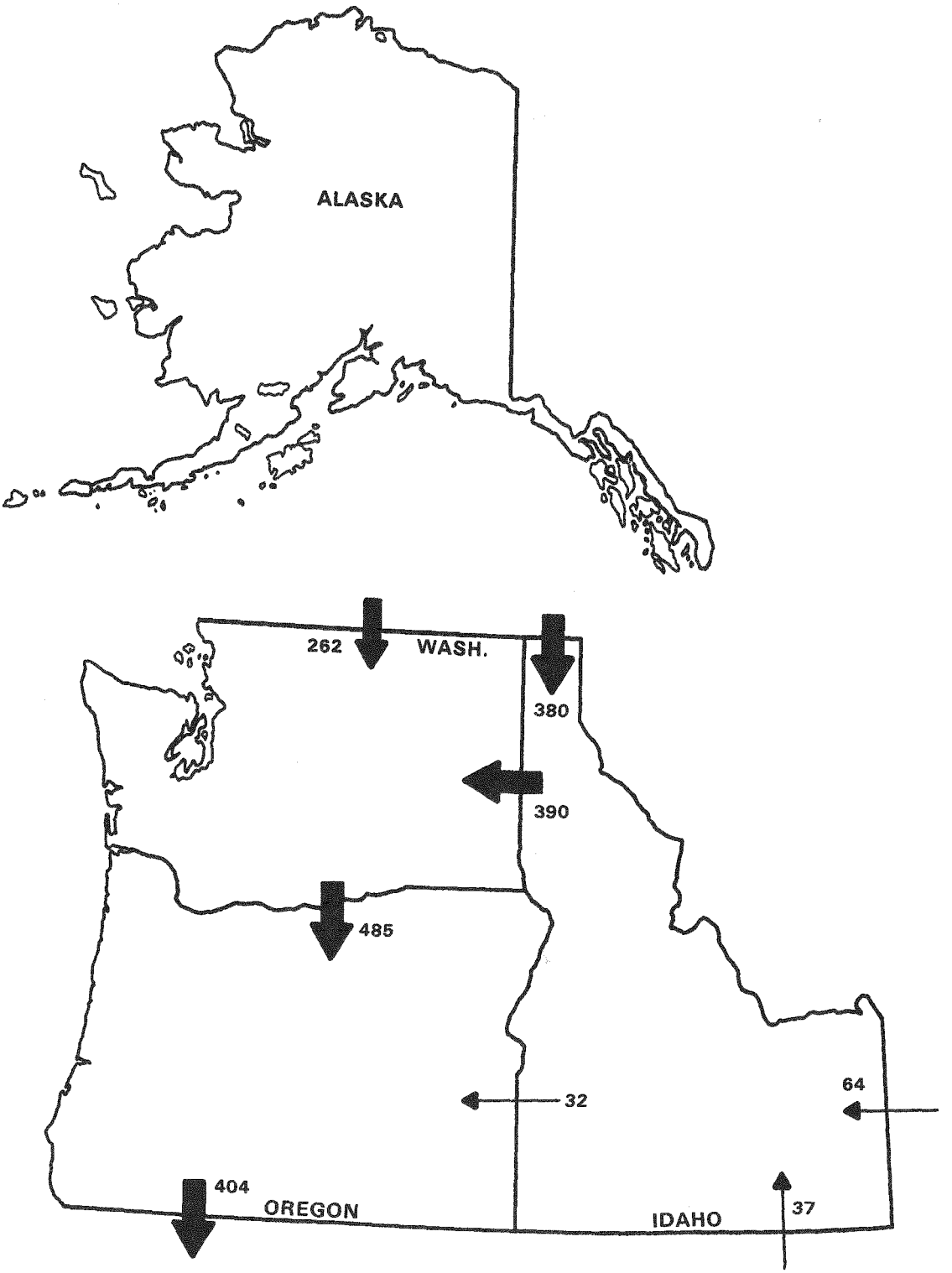

FIGURE I-B-19. Natural Gas Movements (BCF)-1975

Data Source: Ref. 2, The Impact of Increased Coal Consumption, RAP-21, p. A.6.

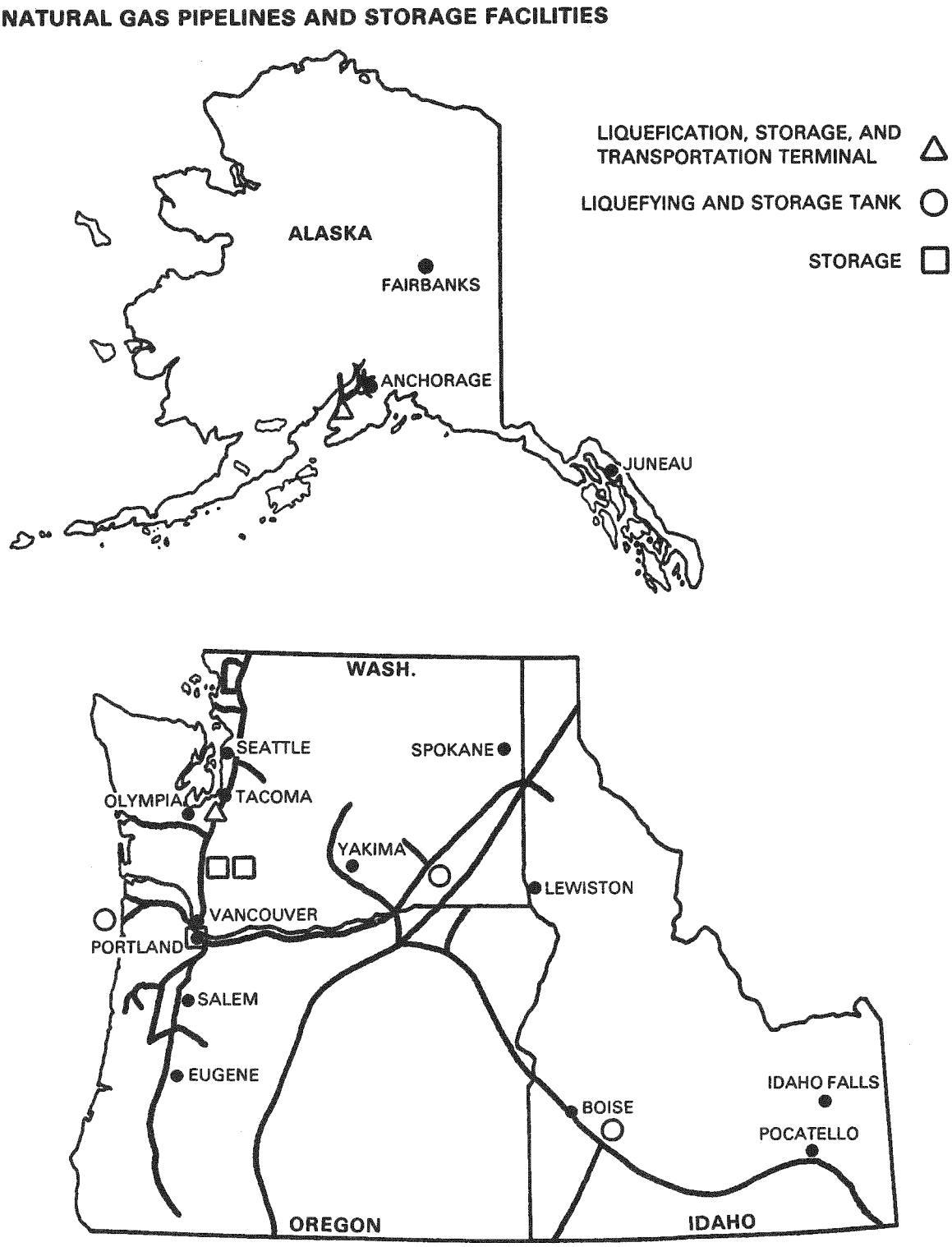

FIGURE I-B-20. Location of Natural Gas Pipelines and Storage Facilities

Data Source: Ref. 4, Energy Northwest, Figure 19.

NATURAL GAS LIQUIDS

The production of natural gas liquids in the northwest region is insignificant to the amount of production in the US. The only producing state is Alaska. Production by Alaska in 1973, 1974, and 1975, is 12, 747, and 760 thousand barrels/year, respectively. US production for the same years was 634,423, 616,098, and 595,958, respectively.

Information Source: Ref. 48, The Oil Producing Industry in Your State, p. 7 and 11.

PETROLEUM

Petroleum production in the United States peaked in 1970 at 3.5 billion bbl/yr, then declined to about 3 billion bbl in 1975. Completion of the Alaska pipeline is expected to boost Regional petroleum supplies significantly.

The Northwest petroleum facilities include refineries and pipeline or tanker transportation for crude and refined oil products. Washington's Puget Sound area receives crude oil by tanker. It is also supplied by Canadian pipeline from Edmonton, Alberta, via a tank farm and terminal at Burnaby, B.C. The United States' share of this pipeline can carry 300,000 bbl of crude oil a day, but Washington refineries actually received only 179,000 bbl/day in 1975. Alaska, Oregon and Washington contain the Region's refineries for converting crude oil into finished petroleum products. Total current capacity of these facilities is 449,000 bbl/day. The fact that the Region's refining capacity for oil and pipeline capacity for both oil and gas are not fully utilized illustrates the Region's dependence upon Canadian imports. Part of this capacity will be available for future Alaskan supplies as import contracts expire.(1)

To deal with the Canadian Government's announced plans to stop all exports by 1983, the FEA has announced the amount of Canadian crude oil allocated to Northern Tier refineries. The Puget Sound refineries were classified as priority two, and the Puget Sound refiners were to continue to receive about 6,500 bbl/day of condensate through the first quarter of 1978.

The Pacific Northwest petroleum industry consists of many companies operating more or less independently of one another. The supply structure is geographically divided by the Cascade Mountains. The western part contains four major refineries, all located in the Puget Sound area: Atlantic Richfield (the largest), Shell (second), Texaco (third) and Mobil (fourth). These refineries distribute products by pipeline and tank truck. Additional

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(1) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

petroleum products are brought into the western part of the Region by barge and truck from refineries in California.

Refineries in Billings and Naurel, Montana and in Salt Lake City, Utah distribute petroleum products to the eastern part of the Region by two pipelines (one from the Billings-Laurel area of Montana; the other from Salt Lake City, Utah). The eastern part of the Region also receives some petroleum products by barge via the Columbia River.(1)

Crude oil production in 1976 averaged 183,000 bbl/day. Of the oil produced, a net of about 70% is exported to the "lower 48." The Prudhoe Bay oil field started producing at 600,000 bbl/day in mid-1977, and will increase to 1.2 million bbl/day in the near future. Ultimate production of this field will be at about 2 million bbl/day. Total known recoverable reserves amount to 9.6 trillion bbl, with expectations of additional reserves yet to be discovered primarily off-shore in the Beaufort Sea and from different strata (Kuparuk River, Lisburne formations) in the Prudhoe structure.

Additional Alaskan oil and gas development activity is expected. A lease sale for Lower Cook Inlet was held in October 1977, with 87 bids accepted. Exploration is underway on National Petroleum Reserve-A (formerly Naval Petroleum Reserve No. 4) on the western North Slope. Exploratory drilling is also occurring in the interior Kandic Basin and off-shore in the eastern Gulf of Alaska.(2)

The Puget Sound imported 7,702,902 bbl of finished and unfinished oil from Canada, Venezuela, Saudi Arabia and Iran in 1975. Of the imported oil, 792,922 bbl were motor gasoline (10.2%), 1,268,135 bbl were jet fuel (16.5%), and 269,272 bbl were middle distillates (3.5%).(3)

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(1) Information Source: Reference 3, Energy Futures Northwest.
(2) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.
(3) Information Source: Reference 9, Petroleum Supply System (Draft).

FIGURE I-B-21. Oil Fields of the Northwest

Data Source: Ref. 4, Energy Northwest, Figure 11.

TABLE I-B-4

PETROLEUM RESERVES

Area	1975 (Thousand bbl)
Alaska	10,094,099
Idaho	0
Oregon	0
Washington	0
Region	10,094,099
U.S.	24,000,000

Data Source: Reference 6, Fuel and Energy Data.

TABLE I-B-5

ALASKAN MAJOR PETROLEUM RESERVES

Alaskan Fields	Estimated Remaining Reserves (Thousand bbl)
Granite Point	40,500
McArthur River	141,100
Middle Ground Shoal	72,300
Prudhoe Bay[a]	9,700,000
Swanson River	45,900

(a) Reserves include 400 million bbl natural gas liquids.

Data Source: Reference 7, Oil and Gas Journal, p. 144.

TABLE I-B-6

ARCTIC REGION - ESTIMATE OF OIL AND GAS RESERVES

Area	Recoverable Oil, Million bbl	Recoverable Gas, TCF
Offshore		
Chukci	6.6	33.0
Beaufort	2.7	13.5
Onshore		
North Slope	15.5	41.8
Total	24.8	88.3

Data Source: Reference 9, Petroleum Supply System (Draft).

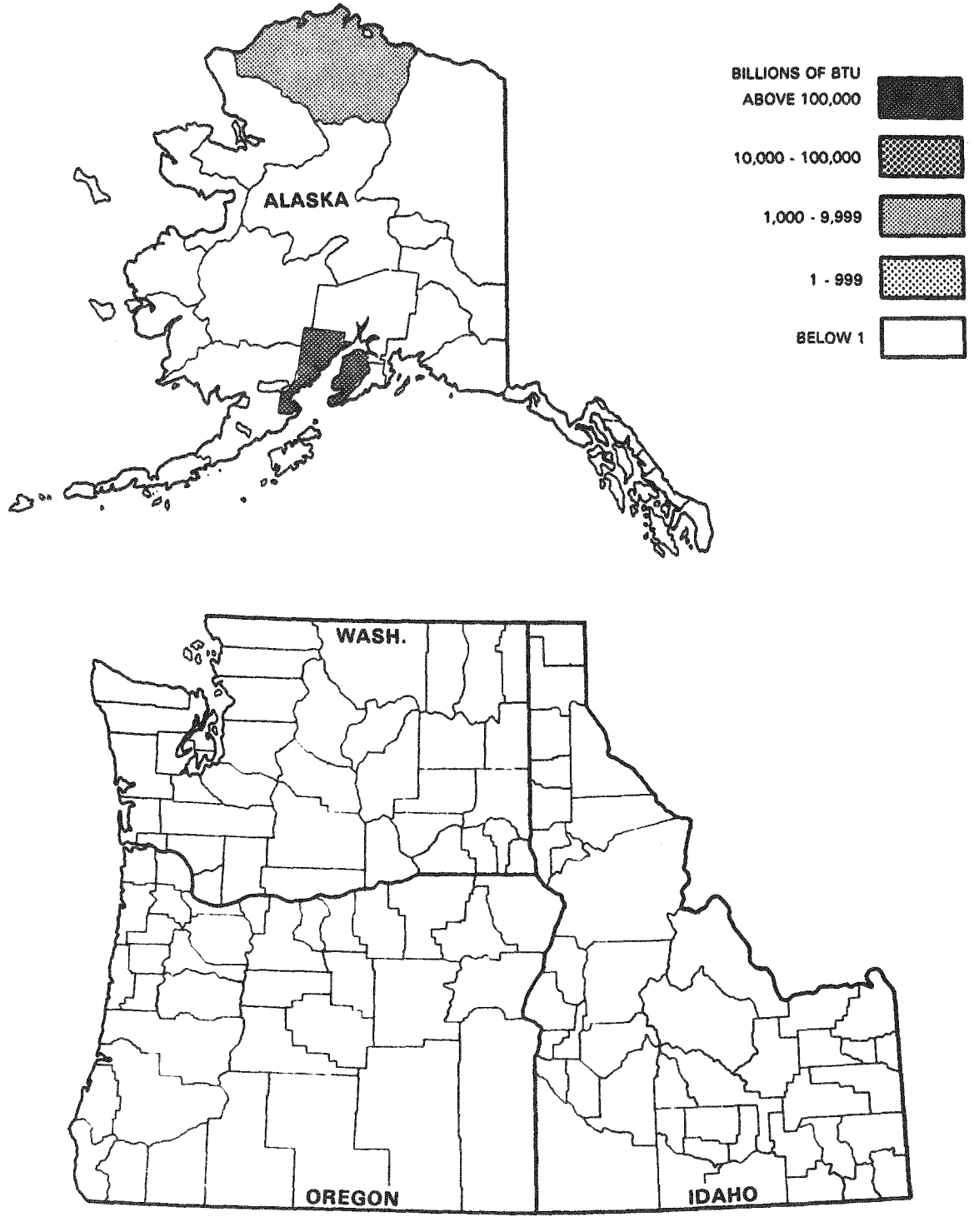

FIGURE I-B-22. Oil Production by County

Data Source: Ref. 5, Energetics of the USA, p. 57.

TABLE I-B-7

CRUDE OIL PRODUCTION BY YEAR

	Millions of bbl					
Year	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	69.8	0	0	0	69.8	3,052.0
1974	70.6	0	0	0	70.6	3,202.6
1973	72.3	0	0	0	72.3	3,360.9
1972	72.9	0	0	0	72.9	3.455.4
1971	79.5	0	0	0	79.5	3,453.9
1970	83.6	0	0	0	83.6	3,517.4
1969	74.9	0	0	0	74.9	3,371.8
1968	66.2	0	0	0	66.2	3,329.0
1967	29.1	0	0	0	29.1	3,215.7
1966	14.4	0	0	0	14.4	3,027.8
1965	11.1	0	0	0	11.1	2,848.5
1964	11.1	0	0	0	11.1	2,786.8
1963	10.7	0	0	0	10.7	2,752.7
1962	10.3	0	0	0	10.3	2,676.2
1961	6.3	0	0	0	6.3	2,621.8

Data Source: Reference 8, Basic Petroleum Data Book (sec. IV. Table 5).

TABLE I-B-8

SUMMARY OF CURRENT CRUDE OIL PRODUCTION FIELDS

Field Name	1972	1973	1974	1975
Beaver Creek	-	416,281	374,750	322,273
Granite Point	4,662,955	4,766,975	4,236,750	4,360,797
McArthur River	40,774,241	38,883,671	39,144,865	40,876,188
Middle Ground Shoal	9,719,674	10,238,961	9,000,512	8,669,611
Swanson River	8,896,198	10,064,499	9,765,402	8,753,796
Trading Bay	8,585,287	7,825,330	7,551,710	6,127,863

Data Source: Reference 9, Petroleum Supply System (Draft).

TABLE I-B-9

MAJOR ALASKAN OIL FIELDS

Alaskan Fields	Estimated Number of Wells
Granite Point	27
McArthur River	62
Middle Ground Shoal	37
Prudhoe Bay	102
Swanson River	42

Data Source: Reference 7, Oil and Gas Journal, p. 144.

TABLE I-B-10

MAJOR OIL WELL PRODUCTION

Alaskan Fields	1977 Production (bbl)
Granite Point	4,485,000
McArthur River	31,857,000
Middle Ground Shoal	7,745,000
Prudhoe Bay	116,870,000
Swanson River	6,057,000

Data Source: Reference 7, Oil and Gas Journal, p. 144.

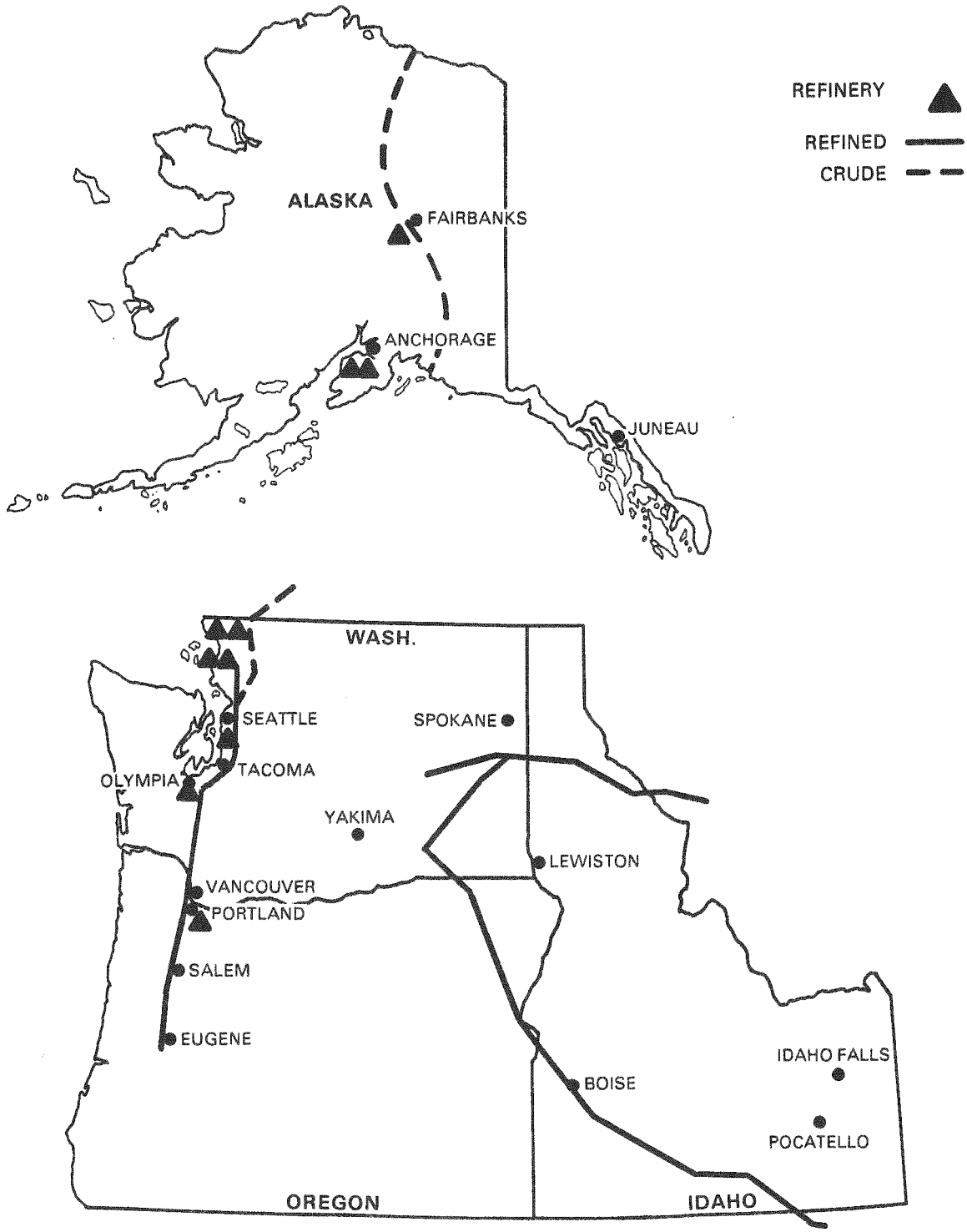

FIGURE I-B-23. Oil Refineries and Pipelines

Data Source: Ref. 4, Energy Northwest, Figure 18.

TABLE I-B-11

REFINERIES

State and County	(Processed in thousands of bbl/day) Capacity	Catalytic Cracking	Catalytic Reforming	Hydro Cracking	Coking	Thermal	Alkylation
Alaska							
Kenai-Cook	53.0	0.0	0.0	0.0	0.0	0.0	0.0
Idaho	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oregon	18.0	0.0	0.0	0.0	0.0	0.0	0.0
Multnamah	18.0	0.0	0.0	0.0	0.0	0.0	0.0
Washington	335.0	85.0	74.0	33.0	28.0	7.0	26.0
Pierce	19.0	0.0	3.0	0.0	0.0	0.0	0.0
Skagit	153.0	59.0	27.0	0.0	0.0	0.0	0.0
Whatcom	163.0	26.0	44.0	33.0	28.0	7.0	10.0

Data Source: Ref. 5, Energetics of the U.S., Table 7, pp. 211-213.

TABLE I-B-12

WASHINGTON REFINERIES

1975 THROUGHPUT

Company	Location	Capacity, bbl/day	Estimated[a] Throughput 1975, bbl/day
Atlantic Richfield	Ferndale	98,000	76,700
Mobil Oil Corp.	Ferndale	71,500	57,300
Shell Oil Co.	Anacortes	91,000	73,000
Texaco, Inc.	Anacortes	78,000	62,600
Sound Refining Co.	Tacoma	4,500	3,600
U.S. Oil & Refining	Tacoma	18,500	14,800
		361,500	288,000

(a) Estimate: Based on total crude inputs of 288,000 bbl/day and allocation to each refinery based on its percent of total capacity.

Data Source: Ref. 9, Petroleum Supply System (Draft)

TABLE I-B-13

WASHINGTON REFINERIES

SELECTED CHARACTERISTICS

	Arco	Mobil	Shell	Texaco	Sound	U.S. Oil
Year Built	1972	1954	1955	1953	--	1957
Acreage	1,200	800	800	850	33	135
Present Capacity (BCD)	95,000	71,500	91,000	78,000	4,500	18,500
Potential Capacity (BCD)	300,000	200,000	200,000	210,000		
Crude Storage (day of refinery capacity)	20	8[a]	7[b]	20		

(a) Being expanded by 650,000 bbl or about 10 additional days.
(b) There are plans to expand storage by 600,000 bbl.

Data Source: Ref. 9, Petroleum Supply System (Draft)

TABLE I-B-14

ALASKA REFINERIES

Company	Location	Rate Capacity
Atlantic Richfield Co.	Prudhoe Bay	13,000 bbl/day
Standard Oil of Calif.	Kenai	22,000 bbl/day
Tesoro-Alaskan Petro.	Kenai	38,000 bbl/day

An additional 32,250 bbl/day of refinery capacity is planned for the State. This includes:

A. BP Alaska's planned topping plant at Prudhoe Bay, with a rated capacity of 1,250 bbl/day. The equipment is on-site; however, construction has not started.

B. Tesoro-Alaskan Petroleum operates a 38,000 bbl/day refinery at Kenai. They have plans to expand this plant to 44,000 bbl/day in 1976.

C. A refinery is planned for the Fairbanks area with an initial capacity of 15,000 bbl/day. The plant will be designed to process North Slope crude. The construction data is not definite, but construction will probably take place in the next 4 yr.

Data Source: Ref. 9, Petroleum Supply System (Draft).

TABLE I-B-15

ALASKA'S SUPPLY SOURCES

Anchorage	Valdez
Barrow	Nome
Dutch Harbor	Ketchikan
Fairbanks	Kotzebue
Juneau	Bethel
Kenai	Dillingham

Data Source: Ref. 9, Petroleum Supply System (Draft).

OIL SHALE

Oil shale is a fine-grained rock containing organic matter known as kerogen. Kerogen can be extracted from the shale and converted into a high-grade oil.

Processing of oil shale may yield 95 ℓ (25 gal) of oil per ton of rock, but there are enormous amounts of processed rock left over. Also involved in the recovery process is the requirement for large amounts of water. It is environmental problems like these, along with tremendous economic and technical complications, that may prevent these large reserves from being used.

Information Source: Reference 10, Oil, p. 59.

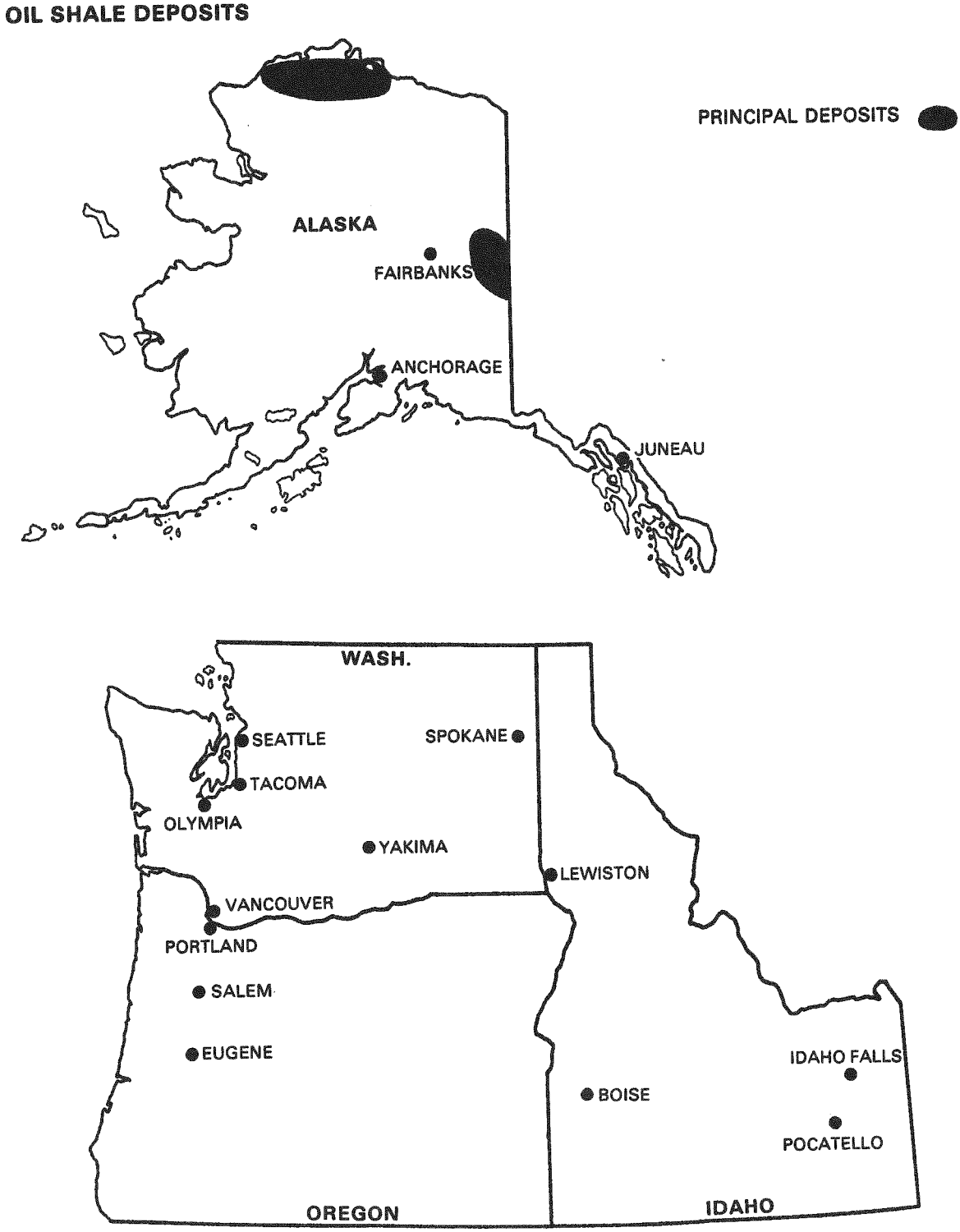

FIGURE I-B-24. Oil Shale Deposits

Data Source: Ref. 11, The Nations Renewable Resources - An Assessment.

COAL

Idaho and Oregon do not contain large, economically recoverable reserves of coal. Only Washington has substantial reserves; it is currently producing significant quantities (3.74 million tons in 1975) in Lewis County, supporting the 1300 megawatt (MW) Centralia station. Although other reserves exist in Washington, the steep dipping of their seams would result in high mining costs.

Major sources of coal for future imports to the three-state region include Alaska, British Columbia, Montana, Utah and Wyoming. The region is served by two primary coal-hauling railroads: Union Pacific from southern Wyoming, and Burlington Northern from Montana. Gulf Interstate has proposed a slurry pipeline from Wyoming through southern Idaho to eastern Oregon. Alaskan coal could be shipped to coastal sites via bulk carriers. Coal in Montana is most likely to come from Rosebud County, and in Wyoming from Campbell, Converse, Lincoln and Sweetwater Counties.

The economics of coal supply for a coal importing region are complex; transportation costs are a major component. Further, the transportation system cost includes both capital charges not subject to escalation, and operating costs that will be subject to escalation. The relative exposure to inflation, coupled with the cost of capital needed to finance the system, will influence the selection of both the transportation mode and the actual mine supply source.

Besides the significant oil and gas reserves, very large surface mineable (>2.25 billion tons) reserves of subbituminous coal are available; however, they are largely untapped. An additional trillion tons of coal is believed present under Cook Inlet, but is not recoverable by traditional mining methods.

Only one coal mine (Usibelli Coal Company) is not active in Alaska. The mine, located near Healy in the Nenana Coal Field, produces approximately

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Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

700,000 tons/yr for utilities and military power production in the Fairbanks area. The 1977 mine-mouth price of coal from the Usibelli mine is about $0.65/MMBtu or about $11/ton.

The Usibelli lease holds estimated reserves of 450 to 500 million tons, with dipping beds that are 30 to 50 ft thick. The mining method is open-pit, and 75 to 80% of the coal is shipped to Fairbanks via the Alaska Railroad. The remainder is consumed by the Golden Valley Electric Cooperative plant, located eight miles from the mine.

The largest Alaskan coal reserves are located north of the Brooks range and are essentially inaccessible. Other coal deposits of significance are the Matanuska Region bituminous coal fields at 10,400 to 14,400 Btu/lb, with a sulfur content of 0.2 to 1.0%, and the subbituminous Beluga coal at 7500 Btu/lb, with a sulfur content of 0.15%. The Beluga coals in the Susitna Region will be important because of their location near tidewater on the west side of Cook Inlet and their low sulfur content. A reserve of 2.4 billion tons has been demonstrated.

A major Alaskan coal reserve is located 15 miles from an existing tanker loading port. The reserve's six beds are up to 40 ft deep, with an average overburden ratio of 3:1. Mining costs have been estimated at $6.40/ton on a clean, dry basis. The coal would be prepared at mine-mouth and delivered as a slurry to the tanker loading point. Delivered cost to Northwest ports would be about $21.15/ton, or $1.32/MMBtu (1975 dollars) at a production level of 8.76 million tons/yr.

Currently, the Region is not a large producer of steam coal. The active mining subregions are at Healy, Alaska and Centralia, Washington. Except for Alaska and Centralia, the Region's coal resources (though substantial in total amount), are difficult to mine and transport due to remote locations or steeply dipping beds. The development of new mining techniques (e.g., hydraulic) or onsite gasification could result in further development, particularly in western Washington.

Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

REGIONAL COAL FIELDS

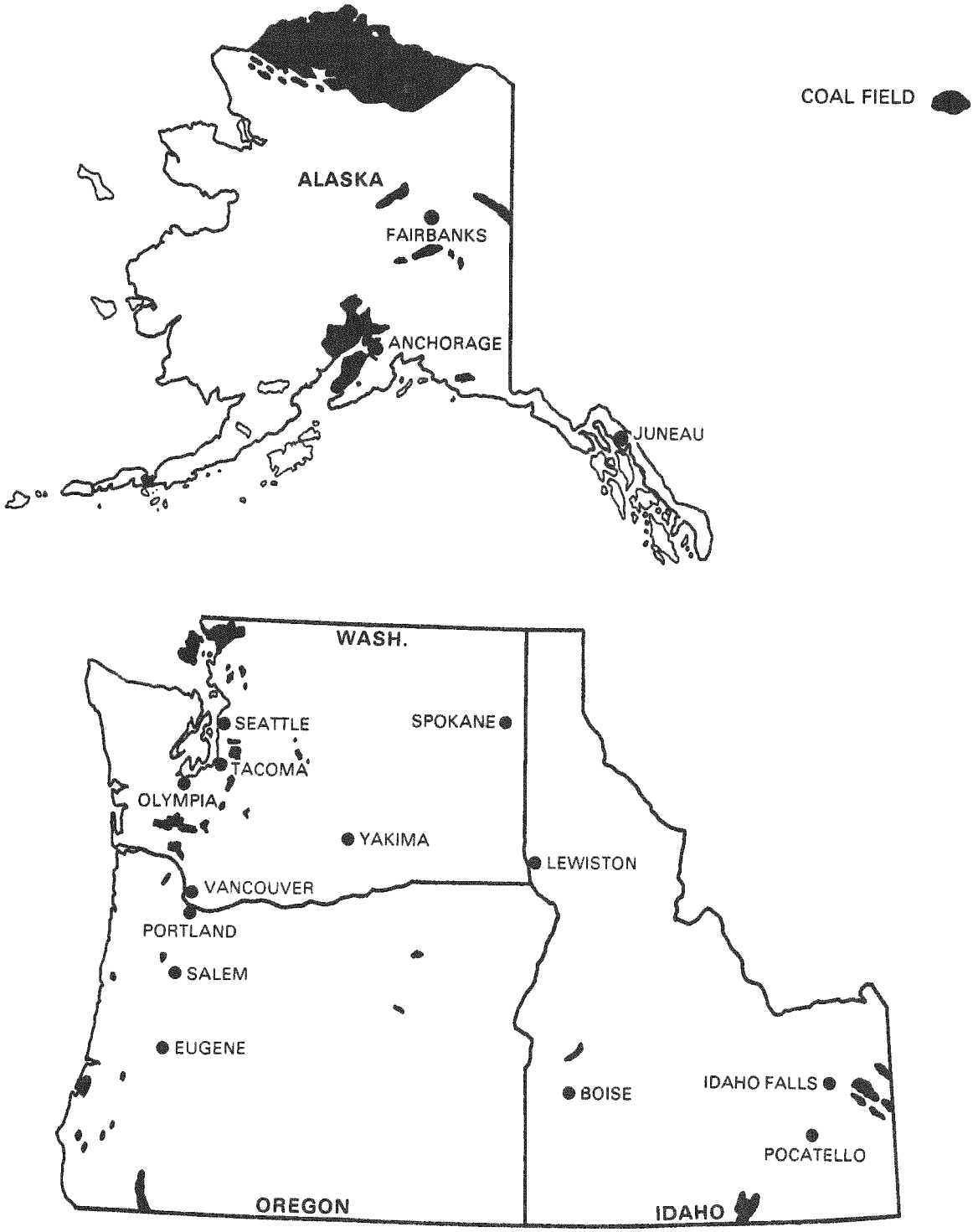

FIGURE I-B-25. Location of Regional Coal Fields

Data Source: Ref. 4, Energy Northwest, Figure 11.

TABLE I-B-16

COAL RESERVES

Area	Billions of Tons
Alaska	5.8
Idaho	0
Oregon	0
Washington	1.0
Regional	6.8
U.S.	210.0

Data Source: Ref. 4, Energy Northwest, p. 22.

TABLE I-B-17

DEMONSTRATED MINING COAL RESERVE, SURFACE AND UNDERGROUND

Area	Sulfur Content (Millions of Tons) ≤1.0%	1.1-3.0%	>3.0%	Unknown	Total
Surface					
Alaska	7,377.6	21.0	0.0	0.0	7,399.0
Oregon	0.5	0.3	0.0	0.0	0.8
Washington	172.5	307.7	25.8	2.2	508.1
NW Region	7,550.6	329.0	25.8	2.2	7,907.9
U.S. Total	73,252.3	33,597.4	18,950.9	11,076.1	136,885.7
Underground					
Alaska	4,080.8	163.2	0.0	0.0	4,246.4
Oregon	1.0	0.0	0.0	0.0	1.0
Washington	431.0	957.8	13.2	42.9	1,445.9
NW Region	4,512.8	1,121.0	13.2	42.9	5,693.3
U.S. Total	126,928.8	59,400.2	73,720.2	39,761.6	299,839.7

Data Source: Ref 12, Mineral Industry Surveys, 1975.

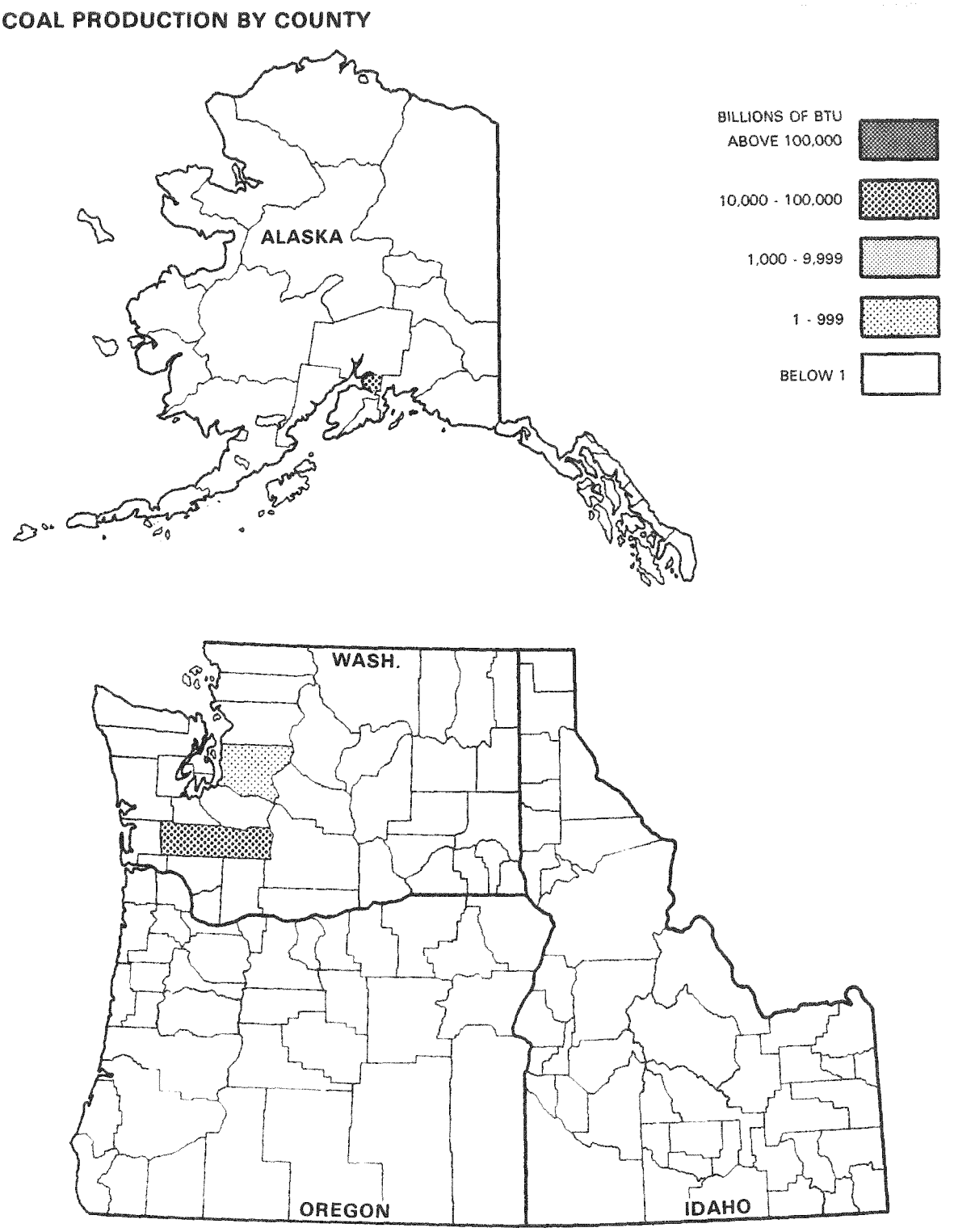

FIGURE I-B-26. Coal Production by County

Data Source: Ref. 5, Energetics of the USA, P. 52a.

TABLE I-B-18

COAL PRODUCTION BY YEAR

	Thousands of Short Tons					
Year	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	766	0	0	3,738	4,504	640,000
1974	700	0	0	3,913	4,613	603,406
1973	694	0	0	3,270	3,964	591,738
1972	668	0	0	2,635	3,303	595,384
1971	698	0	0	1,134	1,832	552,192
1970	549	0	0	37	586	602,932
1969	667	0	0	58	725	560,505
1968	750	0	0	178	928	545,245
1967	925	0	0	58	983	552,626
1966	927	0	0	59	986	533,881
1965	893	0	0	55	948	512,088
1964	745	0	0	68	813	486,998
1963	853	0	0	190	1,043	458,928
1962	871	0	0	235	1,106	439,043
1961	737	0	0	191	928	420,423

Data Source: Ref. 13-16, Minerals Yearbook, Annuals; Fuels and Energy Data; Coal - Bituminous & Lignite, 1974, p. 11; 1976 Keystone Coal Industry Manual

TABLE I-8-19

CHARACTERISTICS OF AS-RECEIVED REGIONAL COALS AND SOLVENT REFINED COALS: PROXIMATE AND ULTIMATE ANALYSES IN WEIGHT PERCENT

	Wt %					
	Alaska-Beluga		Alaska-Nenana		Washington-Centralia	
Substances	Average	Range	Average	Range	Average	Range
Moisture	28	--	--	17.8-27.1	--	16.8-29.0
Volatile matter	32	--	--	33.2-42.0	--	29.7-34.8
Fixed carbon	30	--	--	27.1-35.3	--	28.6-33.9
Ash	10	--	--	3.5-13.2	--	7.6-19.7
Hydrogen	--	--	--	--	--	--
Carbon	--	--	--	--	--	--
Nitrogen	--	--	--	--	--	--
Oxygen	--	--	--	--	--	--
Sulfur	0.15	--	0.2	0.1-0.13	--	0.6
Btu/lb	7500	--	9000	7570-9430		7530-8763

Data Source: Ref. 2, The Impact of Increased Coal Consumption, RAP-21, p. 3.12

URANIUM

The basic raw material for nuclear energy is uranium. Uranium is a hard, nickel-white metallic element found in many rocks and natural waters. Because it usually exists in very low concentrations, its presence can only be detected with sensitive instruments or analytical techniques.

Uranium is most abundant in rocks low in iron and magnesium and high in sodium and potassium. Rocks such as granites, rhyolitic volcanic flows, and tuffaceous ash, for example, are likely sources of uranium deposits.(1)

There are three basic radioactive isotopes in uranium: U-238 (99.28%), U-235 (0.71%), and U-234 (0.005%). U-235 is the only fissionable material that still must be enriched to at least 3% before it can be used in nuclear reactors.

Within the Northwest, the largest production of uranium has come from the Spokane Indian Reservation in Northern Washington. Areas of minor production include Bokan Mountain on Price of Wales Island in Alaska, Mt. Spokane in Washington, and Basin Creek, Idaho. The most significant deposits found on the Spokane Indian Reservation are in rocks of the Togo Formation of the Precambian Deer Trail Group. The uranium in Mt. Spokane is found in shear zones and as coatings on fractures; the Basin Creek deposits are in sandstone less than 300 ft deep. In Alaska the uranium-thorium ore is probably associated with granite. Within nine Tertiary basins in Alaska there is an estimated potential supply of approximately 243,000 tons of U_3O_8.(2)

There is only one uranium milling facility in the Region. During 1975 the Dawn Mining Company in Ford, Washington shipped 3.29 MMBtu[3] to a UF_6 converter in Sallisaw, Oklahoma.(3)

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(1) Information Source: Reference 17, National Uranium Resource Evaluation, Preliminary Report, pp. 25-27.
(2) Information Source: Reference 17, Ibid, pp. 111, 60 and 87.
(3) Information Source: Reference 18, National Energy Transportation, Tables 2 and 3, pp. 10 and 11.

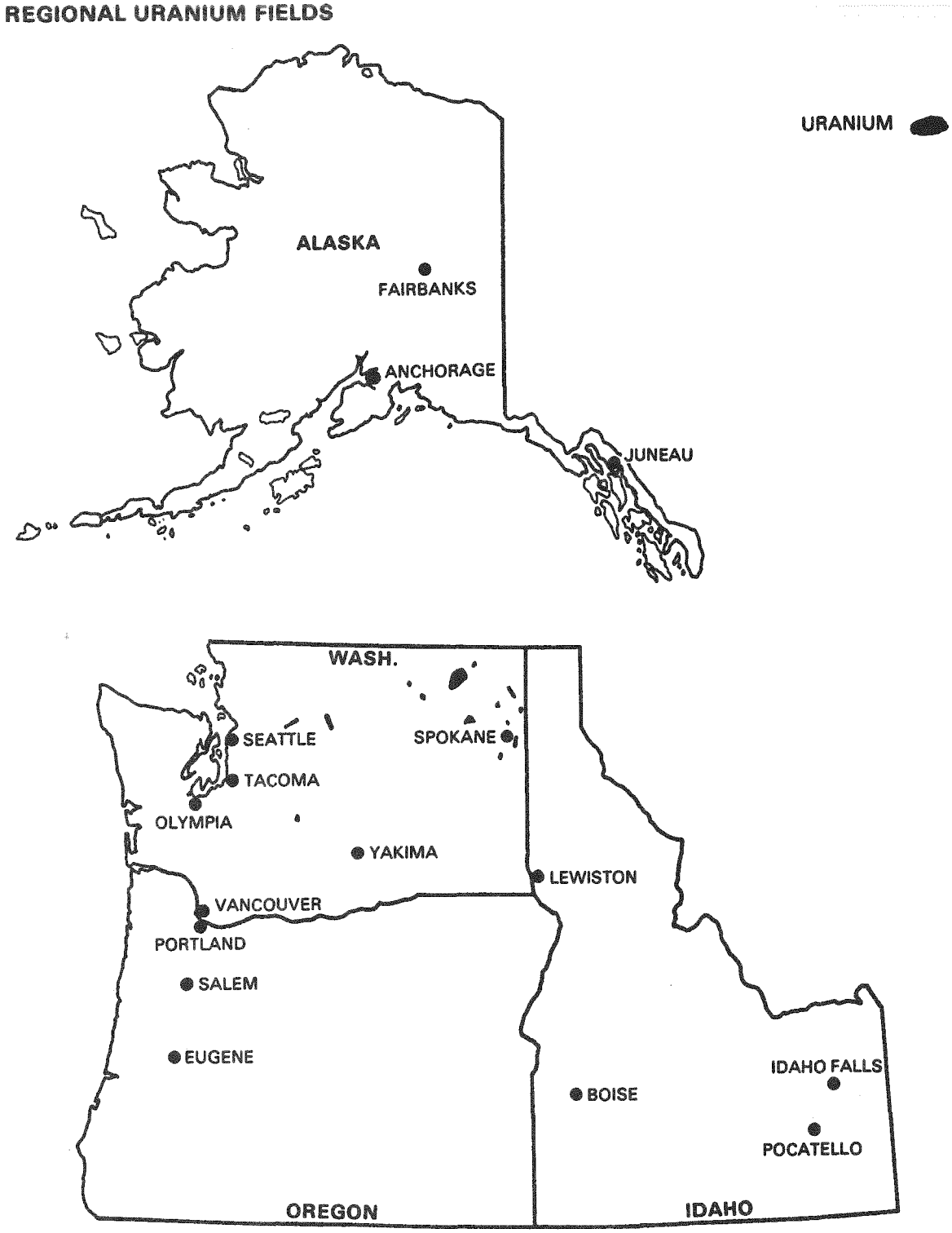

FIGURE I-B-27. Uranium Fields of the Northwest

Data Source: Ref. 4, Energy Northwest, Figure 11.

TABLE I-B-20

URANIUM RESERVES

Area	Thousand Tons
Alaska	0
Idaho	0
Oregon	0
Washington	4.5
Regional	4.5
U.S.	775.0

Data Source: Ref. 2, Energy Northwest, p. 22.

TABLE I-B-21

URANIUM PRODUCTION

Area	Thousand lb			
	1971	1972	1973	1974
Alaska	0	0	0	0
Idaho	0	0	0	0
Oregon	0	0	0	0
Washington	0	W	0	0
Regional	24,520	25,758	23,060	17,436
U.S.				

Data Source: Ref. 19 and 20, Fuels and Energy Data; and U.S. Energy Fact Sheets.

GEOTHERMAL

Dry steam (no liquid water present), wet steam (a combination of steam and water), and hot rocks are the three basic forms of geothermal energy. Although the Northwest does not have high-temperature sites, the area still has some of the nation's most promising geothermal resources. At present, there are 692,656 acres of known geothermal resource sites in the Region, which is 21.4% of the total national figure.

Of the 830 nationwide competitive and noncompetitive geothermal leases, 135 have been issued for federal lands in Oregon and Idaho. As of August 1976, this area covered 217,919 acres. Exploration activities such as geophysical surveys and temperature gradient well drillings have taken place, but no deep exploration wells have been drilled, mainly because of legal, institutional and environmental problems. Furthermore, the lower-temperature geothermal sites in the Region make the process less cost effective and less efficient.

Substantial research is being conducted within the State of Oregon. The Northwest Natural Gas Company, the Oregon Department of Geology and Mineral Industries, and John Hook, a Consulting Geologist, have proposed the drilling of two 2000-ft temperature gradient wells at Old Maid Flat, west of Mt. Hood. Plans are being made to pipe the hot water to Portland for an industrial and municipal heating system.

A deep gradient test hole has already been completed near Doak Mountain. There is more geothermal potential within the Klamath Basin, so more studies and data are being collected within the area.

Areas of promising geothermal potential are continuing to be evaluated. Even the utilization of waste water is being developed by organizations like "Geo-Heat Utilization Center" in Klamath Falls. They are testing the feasibility of using waste water for the commercial production of prawns.

Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, pp. 84-87.

Idaho is also heavily involved with geothermal research. In the Boise area the Department of Energy (DOE) and Boise State University have drilled three test wells in order to gather data for developing a large-scale hot water heating system for the area. DOE is also engaged in a project in the Raft River area. A 5-MW pilot plant is scheduled to be run by geothermal fluid by 1980.

Geothermal generation costs are already competitive with conventional thermal plants, but there are major environmental impacts of concern: high mineral content of water, the risk of well blow-out, thermal pollution, and geological effects such as ground subsidence. However, with research programs similar to those in Idaho and Oregon continuing, environmental data will be generated that will have broad applications and considerable value for the on-going development of geothermal energy.

Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, pp. 84-87.

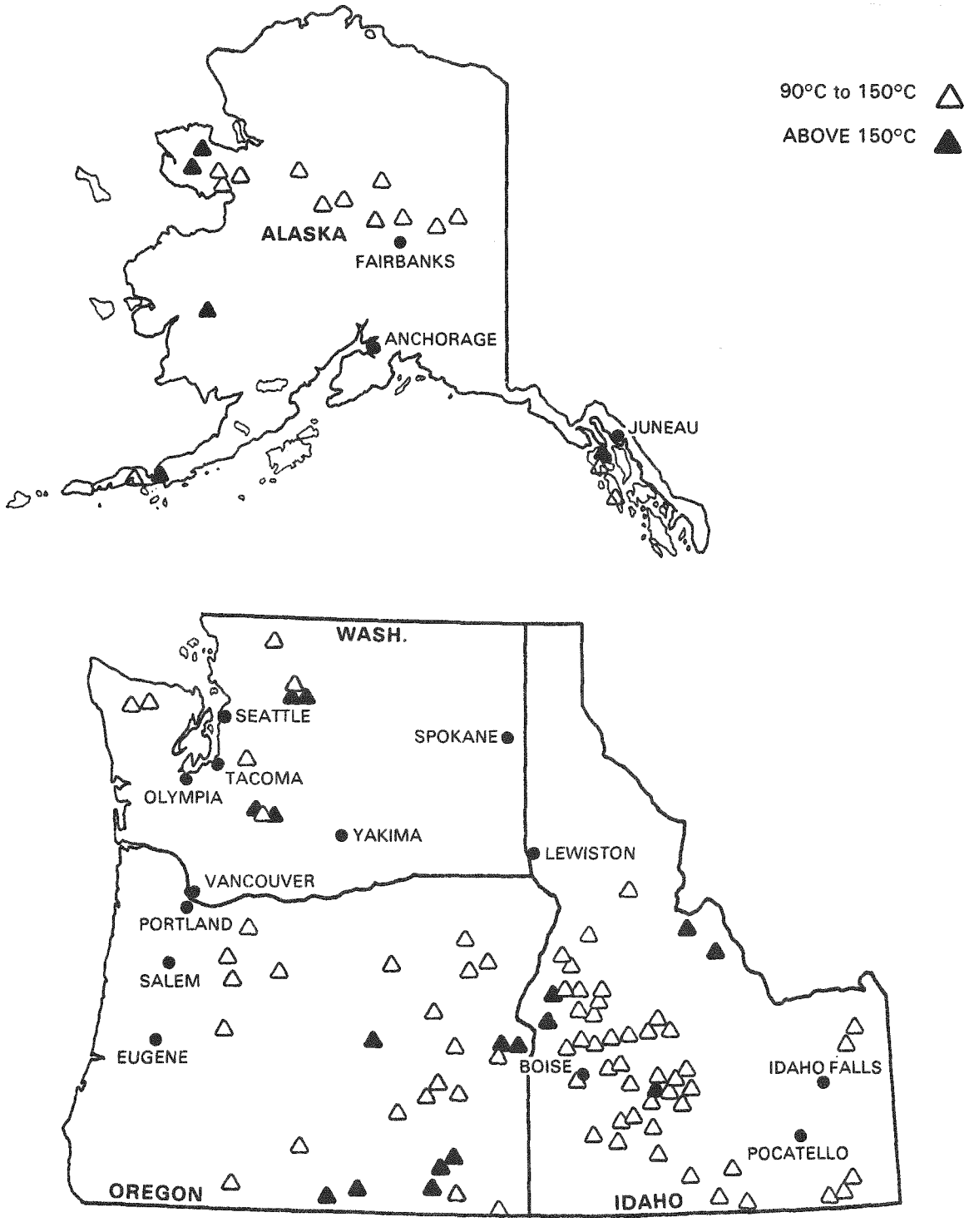

FIGURE I-B-28. Geothermal Resources

Data Source: Ref. 4, Energy Northwest, p. 24 for ID, OR and WA.
Ref. 22, Alaska Profiles, Figure 94.

TABLE I-B-22

KNOWN AND POTENTIAL GEOTHERMAL RESOURCE AREAS

State	Acres	
	KGRA(a)	Potential Geothermal Resource Areas
Oregon	84,279	15,048,000
Washington	17,622	5,759,000
Idaho	21,844	14,845,000
Alaska	88,160	11,277,000
Total	211,905	46,929,000

(a) KGRA = Known Geothermal Resources Areas.

Data Source: Reference 27, Energy Sourcebook.

SOLAR

Solar energy can be utilized in many areas throughout the Northwest. Residential heating and electric generation are both feasible applications of this energy source.

The intensity of solar radiation varies with cloud cover, latitude, and the time of day and season; thus, many people have been skeptical about the efficiency of solar systems. However, with proper storage facilities or backup power for nights and cloudy days, solar energy shows great promise in lessening the burden of the energy crisis.

Throughout the Region, solar space heating is an attractive alternative to conventional fossil fuel systems. Based on climatic factors, solar space heating has more potential in the Northwest Region than in other Northern U.S. locations. In particular, Richland, Washington and Medford, Oregon seem most ideal for solar heating applications; and in general, the clear-sky eastern portions of the Region are well-suited for solar water heating.

"Passive" solar heating can be retrofitted to a building at minimal cost. A study conducted by the University of Oregon has indicated that passive systems in the Region can meet 60 to 70% of a resident's space heating needs. Active solar systems for space and water heating systems are less cost effective than other applications studied; swimming pool heating at present seems to be most cost effective.(1)

A house constructed on Portland city property has been open to the public. The Tera One building is an Energy Conservation Laboratory that utilizes solar heating and cooling. The site has been leased to the Oregon Museum of Science and Industry.

Pacific Power & Light (PP&L) and Portland General Electric Company (PGE) are conducting demonstration and testing programs for the Region. PP&L is publishing the results and data on the performance of hot water heating

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(1) Information Source: Reference 23, Solar Energy for Pacific Northwest Residential Heating.

units that are located in Grants Pass, Pleasant Hill and Tigard, Oregon and in Yakima, Washington. PGE is testing three different solar space heating systems in selected customers' homes. All three homes are well-insulated and are designed to provide 50% of the annual space heating requirements with passive systems. PGE has also set up a working solar heating and photovoltaic (solar cell) display at the Trojan Nuclear Powerplant Visitor's Information Center.(1)

Electrical demands can also be partially met by photovoltaic conversion or solar thermal conversion. The advantage of photovoltaics is that they are environmentally sound; they emit no noise, pollution or waste heat. They also have an advantage over other solar designs in that they are sensitive to diffuse sunlight, thus photovoltaics can function on cloudy days. The major problem of solar cells is their cost. The manufacture of silicon crystals, which are an essential component of solar cells, is extremely expensive. However, there is a good probability that the costs will drop rapidly once the technology is perfected and the crystals are mass-produced; the cost is expected to be competitive with conventional thermal-generated electricity within the next ten years.

Solar thermal electric generation is another means of harnessing solar radiation. Unlike solar cells, these systems are relatively large and centralized. The process involves focusing parabolic mirrors, lenses, or rows of flat plate mirrors onto a tower where the sun's energy will be concentrated to vaporize a working fluid and drive a turbine-generator. Presently there are a few problems confronting the widespread application of this technology: land requirements, aesthetics, and low efficiency. It should also be noted that solar thermal electric generation will not function on cloudy days. Estimates for initial generation in the Region are 55 mills/kWh. Capacity is expected to reach 2000 MW by the year 2000, and costs are expected to be competitive with conventional electric-powered systems. Solar energy can make a significant contribution to our electrical supply by the end of the century.

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(1) Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, pp. 77-79.

SOLAR ENERGY DISTRIBUTION

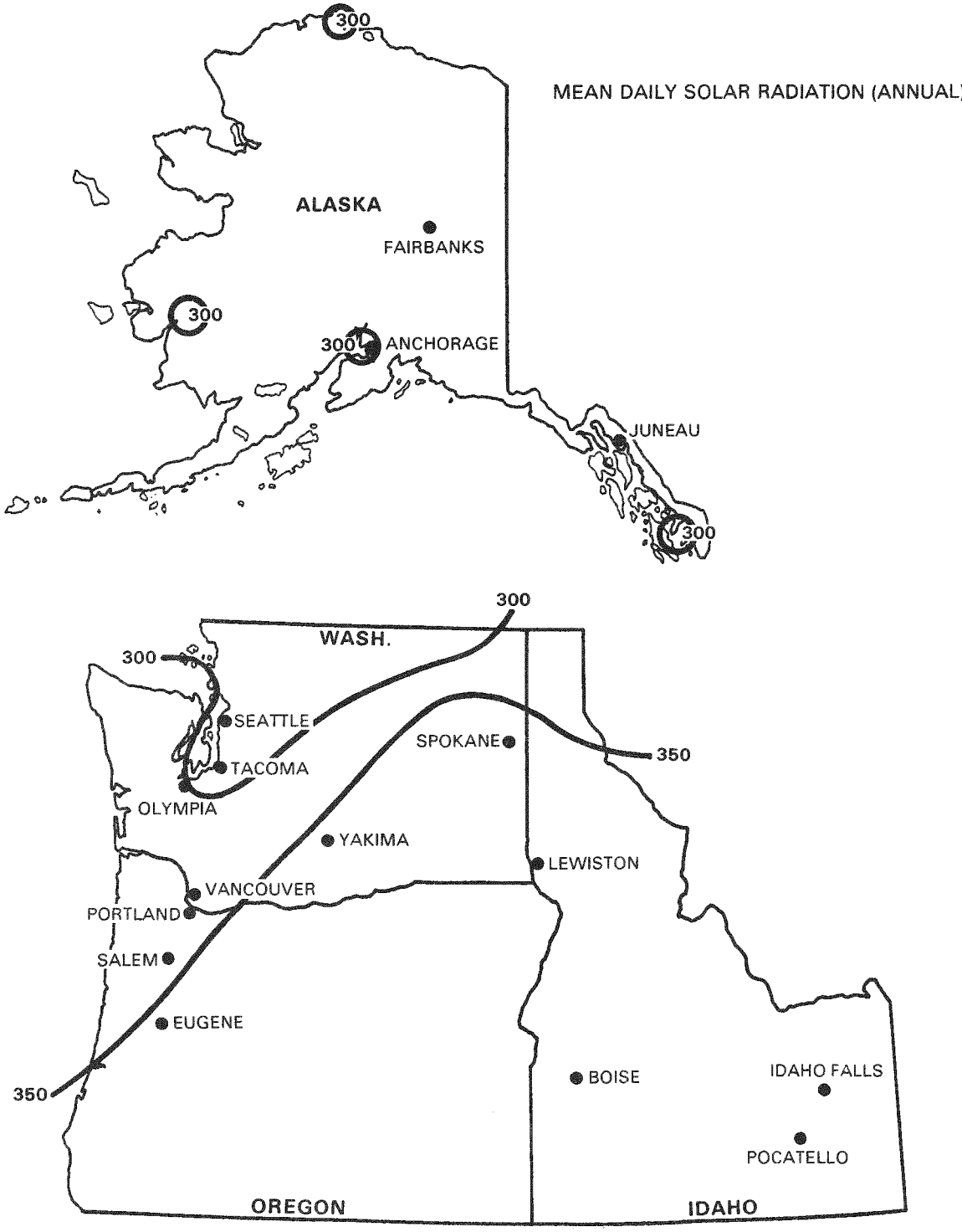

FIGURE I-B-29. Solar Energy Distribution (Annual)

Data Source: Ref. 24, National Atlas.

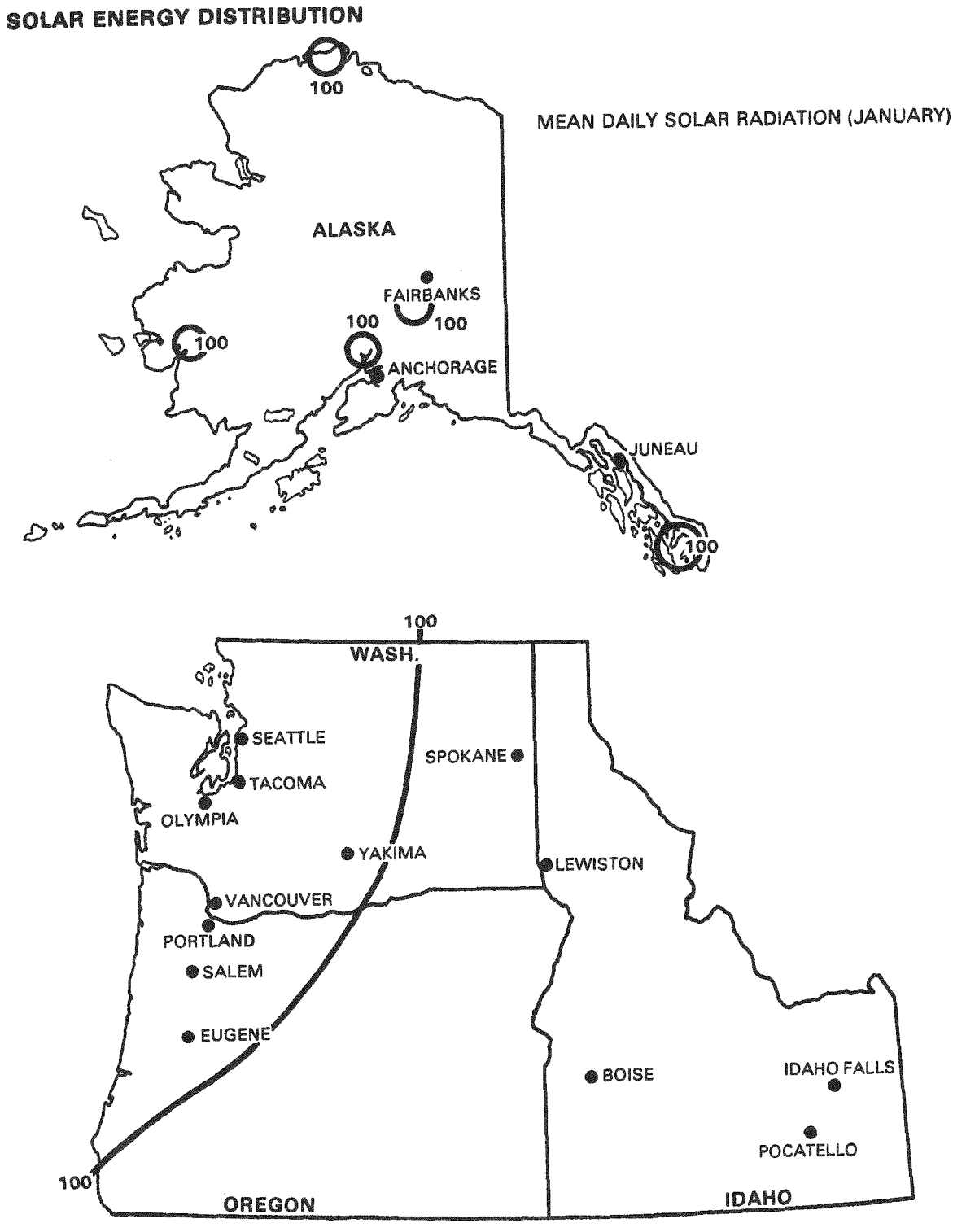

FIGURE I-B-30. Solar Energy Distribution (January)

Data Source: Ref. 24, National Atlas.

SOLAR ENERGY DISTRIBUTION

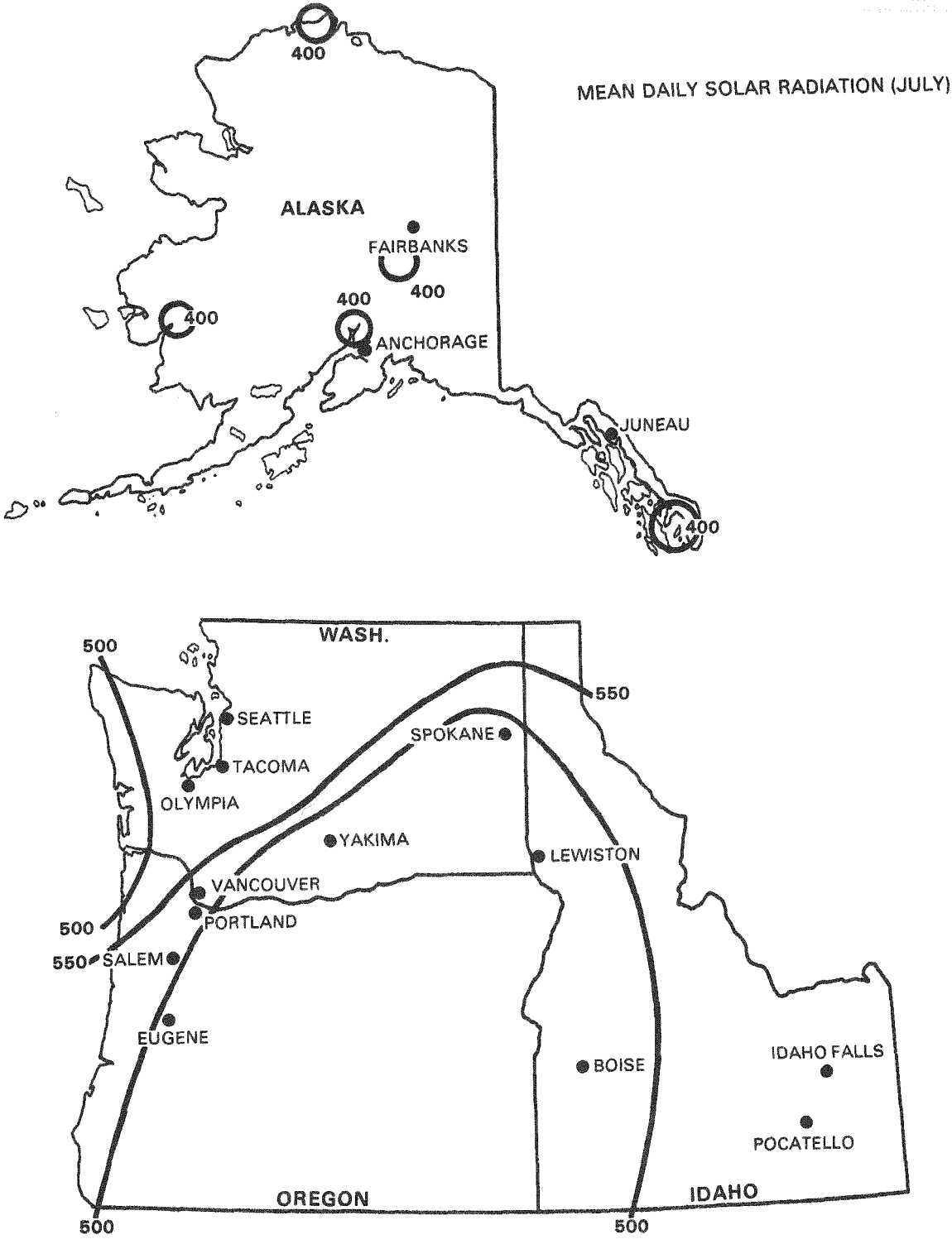

FIGURE I-B-31. Solar Energy Distribution (July)

Data Source: Ref. 24, National Atlas.

TABLE I-B-23

SOLAR RADIATION AND HEATING DEGREE-DAY COMPARISON FOR NORTHWEST LOCATIONS

Location	(A) Average Daily Solar Radiation Received During the Heating Season[a]	(B) Average Monthly Heating Degree-Days During the Heating Season[b]	(C=A/B) Ratio of Solar Energy Received to Heating Degree-Days During the Heating Season[c]
Richland, WA	720	690	1.04
Seattle, WA	520	660	0.79
Spokane, WA	660	920	0.72
Astoria, OR	560	610	0.92
Corvallis, OR	530	610	0.88
Klamath Falls, OR	810	840	0.96
Medford, OR	750	700	1.07
Boise, ID	810	820	0.99
Twin Falls, ID	840	860	0.98

(a) Average daily solar radiation (Btu/ft^2) rounded to two significant digits, for the months of October through March.

(b) Heating degree-days (base 65°F) rounded to two significant digits, for the months of October through March. Heating degree-days are a measure of temperature as it affects energy demand for space heating. For any one day, it is equivalent to the difference between the mean temperature for the day and 65°F. The greater the number of degree-days, the greater the heating demand.

(c) This ratio is calculated by dividing the amount of solar radiation received, column (A), by the heating degree days, column (B). For Richland, Washington, for example, C=A/B=720/690=1.04. The higher the number, the better the location for solar heating.

Data Source: Reference 23, Solar Energy for PNW Residential Heating, p. 1.

TABLE I-B-24

ABILITY TO UTILIZE SOLAR RADIATION
IN THE NORTHWEST

City	Percent Space Heating Supplied by Passive Solar
Eugene, OR	59
Medford, OR	71
Seattle, WA	60
Spokane, WA	61
Boise, ID	71

Data Source: Reference 23, Solar Energy for PNW Residential Heating, p. 3.

WIND

Wind is a renewable resource that is a byproduct of radiant energy emitted by the sun. Unlike fossil fuels, wind does not release waste heat or pollutants into the environment when generating electricity.

The Northwest has some of the windiest sites in the nation. Studies have indicated that the Columbia Gorge, south central Idaho, and the coastal areas and central plains of Washington and Oregon are good sites for wind power systems. The Energy Research and Development Administration (ERDA/DOE) and the National Aeronautics and Space Administration (NASA) are two organizations that have started programs related to wind energy in the Northwest. ERDA has selected the Portland General Electric (PGE) Company at Boardman, Oregon and the BPA site at Augspurger Mountain, Washington for potential installation of demonstrator wind power generators.(1)

In 1976 PGE was selected to monitor wind speeds and directions at the Boardman site (Phase I). Phase II involves the installation of the first 125-kW unit. On the Augspurger site, which received average wind speeds of 19.2 mph over a nine-month test period, PGE will install a wind energy system which can aborb the maximum amount of power (1500-kW) a unit could produce.

Oregon State University has been studying wind power feasibility in the Region since 1971. Their study has shown that there are many potential sites for wind energy systems along the Oregon Coast and in the Columbia Gorge. Medium-sized wind power farms look promising in the area near Cape Blanco and Tillamook; larger, more permanent structures may be sited in the area from the Central Cascade Range into eastern Washington and Oregon.

On a smaller scale, seattle City Light operates a 6-kW wind generator, and John Strickler, a Camino Island resident (50 miles NW of Seattle) operates three 120-V AC generators. The Corps of Engineers are also operating a test

(1) Information Source: Reference 25, BPA Role EIS, p. V-145.

unit at Charbonneau Park, on the Ice Harbor Reservoir. As part of a program to re-establish vegetation that has been disrupted by the raising of reservoir levels, the project is testing windmills that pump water to aid irrigation near the lower Snake River reservoir.(1)

The major environmental concerns of using wind power are primarily the visual impacts of the windmills, the noise, and the land requirements for large-scale systems. Yet, due to economies of scale, large-scale systems which have the potential to generate between 1000 and 2000 megawatts (MW) are competitive with anticipated costs of conventional thermal plants.

Use of the Region's wind to produce partial baseload electric generation could allow storage of water for hydroelectric use during peak power demands or at times when the wind subsides. In addition, wind energy can help meet energy demands in the winter, when wind velocities are highest and water availability for hydroelectric systems is lowest.

(1) Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, pp. 79-81.

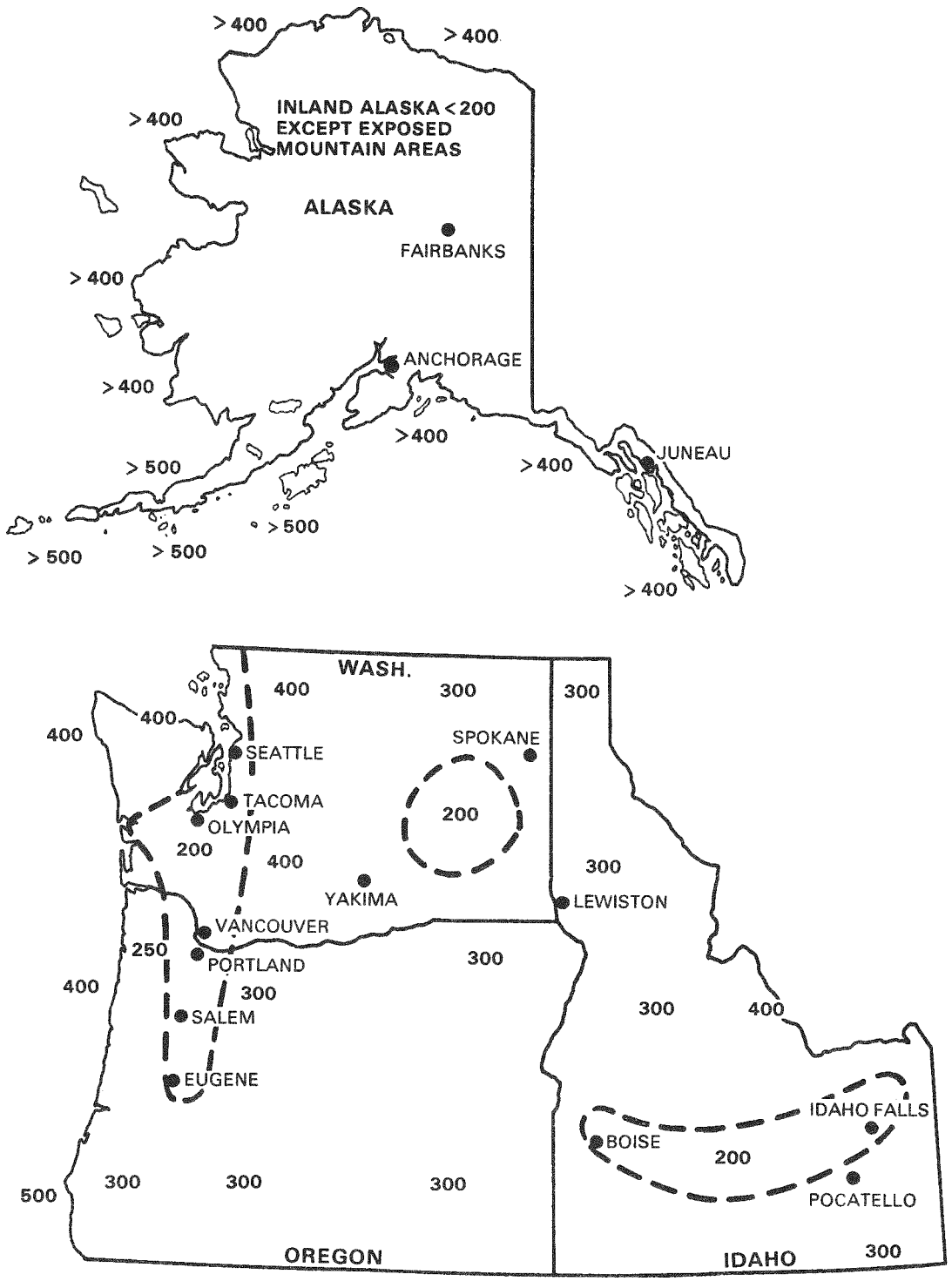

FIGURE I-B-32. Mean Annual Wind Power

Data Source: Ref. 26, An Overview of the National Wind Energy Potential.

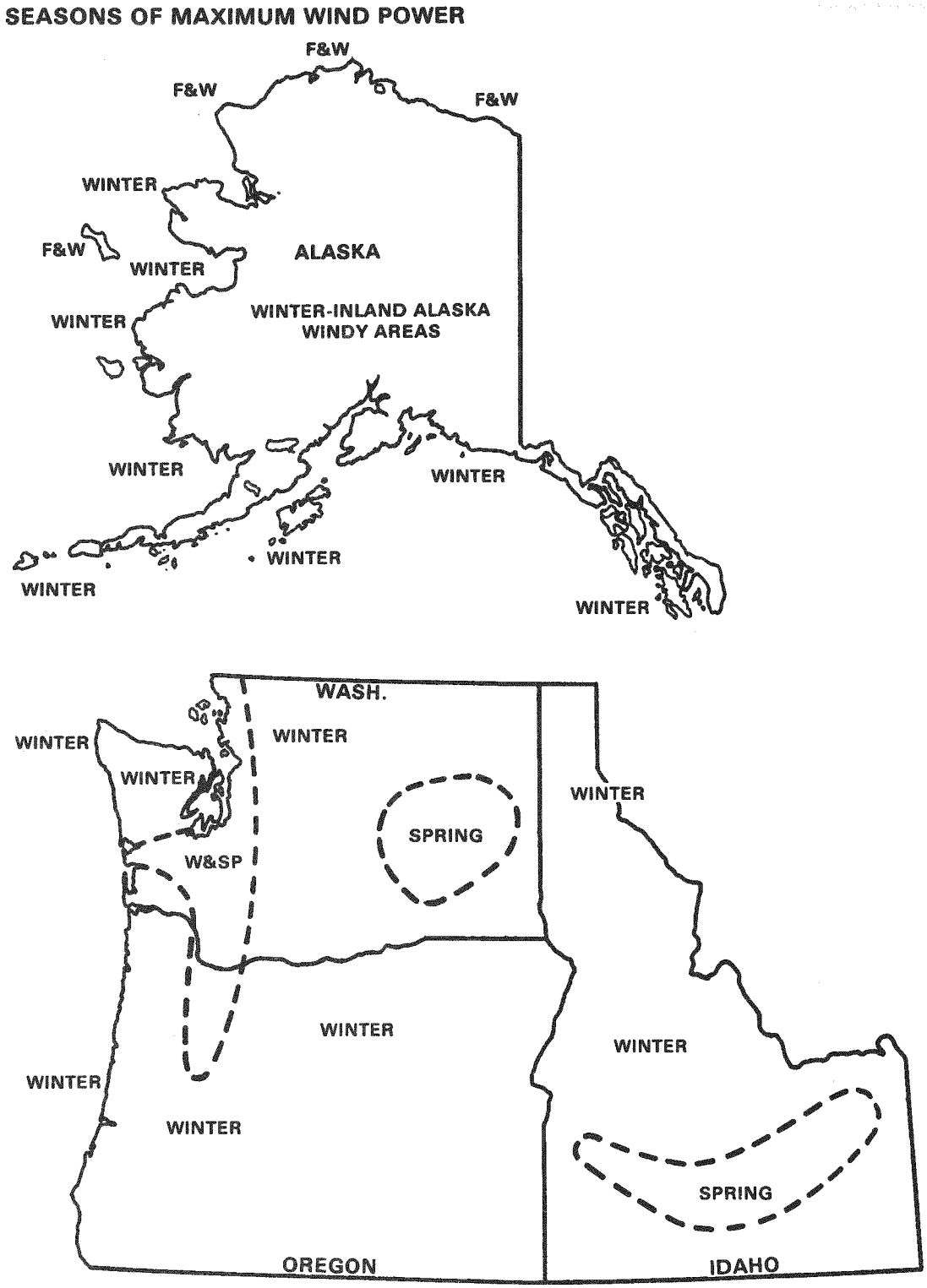

FIGURE I-B-33. Season(s) of Maximum Wind Power

Data Source: Ref. 26, An Overview of the National Wind Energy Potential, Figure 3, p. 86.

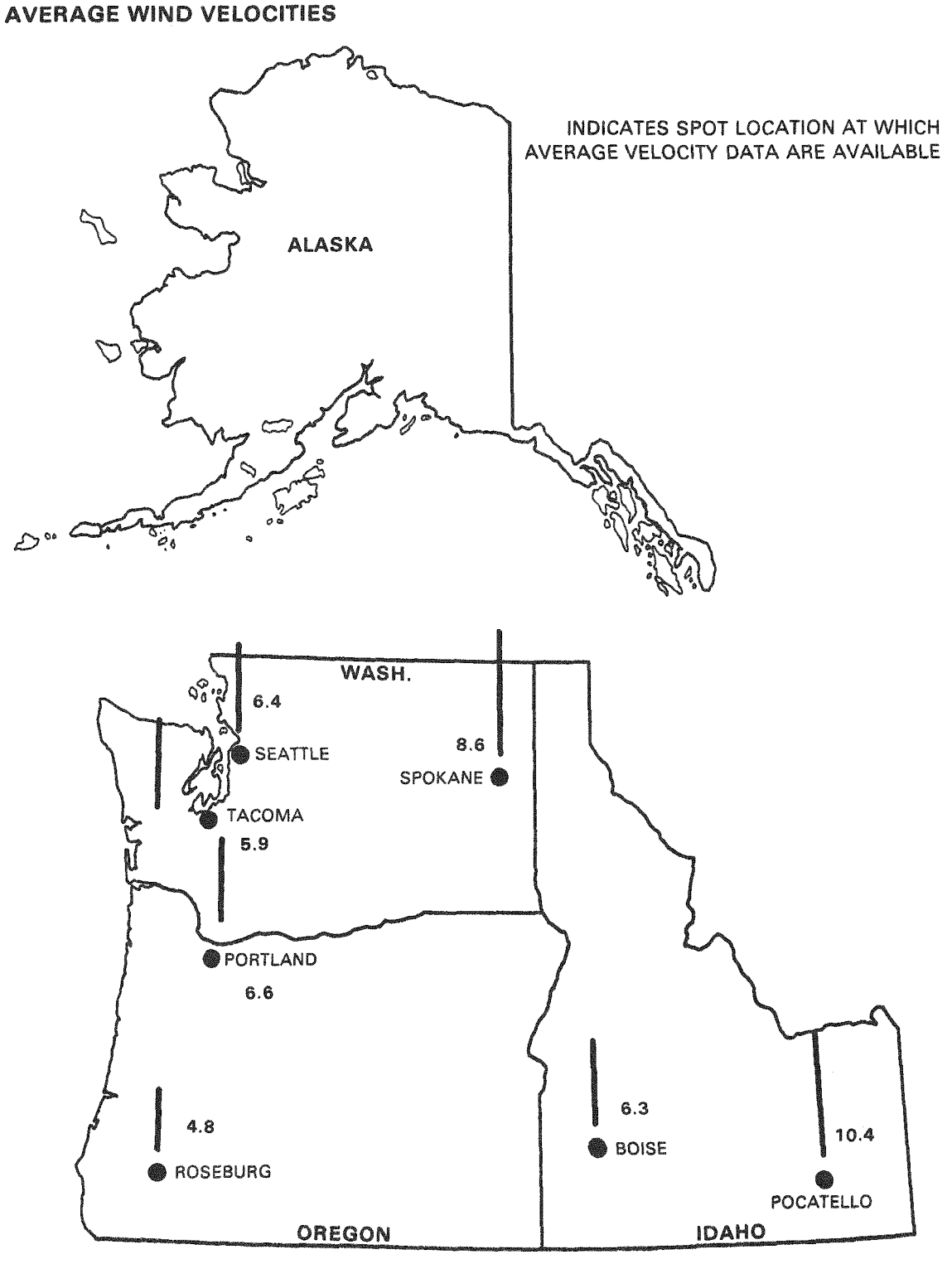

FIGURE I-B-34. Average Wind Velocities

Data Source: Ref. 27, The Energy Source Book, Figure XVIII-4, p. 404.

CANDIDATE SITES FOR FIRST LARGE EXPERIMENTAL WIND TURBINES

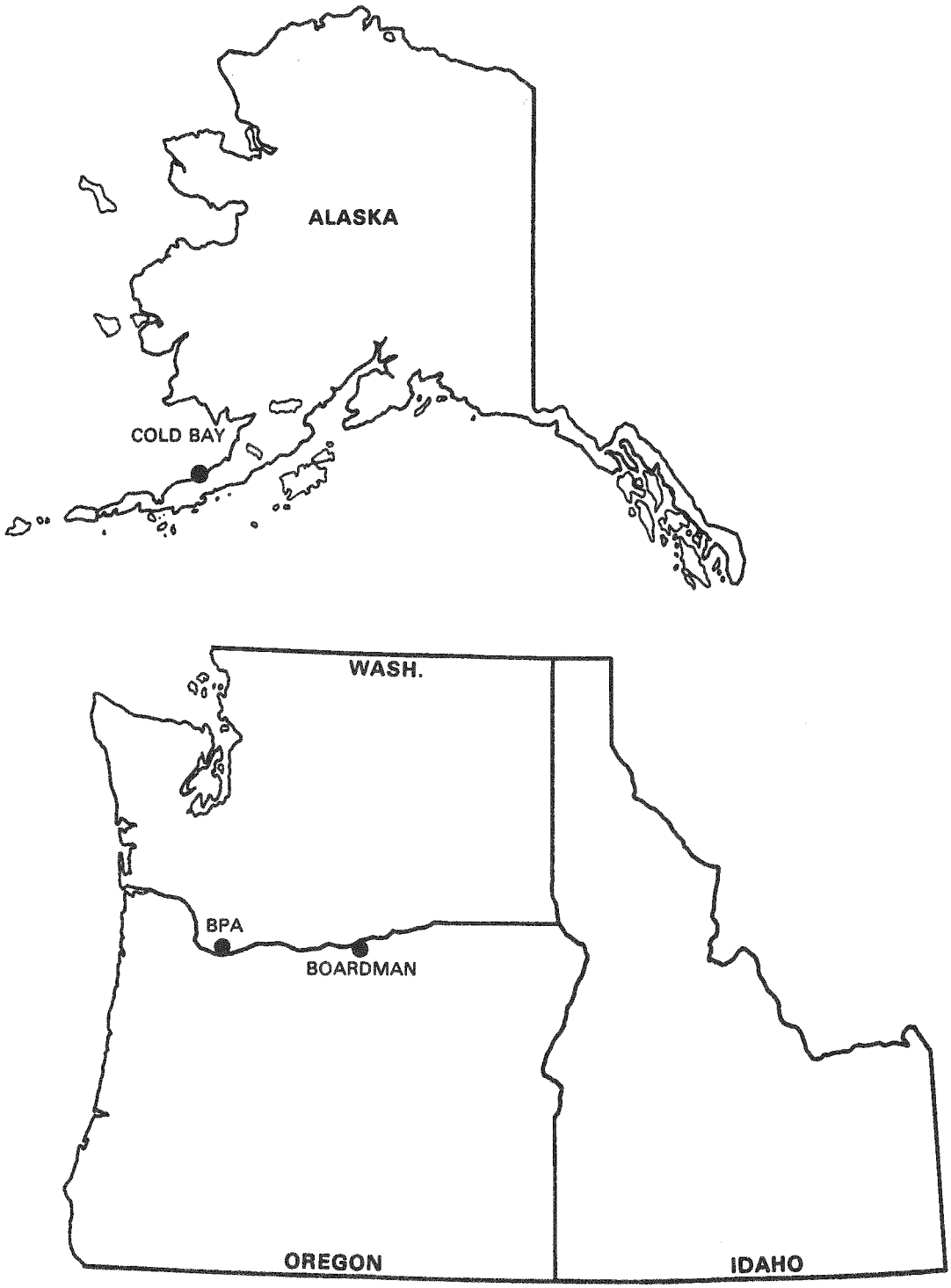

FIGURE I-B-35. Candidate Sites for First Large Experimental Wind Turbines

Data Source: Ref. 27, The Energy Source Book.

BIOMASS

MUNICIPAL WASTE

Each American generates approximately 3.5 lb of trash per day. Because of increasing disposal costs and diminishing ocean and landfill disposal sites, the problem of municipal waste can no longer be avoided. One potential solution is to utilize the waste for "trash power," or energy generation. Fuel from waste can be combined with other fuels or used alone to generate electricity. Generation costs are estimated to be in the range of 20 to 30 mills/kWh. In comparing this cost to disposal and landfill costs, the practicality of trash power becomes more apparent. The only major concerns are the same as for any power plant: atmospheric emissions and waste heat. In the Northwest, Lane County, Oregon has already started to develop a facility which generates steam from processed waste to produce electricity. The facility will produce refuse-derived fuel for market development and for experimental use as a boiler fuel. The energy supplied by the waste-fired system is more than one-fourth the 1977 estimated Eugene Water and Electric Board (EWEB) electrical requirement.

A facility similar to the Lane County plant is also being considered by the Metropolitan Service District in Portland, Oregon. The Department of Environmental Quality and Oregon State have also undertaken the construction of a solid waste energy recovery plant on Bolon Island, north of Reedsport. The entire project is expected to cost about $8.5 million.(1)

A study conducted for Richland, Washington concluded that if Richland were to substitute solid waste for coal in a $400 million powerplant, it would save the state an estimated 45,000 tons of coal/yr. The 500-MW plant would use 1.7 million tons of coal and 59,500 tons of garbage annually.(2)

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(1) Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, p. 82.

(2) Information Source: Reference 25, BPA Role EIS, pp. V-138 and V-139.

Although the energy contained in municipal wastes is not large compared to the energy demands of the Northwest, there would still be a significant impact upon energy production and waste disposal problems. Trash power is just one alternative of many to help solve the "energy crisis."

WOOD AND AGRICULTURAL WASTE

Another alternative to using fossil fuels for electric power generation or conversion to liquid fuels or Substitute Natural Gas (SNG) is the use of plant material (biomass). The U.S. Department of Energy (DOE) defines biomass as: standing vegetation, aquatic crops, forestry and agricultural residues, and animal wastes. It is a product of the chemical process of photosynthesis, which absorbs the sun's visible light to convert carbon dioxide and water into carbohydrates and oxygen. The energy in the carbohydrates can then be utilized or "put to work" when the plant matter is eaten, decayed or burned.(1)

Biomass, unlike coal and other fossil fuels, is renewable, is low in sulfur and ash, and burns relatively cleanly. The amount of energy that may be derived from a pound of dry biomass varies significantly, depending upon the amount of water resin, gum, and other substances found within different species. The heating value of dry plant tissue is, on the average, 7500 Btu/lb or 17 million Btu/ton. A ton of this dry plant tissue is equivalent in energy potential to about 2.8 bbl of residual oil. In direct firing of biomass for power production, a 1000-MW facility would have a heat rate of 10,000 Btu/kWh and would require a biomass production area of about 245 mi^2 if operated at a load factor of 80%. If biomass was processed into SNG, it could be used to fire a low-Btu powerplant.

Species that have the best potential for bioconversion are sugarcane, selected sorghums, sunflowers, kenal, Sundangrass and napiergrass, forage grasses, eucalyptus, sycamore and poplar trees, water hyacinths, algae, and kelp. In the Northwest one of the most attractive biomass fuels is wood.

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(1) Information Source: Reference 20, U.S. Energy Fact Sheets, "Fuels from Plants."

The forest products industry uses mill wastes such as chips, bark and sawdust to fuel a good portion of their energy needs. Still, many biomass resources are underutilized. For example, annual growth rates greatly exceed annual removals; forests are too dense and need to be properly harvested and managed. Moreover, large quantities of wood residues are left in the forests after logging operations, and are usually destroyed in open slash burns.

As illustrated in Table I-B-25, significant amounts of agricultural wastes are generated each year in the Region. Technology exists for converting these resources into usable forms of energy, but little is being utilized. If wastes were more efficiently utilized, some forest product processing plants could become net energy producers, generating electricity with co-generation. Generation costs range from 20 to 40 mills/kWh. Yet, further research is needed in determining the cost of collecting waste, and the environmental impacts of removing the nutrient-rich plant matter. More information is also needed in considering the development of valuable farming lands for the production of biomass fuels.(1)

(1) Information Source: Reference 25, BPA Role EIS, pp. V-139 to V-143.

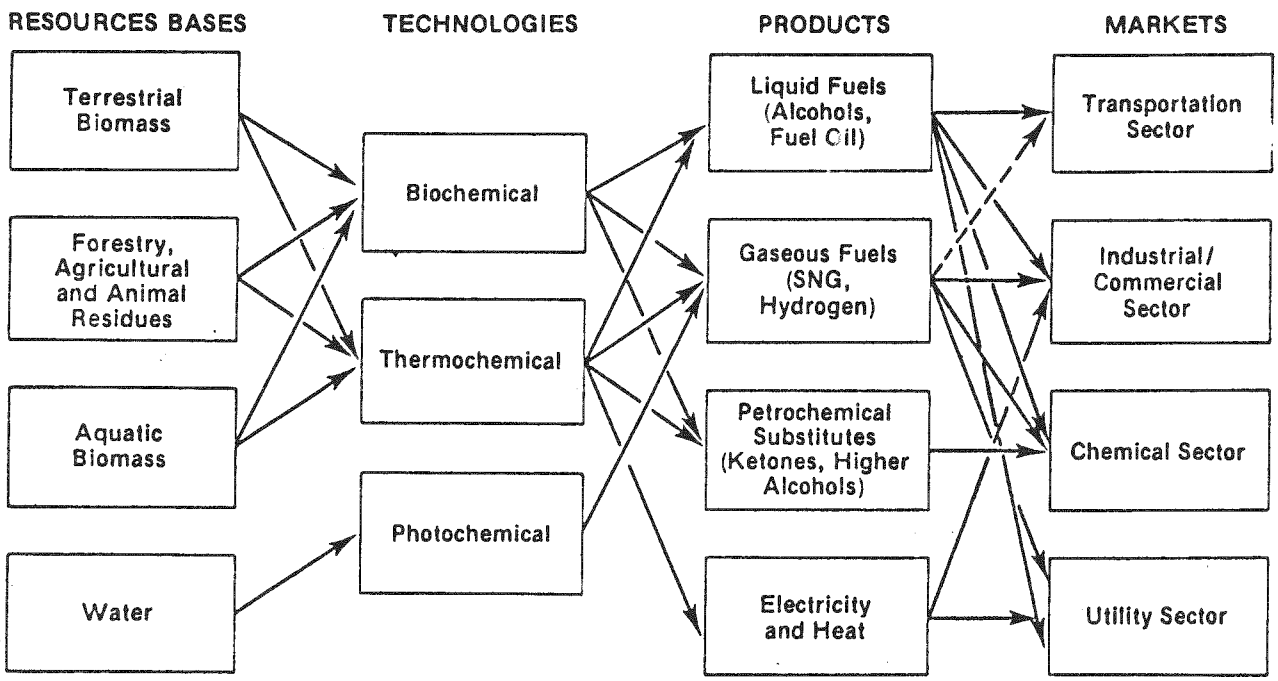
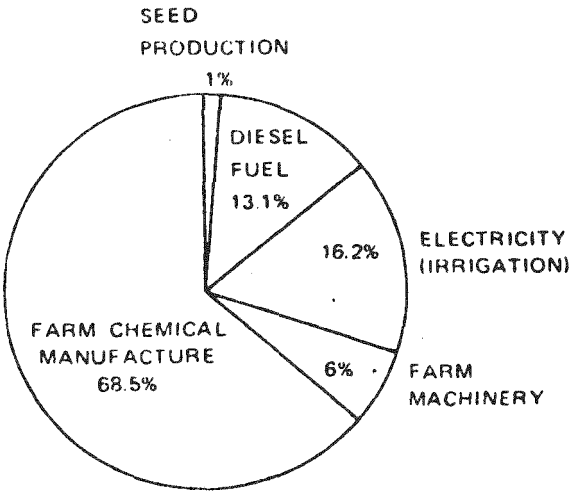
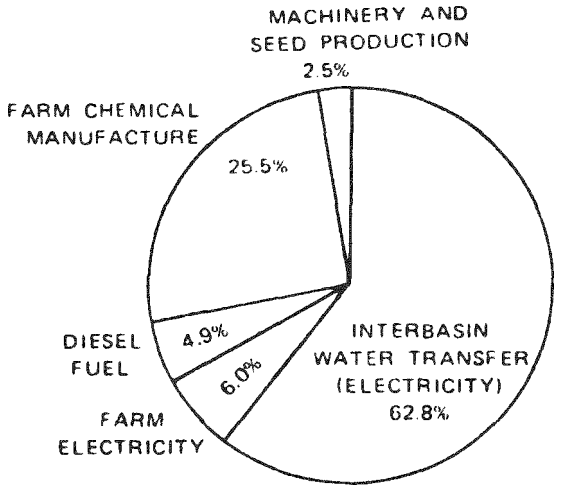


FIGURE I-B-36. Fuels From Biomass

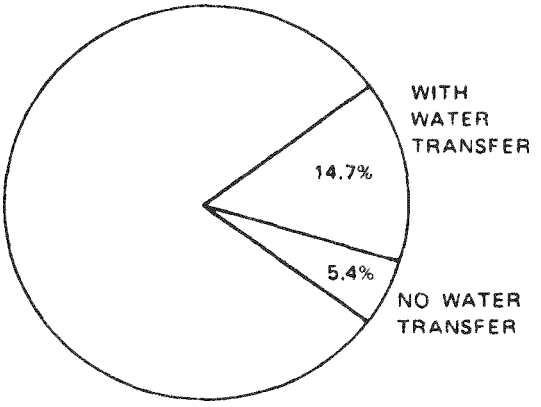
Data Source: Ref. 28, Fuels From the Biomass Program - Summary, p. 4.



(a) PROPORTION OF TOTAL ENERGY INPUT CONSUMED BY USE CATEGORY EXCLUDING INTERBASIN WATER TRANSFER. (TOTAL INPUT: 24,503,939 Btu/acre-year)



(b) PROPORTION OF TOTAL ENERGY INPUT CONSUMED BY USE CATEGORY, INCLUDING INTERBASIN WATER TRANSFER. (TOTAL INPUT: 65,955,302 Btu/acre-year)



(c) PROPORTION OF TOTAL ENERGY OUTPUT (YIELD) CONSUMED BY PRODUCTION OPERATIONS, WITH AND WITHOUT INTERBASIN WATER TRANSFER. (TOTAL YIELD: 450 million Btu/acre-year)

FIGURE I-B-35. Summary of Energy Uses and Balances Associated with the Operation of a Hypothetical Plant Biomass Plantation

Data Source: Ref. 29, Effective Utilization of Solar Energy to Produce Clean Fuel, p. 54.

TABLE 1-B-25

ANNUAL DISPOSITION BY STATE OF AVAILABLE AGRICULTURAL RESIDUES[a]

Residue	Dry Tons			
	Idaho	Oregon	Washington	Total U.S.
Crop				
Sold	272,268	125,009	590,897	11,266,626
Fed	18,161	7,139	51,043	52,142,254
Fuel	-	-	-	1,741,990
Returned	5,546,908	3,125,869	7,182,031	205,599,417
Wasted	2,429	12,526	18,331	6,810,630
Total	5,839,766	3,270,543	7,842,302	277,560,917
Forestry				
Sold	1,259,667	10,731,035	3,418,241	37,449,165
Fed	-	-	-	-
Fuel	383,836	4,790,451	2,351,473	19,301,797
Returned	-	-	-	-
Wasted	1,461,059	6,250,314	4,108,460	67,909,684
Total	3,104,562	21,771,800	9,878,174	124,660,646
Manure				
Sold	10,437	24,181	28,391	3,920,282
Fed	-	-	-	247,064
Fuel	-	-	-	16,436
Returned	294,279	166,238	148,810	17,845,698
Wasted	55,426	8,237	94,490	4,429,867
Total	360,142	198,656	271,691	26,459,348
Total				
Sold	1,542,372	10,880,225	4,037,529	52,636,074
Fed	18,161	7,139	51,043	52,389,318
Fuel	383,836	4,790,451	2,351,473	21,060,223
Returned	5,841,187	3,292,107	7,330,841	223,445,115
Wasted	1,518,914	6,271,077	4,221,281	79,150,181
Total	9,304,470	25,240,999	17,992,167	428,680,911

(a) Data not available for Alaska.

Data Source: Reference 30, Crop, Forestry and Manure Residue Inventory - U.S., Volumes 7 and 8, p. 9.

The utilization categories shown in the tables are defined as follows:

- Sold--that portion of available residues that is collected and sold for any purpose other than fuel in the case of forestry residues. All

forestry residues used as fuel are included as fuel regardless of source or previous sale.

- Fed--that portion of available residues that is fed to animals without collection or with collection but without sale.
- Fuel--that portion of available residues that is used as fuel without sale. This category includes all forestry residues used as fuel.
- Returned--that portion of the available crop and manure residues that is returned to the soil without sale.
- Wasted--that portion of the available residues that must be disposed of at an economic cost (i.e., hauled away or burned). This category includes all logging residues as well as collected residues that are not sold, fed, or used as fuel (i.e., they are returned to the soil at an economic cost).

TABLE I-B-26

SULFUR CONTENT IN PRODUCT OILS

Biomass	% Sulfur
Pine Needles and Twigs	0.100
Sewage Sludge	0.640
Municipal Refuse	0.130
Cow Manure	0.370
Cellulose	0.003-0.200

Data Source: Reference 31, "Energy Potential from Organic Wastes: A Review of the Quantities and Sources," p. 3.

TABLE I-B-27

AGRICULTURAL RESIDUES GENERATED ANNUALLY

(BY QUARTER)

Area	Total Generated in Thousands of Dry Tons				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual
Alaska	N/A	N/A	N/A	N/A	N/A
Idaho	783.5	771.8	6,589.5	1,856.3	10,001.2
Oregon	5,077.2	5,770.5	10,215.7	5,195.3	26,258.7
Washington	2,273.4	2,898.8	11,310.4	2,904.9	19,387.6
U.S. Total	38,675.2	55,260.2	200,444.1	179,833.9	474,213.5

TABLE I-B-28

TOTAL AVAILABLE AGRICULTURAL RESIDUES

Area	Total Available in Thousands of Dry Tons				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual
Alaska	N/A	N/A	N/A	N/A	N/A
Idaho	754.3	747.0	5,663.8	1,735.9	8,901.0
Oregon	5,036.7	5,694.8	9,323.1	5,143.8	25,198.4
Washington	2,226.1	2,821.9	10,073.2	2,809.7	17,930.9
U.S. Total	35,127.5	50,363.1	173,902.6	158,617.1	418,010.4

Data Source: Ref. 32, Crop, Forestry and Manure Residue Inventory, p. 62.

TABLE I-B-29

ENERGY CONVERSION FACTORS[a]
(ROUNDED TO THREE SIGNIFICANT FIGURES)

Wood (ft^3)	Cords Wood	Tons Wood	Oil (bbl)	Tons Coal	MCF Nat. Gas.
1	0.012	0.0188	0.053	0.012	0.291
8.5	1	1.60	4.53	1.05	24.7
53.1	0.625	1	2.83	0.654	15.5
18.8	0.221	0.353	1	0.231	5.45
81.3	0.956	1.53	4.33	1	23.6
3.44	0.040	0.065	0.183	0.042	1

(a) For oven dry wood (less than 10% moisture)

Assuming: Wood - 8,500 Btu/lb (dry); 3200 lb/cord (dry); 85 ft^3/cord.
Oil - 6,000,000 Btu/bbl.
Coal - 26,000,000 Btu/ton.
Nat. Gas. - 1,100,000 Btu/thousand ft^3 (MCF)

Data Source: Reference 33, The Potential of Wood as an Energy Resource, p. 3.

ENERGY FROM THE OCEAN

Energy can be generated from the ocean by utilizing wave action, tidal movements, and ocean thermal gradients. Studies have been underway to apply water surface devices such as navigational buoys or a series of pendulums to convert wave motion into electricity. The estimated peak capacity from a wave-powered device is approximately 600 to 1000 W.

Tidal power was first established in 1967 by Electricite de France, and theirs is the only large-scale tidal power station in operation today. It delivers 65 MWe of mean annual generating capacity (BPA, 1977, p. V-164). A tidal system such as this makes use of the difference in elevation between the sea and an estuary.

Tidal electricity is generated by basically the same principle as standard hydroelectric projects, the difference being that the turbine generators operate at relatively low heads (5 to 10 m) and are capable of reversible action in order to maximize utilization of high and low tide.

Within the Region, a suitable site for the development of tidal power exists on the Southern Coast of Alaska (see Figure I-B-38). However, other coastlines do not seem appropriate for this technology because of the following principal requirements for tidal power: 1) large daily tidal fluctuations, 2) large storage capacity within the estuary, and 3) an entrance into the estuary that requires construction of a relatively small dam (BPA, 1977, p. V-166).

Ocean thermal is another major source of power. The solar energy absorbed by the ocean creates a thermal gradient of approximately 7°C (45°F) between the surface and the depths of the ocean. This thermal energy can be converted to electrical energy by using a volatile fluid that changes state from liquid to vapor at certain temperatures. There is great potential for ocean thermal energy conversion (OTEC) in tropical waters; however, in the Northwest the absence of tropical waters discounts the possibility of utilizing OTEC.

Information Source: Reference 25, BPA Role EIS, p. V-174.

SITES SUITABLE FOR DEVELOPMENT OF TIDAL ENERGY

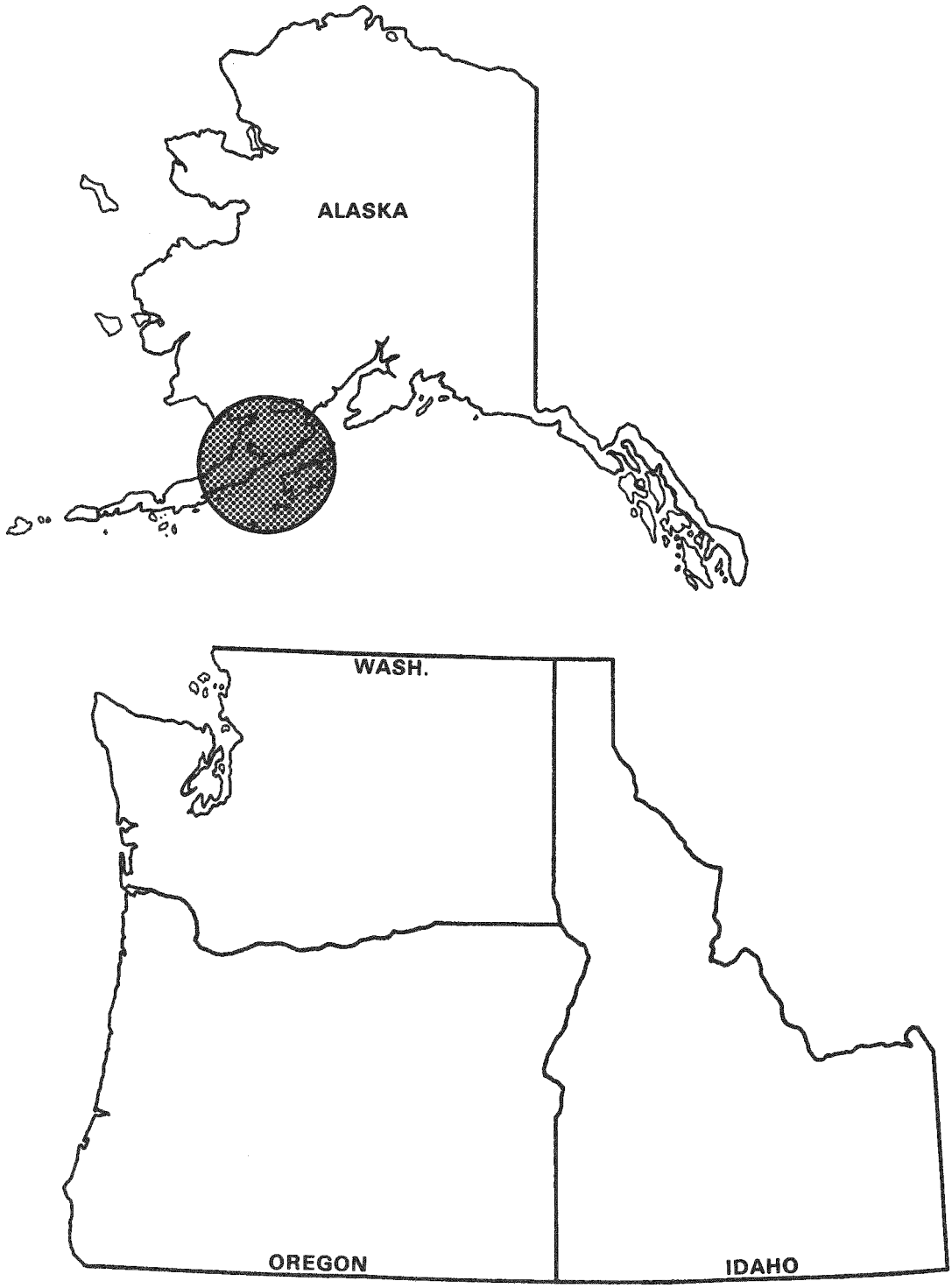


FIGURE I-B-38. Sites Suitable for Development of Tidal Energy

Data Source: Ref. 25, BPA in the Pacific Northwest Power Supply System, p. V-167.

PUMPED STORAGE

Pumped-storage generation offers one of the most promising sources of meeting the Region's future peak electrical requirements. At present installation of additional units is under way at existing hydroelectric plants to meet increased peak demands, but in 10 to 15 yr these projects will be fully developed. Pumped-storage will then most likely be called upon to provide additional peaking power to the system.

Energy is required to support pumped-storage project operation, and this energy is usually obtained from off-peak operation of baseload thermal plants. In the Northwest, sufficient thermal generation will not be available to support pumped-storage operation until the mid-1990s. However, the high value of peaking capacity may warrant providing thermal generation specifically for pumping, and thus result in earlier installation of pumped-storage.(1)

Potential pumped-storage sites have a combined capability of producing nearly 2,000,000 MWe, which is much more power than will be needed in the foreseeable future. The sites are all suitable for a 1000-MW installation, and some could produce as much as 10,000 MW. Although these sites all show favorable investment costs, other factors will render many of them unfeasible. Some are located in National Parks, Wilderness Areas, or other special use areas; some would conflict with existing land and water uses; and others might be impractical from a geological standpoint.(2)

Of the total inventory (530 sites), 389 appear to have no apparent major environmental conflicts at this time. Accordingly, these sites appear to be the most favorable and should be given primary consideration for more detailed investigations.(3)

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(1) Information Source: Reference 21, Review of Power Planning in the Pacific Northwest, p. 63.
(2) Information Source: Reference 3, Energy Futures Northwest, p.
(3) Information Source: Reference 34, Pump-Storage in the PNW, p. 36.

EFFECT ON STREAMFLOW

The effects of seasonal pumped-storage operation on streamflow would be generally similar to weekly-cycle pumped storage when operating in the peaking mode. The exception would be during sustained periods of heavy peaking requirements, when more water is withdrawn from storage than is pumped back. In this case, downstream flows would be increased. This type of operation would occur most frequently in the winter, when streamflows are low. At that time of year, increasing flows slightly would be beneficial. During the run-off season, a seasonal pumped-storage project would be pumping, thus reducing downstream flows. This also would be beneficial, as it would reduce flood peaks.(1)

EFFECT ON RESERVOIR RECREATION

Generally, a seasonal pumped-storage project would be better for reservoir recreation than a weekly-cycle plant because daily fluctuations would be small. During the summer months the reservoir would normally be full, or at least near full and at a stable elevation, and this would be beneficial for recreation. During the winter months the reservoir would be drawn down, but this would have very little impact because recreational use would be low.(2)

EFFECT ON FISH AND WILDLIFE

Pumped-storage projects would undoubtedly have negative impacts upon the fish and wildlife resources. The impact may be reduced where existing lakes or reservoirs are utilized. The extent of fish and wildlife impacts would vary depending upon the site, and detailed studies would be needed to indicate the magnitude of the impacts.(3)

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(1) Information Source: Reference 34, Pump-Storage in the PNW, p. 52.
(2) Information Source: Reference 34, Ibid, pp. 52 and 53.
(3) Information Source: Reference 34, Ibid, p. 53.

RELATIVE COST

The cost of pumped-storage power is not a limiting factor if compared to other alternative energy source costs. For even though pumped-storage power is $18.40/kWh and hydropower is only $13.50/kWh, an alternative such as combustion turbine power costs $41.50/kWh.(1)

(1) Information Source: Reference 34, Pump-Storage in the PNW, p. 41.

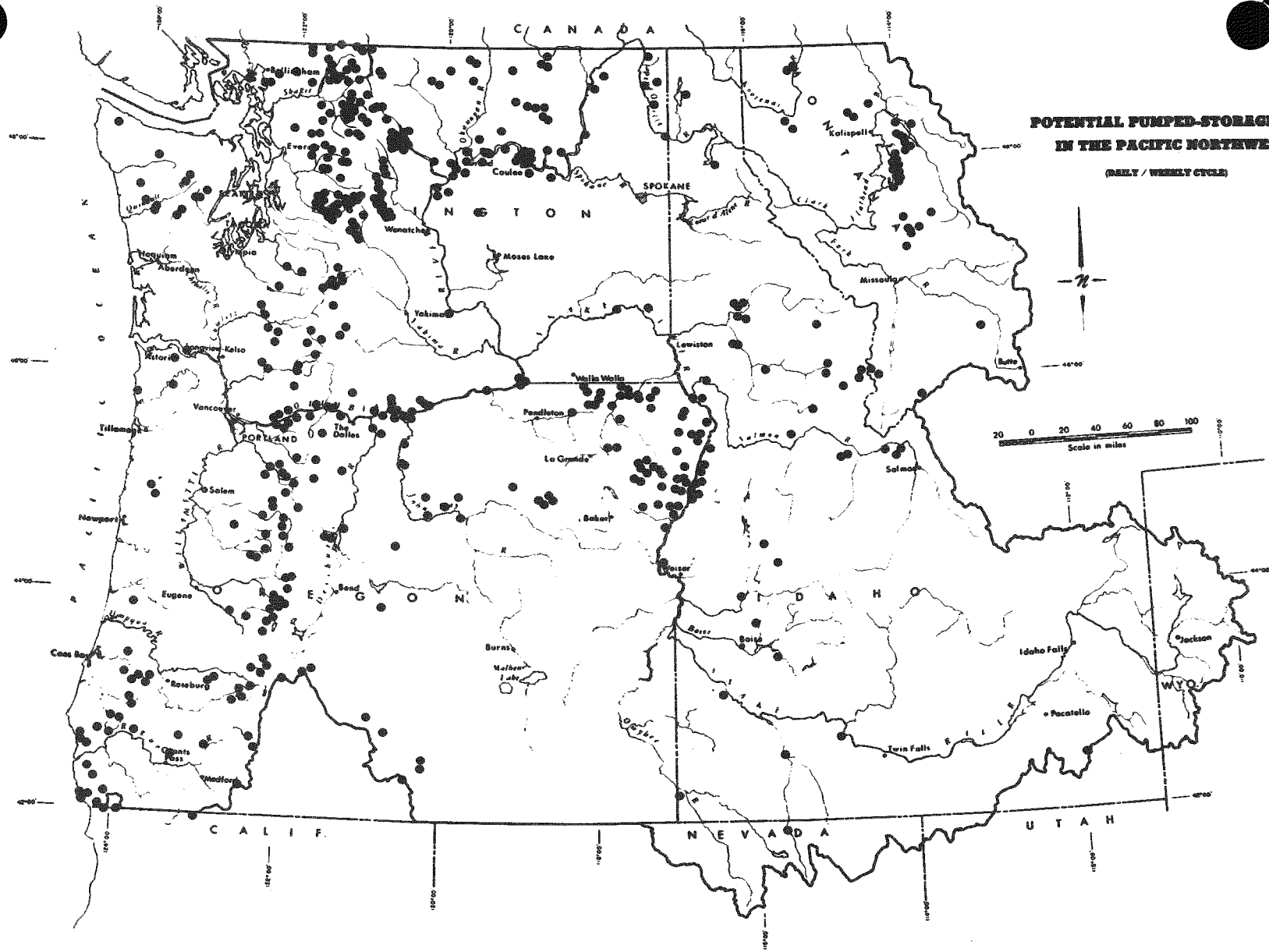

FIGURE I-B-39. Potential Pumped-Storage Sites in the Pacific Northwest

Source: Ref. 34, Pumped-Storage in the Pacific Northwest, p. 34.

TABLE I-B-30

COMPLETED PUMPED-STORAGE PROJECTS WITH REVERSIBLE CAPABITY EXCEEDING 50 MW IN THE UNITED STATES AS OF SEPTEMBER 5, 1975

Name of Project Jurisdiction	Owner	State	River	Number and Type of Units	Generating Capacity (MW)[a]		Pumping Capacity Output		Date of Operation
					Total	Unit	(MW)[a]	(cfs)[b]	
Grand Coulee Federal	U.S. Bureau of Reclamation	Wash.	Columbia	2-Revs.	100[c]	48.5	100	2,500	1974

PROJECTED PUMPED-STORAGE PROJECTS IN THE UNITED STATES AS OF SEPTEMBER 5, 1975

Name of Project Jurisdiction	Owner	State	River	Number and Type of Units	Generating Capacity (MW)[a]	Pumping Capacity Output		Estimated Date of Completion	Status
						(MW)[a]	(cfs)[b]		
Antilon Lake Proj. No. 2718	Chelan Co. Public Utility District No. 1	Wash.	Antilon Creek	4-Revs.	1,000	1,000	8,200	1976	Preliminary Permit Issued
Browns Canyon Project No. 2723	P.U.D. No. 1 Douglas Co., Wash.	Wash.	Lake Entia	-	1,000	1,000	5,000	-	Preliminary Permit Issued

(a) Nameplate or estimated nameplate.
(b) Estimated average output using 80% pumping efficiency at average head and average pumping capacity.
(c) Ultimate capacity of 300 MW with the addition of four 50.0 MW reversible units in the future.

Data Source: Reference 35, Environmental Control Technology R&D Requirements for Industrial Energy Storage Systems, Tables 2 and 3, pg. 27.

ELECTRIC GENERATION

Currently the Northwest has a total of 160 hydroelectric projects, consisting of federal, private, and public utility installations. Federal hydroelectric power development began in the 1930s with the construction of Bonneville Dam near Portland, Oregon by the U.S. Army Corps of Engineers. During the same period the Bureau of Reclamation, Department of the Interior, undertook construction of Grand Coulee Dam on the Columbia in northeast Washington. By January 1, 1976 the federal system had 29 hydroelectric facilities on-line with a total installed capacity of 12,500 MW, and provided more than half the power generated in the three-state region. Municipal and publicly owned hydroelectric facilities accounted for 7367 MW, while privately owned facilities accounted for 2744 MW.

Public Utility Districts were established in the Northwest after the Bonneville Project Act of 1937 was passed. The BPA was created to be the marketing agent for the power produced by federal dams in the Pacific Northwest. The BPA also manages the development of the regional power transmission network. Currently, the transmission system consists of more than 12,000 circuit miles and acts as a common carrier for all Northwest utilities. Besides enhancing reliability of the overall power system, the transmission grid has enabled coordinated regulation of hydroelectric facilities.

Throughout the history of electric power development in the Northwest, hydroelectric generation has contributed the majority of the generating capacity. Before the construction of the large federal hydropower projects, small privately owned hydroelectric facilities accounted for nearly 70% of the installed generating capacity.

In 1964 Congress approved construction funding for the Pacific Northwest-Pacific Southwest Intertie. Interties also exist between BPA and British Columbia Hydro in Canada. These lines provide the means for sales and the exchange of power between the power systems in both countries. They also increase the reliability of the power systems during system emergencies.

Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

The Hydro-Thermal Power Program envisions construction of large thermal plants to meet increasing baseload needs: existing hydroelectric facilities will be expanded to provide peaking power. The new thermal facilities are being constructed by the Regional utilities, while the hydro-peaking and high-voltage transmission facilities are being developed by the federal government.

Since nearly all of the most productive hydropower sites have been developed, and since those not developed are subject to increasing social pressure by conservationists, the potential for adding firm hydroelectric energy is limited. For the foreseeable future, large thermal facilities, either nuclear or coal-fired, will be the most feasible means of adding generating capacity in the Northwest.(1)

There are over 100 electric utilities operating in the Region. The Federal Columbia River Power System (consisting of hydroelectric dams operated by the Army Corps of Engineers and the Bureau of Reclamation, and a transmission system operated by BPA) accounts for about 50% of the electric energy generated and 80% of the Region's high-voltage transmission.

Of the 375 trillion Btu of electricity sold to ultimate consumers in the Northwest in 1975, about 46% was distributed by six large private utilities (Pacific Power and Light, Portland General Electric, Puget Sound Power and Light, Idaho Power, Utah Power and Light, and Washington Water Power). The other 33% was distributed by over 100 publicly owned or cooperative utilities. These publicly owned utilities were supplied by BPA. Larger public and private utilities, such as Seattle, Tacoma, Eugene, Snohomish County PUD and Cowlitz County PUD, are able to generate additional power. The remaining 21% was sold directly by BPA to "direct-service" industries (19% to aluminum companies and 2% to other electroprocess industries), a portion of which was interruptible power subject to curtailment.

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(1) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

Despite the large number of operating electric utilities, the entire electrical system of the Region is interconnected and in many ways operates as a giant regional power pool. A great deal of coordination in operations and power planning occurs, and there are substantial interregional interconnections with California and British Columbia. On some occasions the Northwest is an exporter of electricity, and on other occasions an importer. Exchanges of electric energy and peaking capacity back and forth across three high-voltage intertie lines to California are common, as is importation of electricity from coal-fired power plants in Wyoming, Montana and Utah.(1)

(1) Information Source: Reference 3, Energy Futures Northwest, p.

TABLE I-B-31

POTENTIAL NEW HYDROELECTRIC RESOURCES
INCLUDED IN TEN-YEAR HYDROTHERMAL PROGRAM
BUT NOT YET SCHEDULED FOR DEVELOPMENT

Project	Units	State	Drainage	Storage 1000 AF	Average Annual Energy, MW	Capacity, MW
Asotin	5	WA ID	Snake	--	241	675
Muddy		WA	Lewis	343	48	110
Meadows Project (Upper & Lower)	3	WA	Meadow Cr.	85	30	85
Appaloosa & Low Mt. Sheep	6 4	OR ID	Snake	1500	616	2500
Lower Scriver	4	ID	N.F. Payette		54	120
Upper Scriver	4	ID	N.F. Payette		33	38
Ben Franklin	16	WA	Columbia		428	848
High Guffey	4	ID	Snake	27	62	85
Lynn Crandall	4	ID	Snake	1620	135	240
North Fork	3	WA	N.F. of Snoqualmie	100	32	60
Lucky Peak	2	ID	Boise	270	50	106
Lenore	4	ID	Clearwater		86	432
Garden Valley & Rereg. Res.	4	ID	S.F. Payette	1940	56	211
Twin Springs	4	ID	Boise	490	38	104
Sullivan Creek	2	WA	Pend Oreille	62	7	14
Cougar Added Units w/Strube	2	OR	S.F. McKenzie	6	2	40
Wenatchee Project: Chiwawa (Dirty Face Mt.)	3	WA	Wenatchee	205	21	145
Beaver Creek	2	WA	Wenatchee	4	7	14
Levenworth	2	WA	Wenatchee		112	120
Dryden	2	WA	Wenatchee	4	11	20
Klamath River Additions		OR	Klamath		170	279
Total				9864	2756	7033

Data Source: Reference 25, BPA Role EIS, p. V-19.

TABLE I-B-32

FEDERAL COLUMBIA RIVER POWER SYSTEM
AUTHORIZED AND POTENTIAL PROJECTS

Project	River	River Mile (above mouth)	Number of Units	Average Annual Energy, MW	Capacity, MW
Authorized					
Cougar	S.F. McKenzie	4.5	1	0	40
John Day	Columbia	215.6	4	4	621
Dworshak	N.F. Clearwater	1.9	3	7	759
Strube[a]	S.F. McKenzie	2.5	1	2	5
Subtotals			9	13	1425
Potential					
Grand Coulee	Columbia	596.6	6	0	4140
McNary	Columbia	292.6	10	60	1207
Chief Joseph	Columbia	545.1	13	0	1809
Anderson Ranch	S.F. Boise	43.5	1	6	17
Palisades	Snake	901.6	2	33	155
Totals			41	112	8753

(a) New project; all others are additional generating units.

Data Source: Reference 25, BPA Role EIS, p. V-20

TABLE I-B-33

GENERATOR UNIT ADDITIONS UNDER CONSIDERATION BY
PUBLIC AGENCY AND INVESTOR-OWNED UTILITIES

Project	Units	State	Drainage	Average Annual Energy, MW	Capacity, MW
Boundary	2	WA	Pend Oreille	63	105
Mossyrock	1	WA	Cowlitz	34	150
Mayfield	1	WA	Cowlitz	11	41
Priest Rapids	6	WA	Columbia	11	404
Wanapum	6	WA	Columbia	0	460
				119	1160

Data Source: Reference 25, BPA Role EIS, p. U-22.

TABLE I-B-34

POTENTIAL HYDROELECTRIC PROJECTS
PACIFIC NORTHWEST
DECEMBER 31, 1977

New Projects	Agency or Utility	Status[a]	Stream	Useable Storage Acre-Feet	Ultimate Installed Nameplate Rating - kW
American Falls Reconstruction[b]	IPCO/USBR[d]	Licensed	Snake	Existing	92,400
Antilon Lake (pumped-storage)	Chelan Co. PUD	Permit gtd.	Chelan	Pondage	1,600,000
Ben Franklin	Corps of Engineers	Study inactive	Columbia	Pondage	848,000
Browns's Canyon (pumped-storage)	Douglas Co. PUD	Permit gtd.	Columbia	Pondage	1,000,000
Buffalo Rapids #2[b,1]	Conf. Flathead Tribes and Montana			Pondage	120,000[1]
Buffalo Rapids #4[b]	Conf. Flathead Tribes and Montana	Appl. lic.	Flathead	Pondage	120,000[1]
Clark Ranch[c]	Bureau of Reclamation	Study inactive	Snake	Pondage	0
Copper Creek	Seattle City Light	Under study	Skagit	Pondage	100,000
Days Creek	Corps of Engineers	Under study	South Fork Umpqua	--	44,000
Garden Valley	Bureau of Reclamation	(e)	South Fork Payette	1,940,000	175,000
Garden Valley (re-regulating)	Bureau of Reclamation	(e)	South Fork Payette	Pondage	36,000
Guffey (High)[b,1]	Bureau of Reclamation	Recommended	Snake	Pondage	85,000[1]
Guffey (Low)[b]	Idaho Water Res. Board	Under study	Snake	Pondages	29,000
High Buffalo Rapids[b]	Bureau of Reclamation	Study inactive	Flathead	668,000	516,000
Kootenai Falls	Northern Lights, Inc.	Appl. permit	Kootenai	Pondage	140,000
Libby Re-regulator	Corps of Engineers	Authorized	Kootenai	Pondage	43,800
Lower Scriver Creek	Bureau of Reclamation	(e)	Scriver Creek	Pondage	120,000
Lynn Crandall	Bureau of Reclamation	Under study	Snake	1,420,000	240,000
Moiese (High Buffalo Rapids) (Re-regulating)	Bureau of Reclamation	Study inactive	Flathead	Pondage	0
Mountain Brook-Husum (pumped-storage)	Bureau of Reclamation	Study inactive	White Salmon	Pondage	1,500,000
Strube (Cougar re-regulating)[i]	Corps of Engineers	Authorized	South Fork McKenzie	Pondage	4,500
Sultan #1	Snohomish Co. PUD #1	Licensed	Sultan	97,700	84,000
Sultan #2	(jointly with City	Licensed	Sultan	Pondage	32,000
Sultan #3	of Everett)	Licensed	Sultan	Pondage	24,000
Swan Falls (new)[b]	Idaho Water Res. Board	Under study	Snake	Pondage	157,300
Upper Scriver Creek	Bureau of Reclamation	(e)	Scriver Creek	Pondage	37,500
Subtotal				4,125,700	6,823,500

Additions to Projects Existing or Under Construction

New Projects	Agency or Utility	Status	Stream	No. of Units	Ultimate Installed Nameplate Rating - kW
Anderson Ranch	Bureau of Reclamation	Under study	South Fork Boise	1	13,500
Bliss	Idaho Power Company	Potential[h]	Snake	1	25,000
Boundary	Seattle City Light	Potential[h]	Pend Oreille	2	275,500
Brownlee	Idaho power Company	Appl. amend.	Snake	1	225,000
Bull Run #1	City of Portland	Under study	Bull Run	2	2,400
Bull Run #2	City of Portland	Under study	Bull Run	1	1,200
Chelan	Chelan Co. PUD	Under study	Chelan	3	225,000
Chief Joseph Units Beyond #27	Corps of Engineers	Under study	Columbia	13[f]	1,573,000[f]
Cougar	Corps of Engineers	Authorized	South Fork McKenzie	1	35,000
Detroit	Corps of Engineers	Under study	North Santiam	2	100,000
Dworshak	Corps of Engineers	Authorized	North Fork Clearwater	3	660,000

TABLE I-B-34 (Contd)

New Projects	Agency or Utility	Status	Stream	No. of Units	Ultimate Installed Nameplate Rating - kW
Grand Coulee Third Power Plant Extension	Bureau of Reclamation	Under study	Columbia	6[g]	4,200,000
Hells Canyon	Idaho Power Company	Potential[h]	Snake	1	130,500
John Day	Corps of Engineers	Authorized	Columbia	4	540,000
Keno	Pacific Power and Light Company	Potential[h]	Klamath	2	100,000
Libby	Corps of Engineers	Autorized	Kootenai	4	420,000
Lower Salmon	Idaho Power Company	Potential[h]	Snake	1	15,000
Lucky Peak	Corps of Engineers	Under study	Boise	4	75,000[j]
Mayfield	Tacoma City Light	Appl. amend.	Cowlitz	1	45,000
McNary	Corps of Engineers	Recommended	Columbia	10	1,200,000
Merwin	Pacific Power and Light Company	Potential[h]	Lewis	1	45,000
Minidoka	Bureau of Reclamation	Under study	Snake	2	20,000
Mossyrock	Tacoma City Light	Potential[h]	Cowlitz	1	150,000
Oxbow	Idaho Power Company	Potential[h]	Snake	1	47,500
Palisades	Bureau of Reclamation	Study inactive	Snake	2	135,000
Priest Rapids	Grant Co. PUD	Under study[h]	Columbia	6	473,100
Ross (ultimate height)	Seattle City Light	Appl. amend.[h]	Skagit	0	274,000[k]
Teton	Bureau of Reclamation	Authorized	Teton	1	10,000
Wanapum	Grant Co PUD	Under study[h]	Columbia	6	498,750
Yale	Pacific Power and Light Company	Potential[h]	Lewis	2	108,000
Subtotal				85	11,622,450
Total Kilowatts					18,445,950

(a) Authorized - authorized for Federal construction; Recommended - recommended for authorization for construction by the Federal agency; Licensed - license has been granted by FPC; Appl. License - application for license filed with FPC; Appl. Permit - application for preliminary permit filed with FPC; Permit gtd. - Preliminary permit granted by FPC; App. Amend. - application for amendment to existing FPC license.
(b) Alternative project, conflicts with another project shown.
(c) Re-regulator for Lynn Crandall.
(d) Idaho Power Company would own the new power plant. The Bureau of Reclamation would own the reconstructed dam.
(e) At one time this project was in "Recommended" status. It would now require a restudy before authorization by Congress.
(f) Approximate installation to match Grand Coulee Units 25-30. Other installation sizes are being studied also.
(g) In addition to the six units existing and under construction listed on Table .
(h) Although structural provisions have been included, an amendment to the existing FPC license for the project will be required before construction of the added units.
(i) Would be constructed in conjunction with the 35 MW 3rd unit at Cougar.
(j) Tentative.
(k) Increase in dependable capacity is due to raising of head 122.5 feet.
(l) Totals do not include alternative projects indicated by (l).
Data Source: Ref. 21, Review of Power Planning in the Pacific Northwest, p. 56.

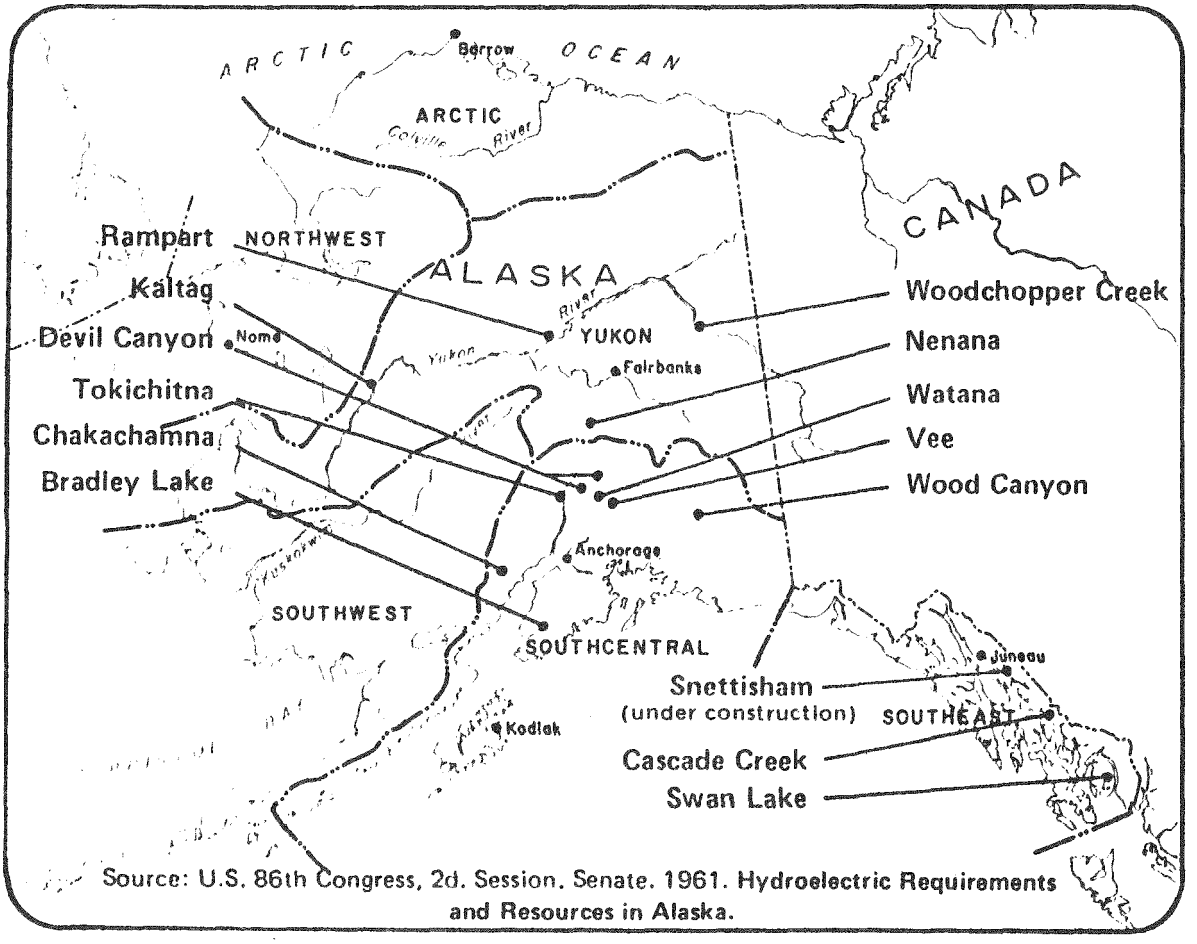

FIGURE I-B-40. Proposed Major Hydroelectric Power Sites in Alaska

Data Source: Ref. 22, Alaska Regional Profiles, Figure 145.

TABLE I-B-35

Federal Hydroelectric Projects
General Specification on Existing Projects,
Nameplate Rating of Installations as of December 31, 1977

Project	Location	Stream	Number of Units	Total Capacity, kW
Bonneville	OR-WA	Columbia	10	518,400
Grand Coulee	WA	Columbia	18-3	2,263,000[a]
Pumped storage			2	100,000
Third powerplant			3	1,800,000
Detroit	OR	North Santiam	2	100,000
McNary	OR-WA	Columbia	14	980,000
Big Cliff	OR	North Santiam	1	18,000
Lookout Point	OR	Middle Fork Willamette	3	120,000
Albeni Falls	ID	Pend Oreille	3	42,600
Dexter	OR	Middle Fork Willamette	1	15,000
Chief Joseph	WA	Columbia	16	1,024,000
Green Springs	OR	Rogue	1	16,000
Chandler	WA	Yakima	2	12,000
The Dalles	OR-WA	Columbia	22-2	1,807,000[b]
Roza	WA	Yakima	1	11,250
Ice Harbor	WA	Snake	6	602,880
Hills Creek	OR	Middle Fork Willamette	2	30,000
Minidoka	ID	Snake	7	13,400
Boise Diversion	ID	Boise	3	1,500
Black Canyon	ID	Payette	2	8,000
Anderson Ranch	ID	South Fork Boise	2	27,000
Palisades	ID	Snake	4	118,750
Cougar	OR	South Fork McKenzie	2	25,000
Green Peter	OR	Middle Santiam	2	80,000
Foster	OR	South Santiam	2	20,000
John Day	OR-WA	Columbia	16	2,160,000
Lower Monumental	WA	Snake	3	405,000
Little Goose	WA	Snake	3	405,000
Lower Granite	WA	Snake	3	405,000
Teton[c]	ID	Teton	--	--
Lost Creek	OR	Rogue	2	49,000
Dworshak	ID	North Fork Clearwater	3	400,000

(a) Includes three service units and increase of 17,000 kW each for 18 rewound main units.
(b) Includes two fishway units at 13,500 kW each.
(c) Status undeterimined.

Data Source: Ref. 21, Review of Power Planning in the Pacific Northwest, p. 46.

TABLE I-B-36

Nonfederal Hydroelectric Existing and Under Construction
December 31, 1977

Operating Utility	Location	Installed Capacity kW[a]	Additional Capacity kW[b]
Existing			
Public			
City of Baker	Oregon	115	
City of Bonners Ferry	Idaho	2,380	
City of Centralia	Washington	10,000[c]	
Chelan County PUD	Washington	1,473,400[d]	
Cowlitz County PUD	Washington	70,000	
Douglas County PUD	Washington	774,300	
City of Eugene	Oregon	111,500	
Grant County PUD	Washington	1,619,750	971,850
City of Idaho Falls	Idaho	7,400	
Pend Oreille County PUD	Washington	60,560	
City of Seattle	Washington	1,193,555	395,500
City of Soda Springs	Idaho	570	
City of Spokane	Washington	3,900	
City of Tacoma	Washington	659,700	195,000
Washington Public Power Supply System	Washington	26,125	
Subtotal		6,014,755	1,562,350
Private			
California-Pacific Utilities Company	Oregon	800	
Idaho Power Company	ID-OR	1,290,145	218,000
Pacific Power and Light Company	WA-OR-CA-MT	862,395	253,000
Portland General Electric Company	Oregon	534,350	
Puget Sound Power and Light Company	Washington	297,090	113,200
Washington Water Power Company	WA-ID	761,530	
Subtotal		3,746,310	584,200
Under Construction			
Chelan County PUD	Rock Island (second powerhouse)	410,000	
Idaho Power Company	American Falls	92,400	
Idaho Power Company	Brownlee (Unit No. 5)	225,000	
Subtotal of under-construction projects		727,400	
TOTAL		10,685,105	2,146,550

(a) Nameplate rating.
(b) Additional capacity installations provided for at time of construction project.
(c) Units 1 and 2 have been rewound.
(d) Chelan: includes 200 kW Stehekin hydro, excludes 2450 kW Dryden hydro which is inoperative.

Data Source: Ref. 21, Review of Power Planning in the Pacific Northwest, p. 47.

TABLE I-B-37

Thermal-Electric Generation in the Pacific Northwest
Existing and Under Construction
December 31, 1977

Utility	Plant	Location	Type[a]	Rating MW	In-Service Date
Fossil Fuel - Existing					
Chelan County PUD	Stehekin	Stehekin, WA	IC	0.5	1966, 1975, 1977
Eugene Water and Electric Board	Eugene	Eugene, OR	St	25.0	1931
Eugene Water and Electric Board	Weyco	Springfield, OR	St	51.2	1976
Idaho Power Company	Wood River	Hatley, ID	CT	50.0	Aug. 1974
	Lincoln	Portland, OR	St	35.5	1919
Pacific Power and Light and Washington Water Power	Centralia	Centralia, WA	St	1313.0	Aug. 1971
Portland General Electric Company	Summit	Government Camp, OR	IC	5.5	Dec. 1970
	Bethel	Salem, OR	CT	128.0	Sept. 1973
	Harborton	Portland, OR	CT	258.0	Nov. 1973
	Beaver, base load	Clatskanie, OR	CC	510.0	Aug. 1974, Nov. 1977
Puget Sound Power and Light Company	Shuffleton	Seattle, WA	St	87.5	1929
	Crystal Mountain	Parkway, WA	IC	2.8	Dec. 1969
	South Whidbey	Langley, WA	CT	28.5	Dec. 1972
	Whitehorn	Ferndale, WA	CT	67.5	Dec. 1974
Seattle City Light	Lake Union	Seattle, WA	St	30.0	1914
City of Bonners Ferry	Bonners Ferry	Bonners Ferry, ID	IC	2.4	1930
City of Idaho Falls	Idaho Falls	Idaho Falls, ID	IC	2.5	1926
Orcas Power and Light Company	East Sound	East Sound, WA	IC	1.3	1938
	Friday Harbor	Friday Harbor, WA	IC	1.1	1941
Washington Water Power Company	Othello	Othello, WA	CT	32.8	June 1973
Subtotal, Fossil Fuel				2633.1	
Nuclear - Existing					
Washington Public Power Supply System	Hanford No. 1	Hanford, WA	Nu	860.0	Nov. 1966
Portland General Electric Company	Trojan	Rainier, OR	Nu	1130.0	Dec. 1975
Subtotal, Nuclear				1990.0	
Total Existing, Thermal Electric			6470.2		
Fossil Fuel - Under Construction					
Washington Water Power Company	Spokane CT	Spokane, WA	CT	34.5	Oct. 1978
Portland General Electric Company	Boardman Coal	Boardman, OR	St	530.0	July 1980
Subtotal, Fossil Fuel				564.5	
Nuclear - Under Construction					
Washington Public Power Supply System	WNP No. 1	Hanford, WA	Nu	1250.0	Sept. 1981
Washington Public Power Supply System	WNP No. 2	Hanford, WA	Nu	1100.0	Sept. 1980
Washington Public Power Supply System	WNP No. 4	Hanford, WA	Nu	1250.0	March 1983
Subtotal, Nuclear				3600.0	
Total, Under Construction, Thermal Electric					
Total, Existing and Under Construction					

(a) Key: IC - internal combustion (generally diesel); St - fossil fuel-fired steam; CT - combustion turbine; Nu - nuclear; CC - combined cycle.

Data Source: Ref. 21, Review of Power Planning in the Pacific Northwest, p. 52.

TABLE I-B-38

Thermal Generation: Hydro-Thermal Program
December 31, 1977

Plant	Location	Sponsor[a]	Fuel	Capacity, MW	On Line Date	Delay Months[b]
In Operation						
Hanford	Hanford, WA	WPPSS	Nuclear	860	Nov. 1966	--
Centralia	Centralia, WA	PP&L & WWP	Coal	1400	Aug. 1971	0
Trojan	Rainier, OR	PGE	Nuclear	1130	Dec. 1975	15
Under Construction						
WNP No. 2	Hanford, WA	WPPSS	Nuclear	1100	Sept. 1980	36
Boardman (Carty)	Boardman, OR	PGE	Coal	500	July 1980	24
WNP No. 1	Hanford, WA	WPPSS	Nuclear	1250	Dec. 1982	27
Committed						
WNP No. 3	Satsop, WA	WPPSS	Nuclear	1240	Jan. 1984	27
WNP No. 4	Hanford, WA	WPPSS	Nuclear	1250	June 1984	-1
WNP No. 5	Satsop, WA	WPPSS	Nuclear	1240	July 1985	28
Skagit No. 1	Sedro Wooley, WA	PSP&L	Nuclear	1288	July 1985	51
Skagit No. 2	Sedro Wooley, WA	PSP&L	Nuclear	1288	July 1987	36
Pebble Springs No. 1	Arlington, OR	PGE	Nuclear	1260	Apr. 1986	67
Pebble Springs No. 2	Arlington, OR	PGE	Nuclear	1260	Apr. 1989	45

(a) PGE - Portland General Electric Company; PP&L - Pacific Power and Light Company; PSP&L - Puget Sound Power and Light Company; WPPSS - Washington Public Power Supply System; WWP - Washington Water Power Company.
(b) From scheduled date when plant first announced.

Data Source: Ref. 21, Review of Power Planning in the Pacific Northwest, p. 24.

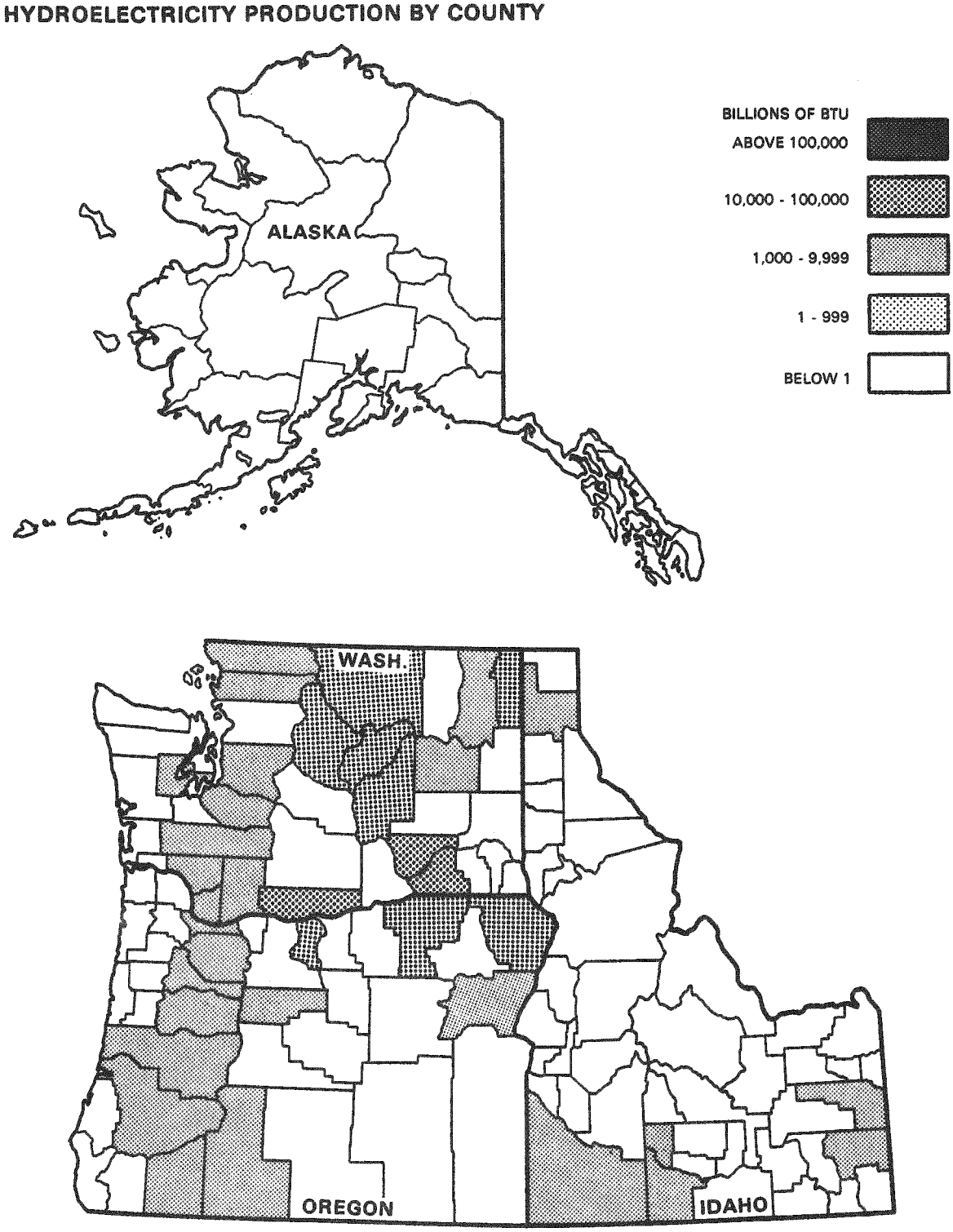

FIGURE I-B-41. Hydroelectricity Production by County

Data Source: Ref. 5, Energetics of the USA, p. 61.

TABLE I-B-39

REGIONAL ELECTRICAL GENERATING CAPACITIES
BY STATE

State	Capacity (MWe)
Alaska	604
Idaho	1,700
Oregon	7,643
Washington	16,856
Regional Total	25,803

Data Source: Ref. 2, Impact of Increased Coal Consumption in PNW, RAP-21, p. A.4.

TABLE I-B-40

TOTAL ELECTRICAL GENERATING CAPACITIES BY SOURCE

Source	Capacity (MWe)
Hydroelectric	22,306
Nuclear	2,016
Coal[(a)]	2,509
Oil and Gas	652
Regional Total	27,483

(a) This accounts for power supplied outside the Region by the Jim Bridger No. 1 in Wyoming and the 179 MW that is the Region's share of Colstrip No. 1 in Montana.

Data Source: Ref. 2, Impact of Increased Coal Consumption in PNW, RAP-21, p. A.4.

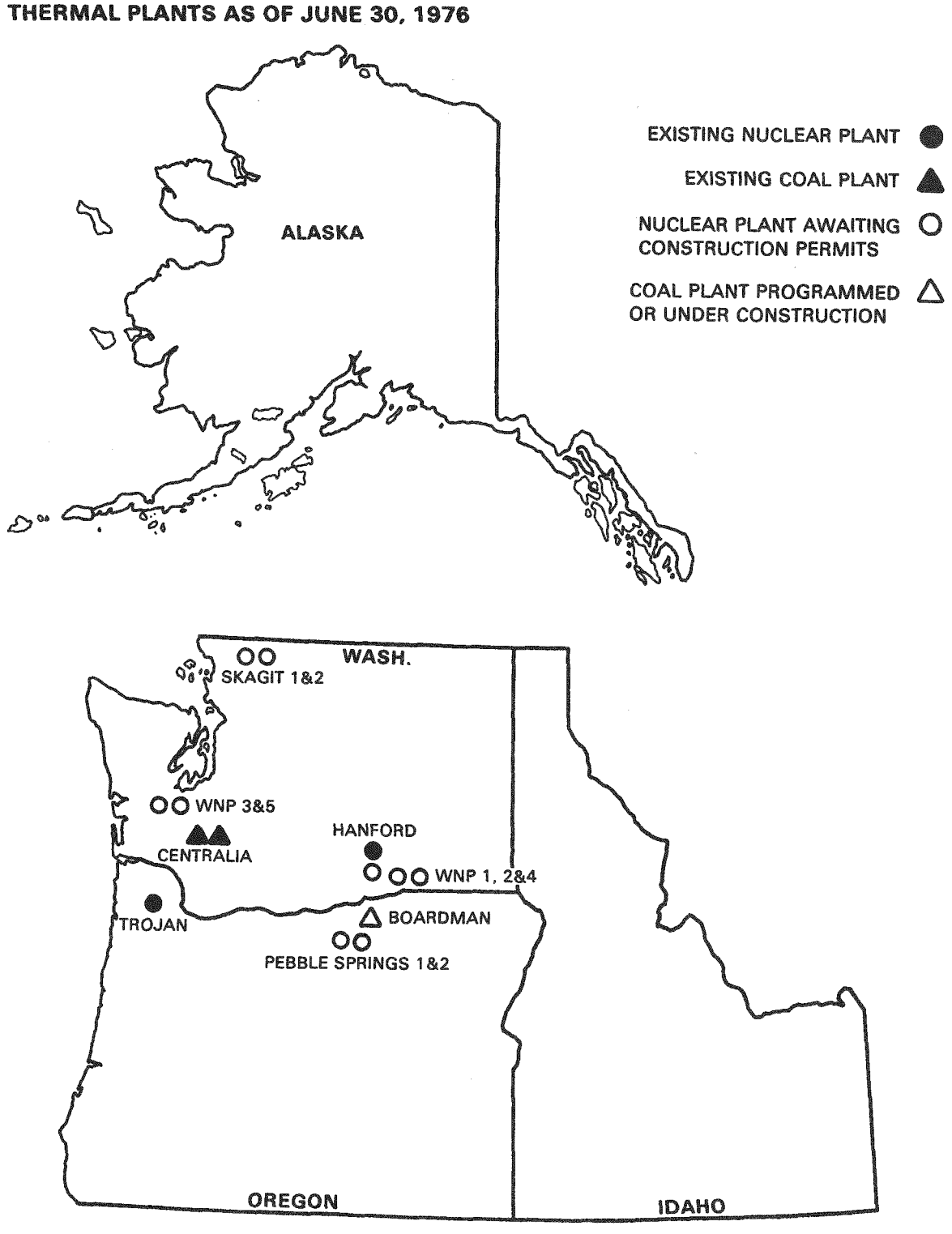

FIGURE I-B-42. Northwest Thermal Plants as of June 30, 1976

Data Source: Ref. 25, BPA in the Pacific Northwest Power Supply System.

TABLE I-B-41

EXISTING HYDROELECTRIC FACILITIES IN ALASKA

System	Plant Name or FPC Project No.	Location	Kilowatt Capacity	Ownership[a]
Southeast Region:				
Alaska Electric Light and Power[b]	Gold Creek	Juneau	1,600	P
Alaska Electric Light and Power	Annex Creek	Juneau	2,800	P
Alaska Electric Light and Power	Salmon Creek	Juneau	2,800	P
Alaska Electric Light and Power	Salmon Creek	Juneau	2,800[c]	P
Alaska Power and Telephone Co.	1051	Skagway	338	P
Pelican Utility Co.		Pelican	500	P
Ketchikan Public Utilities	420	Ketchikan	4,200	NF
Ketchikan Public Utilities	1922	Ketchikan	5,600	NF
Metlakatla Indian Community	Purple Lake	Metlakatla	3,000	NF
City of Petersburg	201	Petersburg	2,000	NF
Sitka Public Utilities	2230	Sitka	6,000	NF
Alaska Power Administration[d]	Snettisham	Speel River (near Juneau)	46,700	F
Subtotal (rounded)			78,300	

(a) Ownership designations: F = Federal; NF = Public/Nonfederal; P = Private.
(b) Formerly owned by Juneau Hydro Electric.
(c) 1,400 kilowatts at Juneau and 1,400 kilowatts at Ketchikan presently inoperable.
(d) Under construction by U.S. Army Corps of Engineers. 46,700 kilowatts represents first phase of construction toward ultimate capacity of 70,000 kilowatts.

Data Source: Reference 22, Alaska Regional Profiles, Figure 111.

TABLE I-B-42

ALASKAN ELECTRIC GENERATION BY YEAR

Year	Millions of kWh				
	Total Electric Utility Industry	Hydro	Conventional Steam	Nuclear Steam	Internal Combustion
1975(p)	2207	357	1645	0	205
1974(r)	1887	327	1383	0	177
1973(r)	1744	286	1306	0	152
1972(p)	1617	346	1114	0	157
1971(p)	1428	357	930	0	141
1970	1245	362	754	0	129
1969	1080	340	620	0	120
1968	974	363	506	0	105
1967	859	363	400	0	96
1966	787	316	385	0	86
1965	713	350	283	0	80
1964	629	321	246	0	62
1963	532	325	155	0	52
1962	N/A	N/A	N/A	N/A	N/A
1961	N/A	N/A	N/A	N/A	N/A

Data Source: Reference 36, Statistical Yearbook

1961-1970	2nd Edition,	Pub. No. 73-14, Table 13
1971-1972	No. 40	Pub. No. 73-13, Table 13S
1974	No. 42	Pub. No. 75-39, Table 13S
1975	No. 43	Pub. No. 76-51

Note: (p) denotes preliminary; (r) denotes revised

TABLE I-B-43

IDAHO ELECTRIC GENERATION BY YEAR

Year	Millions of kWh				
	Total Electric Utility Industry	Hydro	Conventional Steam	Nuclear Steam	Internal Combustion
1975(p)	10,279	10,275	4	0	0
1974(r)	9,697	9,688	9	0	0
1973(r)	8,223	8,222	0	0	1
1972(p)	7,844	7,844	0	0	0
1971(p)	7,470	7,469	0	0	1
1970	7,077	7,077	0	0	0
1969	6,280	6,280	0	0	0
1968	6,746	6,746	0	0	0
1967	6,897	6,897	0	0	0
1966	6,828	6,827	1	0	0
1965	6,641	6,641	0	0	0
1964	6,292	6,292	0	0	0
1963	5,978	5,978	0	0	0
1962	5,982	6,982	0	0	0
1961	5,595	5,595	0	0	0

Data Source: Reference 36, Statistical Yearbook

1961-1970	2nd Edition,	Pub. No. 73-14
1972	No. 40	Pub. No. 73-13
1974	No. 42	Pub. No. 75-39
1975	No. 43	Pub. No. 76-51

Note: (p) denotes preliminary; (r) denotes revised.

TABLE I-B-44

OREGON ELECTRIC GENERATION BY YEAR

Year	Millions of kWh				
	Total Electric Utility Industry	Hydro	Conventional Steam	Nuclear Steam	Internal Combustion
1975(p)	34,538	34,524	12	1	1
1974(r)	36,051	35,964	87	0	0
1973(r)	28,441	28,139	302	0	0
1972(p)	36,524	36,469	55	0	0
1971(p)	34,333	34,305	28	0	0
1970	29,875	29,836	39	0	0
1969	27,813	27,814	(1)	0	0
1968	20,378	20,377	1	0	0
1967	17,793	17,797	(4)	0	0
1966	16,712	16,653	59	0	0
1965	16,473	16,447	26	0	0
1964	14,947	14,941	6	0	0
1963	13,600	13,561	39	0	0
1962	13,270	13,233	37	0	0
1961	12,444	12,413	31	0	0

Data Source: Reference 36, Statistical Yearbook.

1961-1970	2nd Edition,	Pub. No. 73-14
1971-1972	No. 40	Pub. No. 73-13
1974	No. 42	Pub. No. 75-39
1975	No. 43	Pub. No. 76-51

(a) Parenthetical figures indicate a negative entry.

Note: (p) denotes preliminary; (r) denotes revised.

TABLE I-B-45

WASHINGTON ELECTRIC GENERATION BY YEAR

Year	Millions of kWh				
	Total Electric Utility Industry	Hydro	Conventional Steam	Nuclear Steam	Internal Combustion
1975(p)	93,562	84,122	6,123	08	0
1974(r)	90,406	82,301	4,216	89	0
1973(r)	78,565	68,844	5,290	4,431	0
1972(p)	78,658	75,716	23	2,919	0
1971(p)	73,979	71,429	(3)	2,553	0
1970	72,001	69,390	(3)	2,614	0
1969	71,055	67,387	1	3,667	0
1968	68,043	64,141	0	3,902	0
1967	60,727	58,713	(1)	2,015	0
1966	53,681	52,610	82	989	0
1965	49,101	49,104	(3)	0	0
1964	46,854	46,855	(1)	0	0
1963	42,928	42,929	(1)	0	0
1962	39,364	39,365	(1)	0	0
1961	37,176	37,177	(1)	0	0

Data Source: Reference 36, Statistical Yearbook.

1961-70	2nd Edition,	Pub. No. 73-14
72	No. 40	Pub. No. 73-13
74	No. 42	Pub. No. 75-39
75	No. 43	Pub. No. 76-51

(a) Parenthetical figures indicate a negative entry.

Note: (p) denotes preliminary; (r) denotes revised.

TABLE I-B-46

REGIONAL ELECTRIC GENERATION BY YEAR

	Millions of kWh					
Year	Total	Hydro	Conventional Steam	Nuclear Steam	Internal Combustion	U.S.
1975	140,585	129,278	7,793	3,309	205	1,916,578
1974	138,041	128,280	5,695	3,889	177	1,866,216
1973	117,973	105,491	6,898	4,431	153	1,856,216
1972	124,643	120,375	1,192	2,919	157	1,747,323
1971	117,210	113,560	955	2,533	142	1,613,936
1970	110,198	106,665	790	2,614	129	1,531,609
1969	106,228	101,821	620	3,667	120	1,442,182
1968	96,141	91,627	507	3,902	105	1,329,443
1967	86,276	83,770	395	2,015	96	1,214,365
1966	78,008	76,406	527	989	86	1,144,350
1965	72,928	72,542	306	0	80	1,055,252
1964	68,796	68,409	251	0	62	983,990
1963	63,038	62,793	193	0	52	916,793
1962	58,616	58,580	36	0	0	852,314
1961	55,215	55,185	30	0	0	792,039

Data Source: Reference 36, Statistical Yearbook. Derived from State Data. 1961 and 1962 figures do not contain Alaska generation. Regional forecast equals the sum of the states.

TABLE I-B-47

ELECTRIC NET GENERATION - 1975

Area	Type of Prime Mover (Millions of KWh) Utilities	Industrial
Alaska	2,209	273
Idaho	10,278	145
Oregon	34,536	324
Washington	93,560	532
NW Region	140,583	1,274
United States Total	1,915,824	84,899

Data Source: Reference 37, FPC News, Vol. 9, No. 23, p. 20.

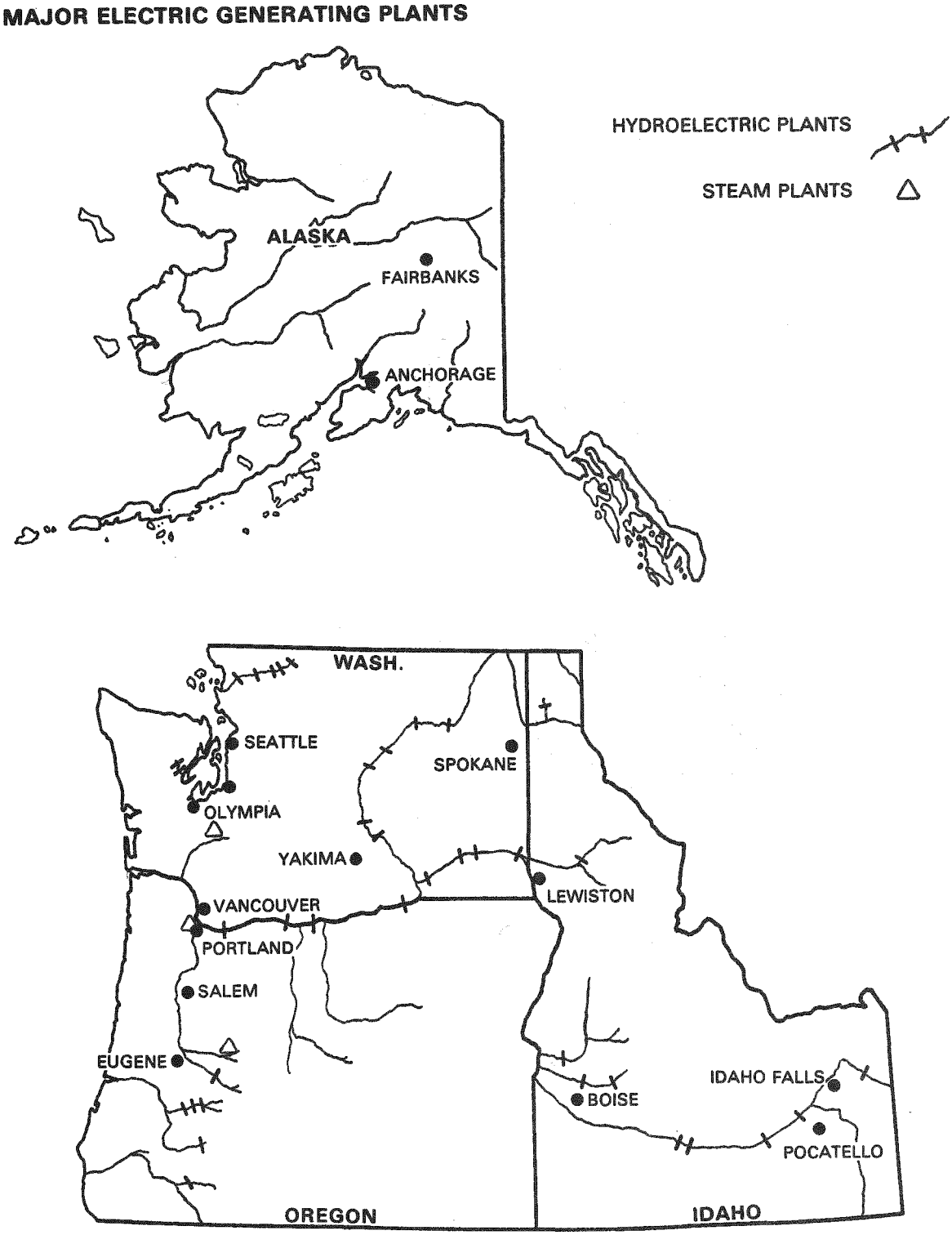

FIGURE I-B-43. Major Electric Generating Plants

Data Source: Ref. 4, Energy Northwest, Figure 20.

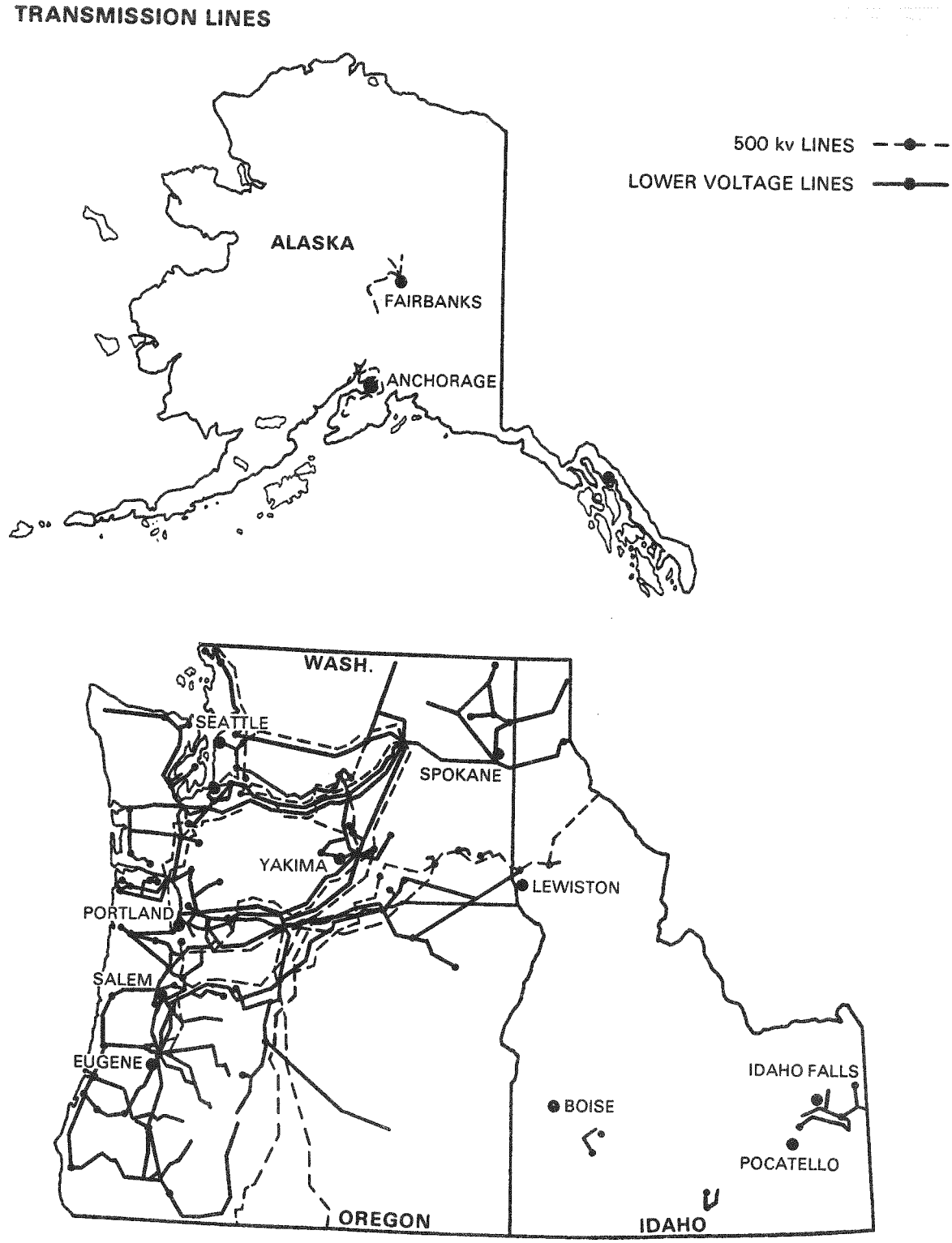

FIGURE I-B-44. Major Transmission Lines

Data Source: Ref. 4, Energy Northwest, Figure 20.

TABLE I-B-48

CIRCUIT MILES OF OVERHEAD ELECTRIC LINE OF 22,000 VOLTS AND ABOVE IN SERVICE-
TOTAL ELECTRIC UTILITY INDUSTRY, BY STATES AND VOLTAGE GROUPS

States and Voltage Groups	Circuit Miles		
	1975	1974	1973
Alaska	52	52	52
Idaho	9,064	8,744	8,538
Oregon	10,035	9,964	9,990
Washington	15,124	14,311	14,892
Region	34,275	33,071	33,442
Total United States	513,925	504,890	491,162

Data Source: Reference 36, Statistical Yearbook, p. 56.

ENERGY: REGIONAL CONSUMPTION

Overall, the Pacific Northwest (Idaho, Oregon, Washington) uses somewhat less energy per capita (although it uses significantly more electricity per capita) than does the nation as a whole. Residential and commercial users consume a smaller portion of the three-state regional total than such users do nationally. Industry consumes about the same share of the total energy in the region as in the nation. Transportation is the one sector that uses a greater share of the region's total energy supply than it does nationally. The greater distances traveled in the Northwest, its sparser population, and a greater reliance on trucking (which uses more fuel per ton-mile of freight than rail or barges) have established this pattern.(1)

In 1975 Washington consumed 16.7 million bbl of distillate oil, Oregon 13.2 million bbl, Idaho 7.4 million bbl, and Alaska 7.0 million bbl. All states except Washington have increased consumption slightly each year since 1960; Washington's consumption has remained basically stable. Regional distillate oil consumption peaked at 48.8 million bbl in 1973, then fell to 44.3 million bbl in 1974. The Region accounted for over 4% of total U.S. distillate oil consumption in 1975.

Regional residual oil consumption totaled 14.7 million bbl in 1975, with Washington consuming 8.6 million bbl, Oregon 4.4 million, Alaska 1.1 million, and Idaho just over 700,000 bbl. The Region accounted for 1.6% of all U.S. residual oil consumption.

The Region used 3.6 billion gal of gasoline in 1975. More than 47% of that was used in Washington. Oregon used nearly 34% of the Region's total, Idaho more than 13%, and Alaska just over 5%. The total is approximately 3.5% of the nation's gasoline consumption.(2)

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(1) Information Source: Reference 3, Energy Futures Northwest, p. 44.
(2) Information Source: Reference 2, The Impact of Increased Coal Consumption, RAP-21.

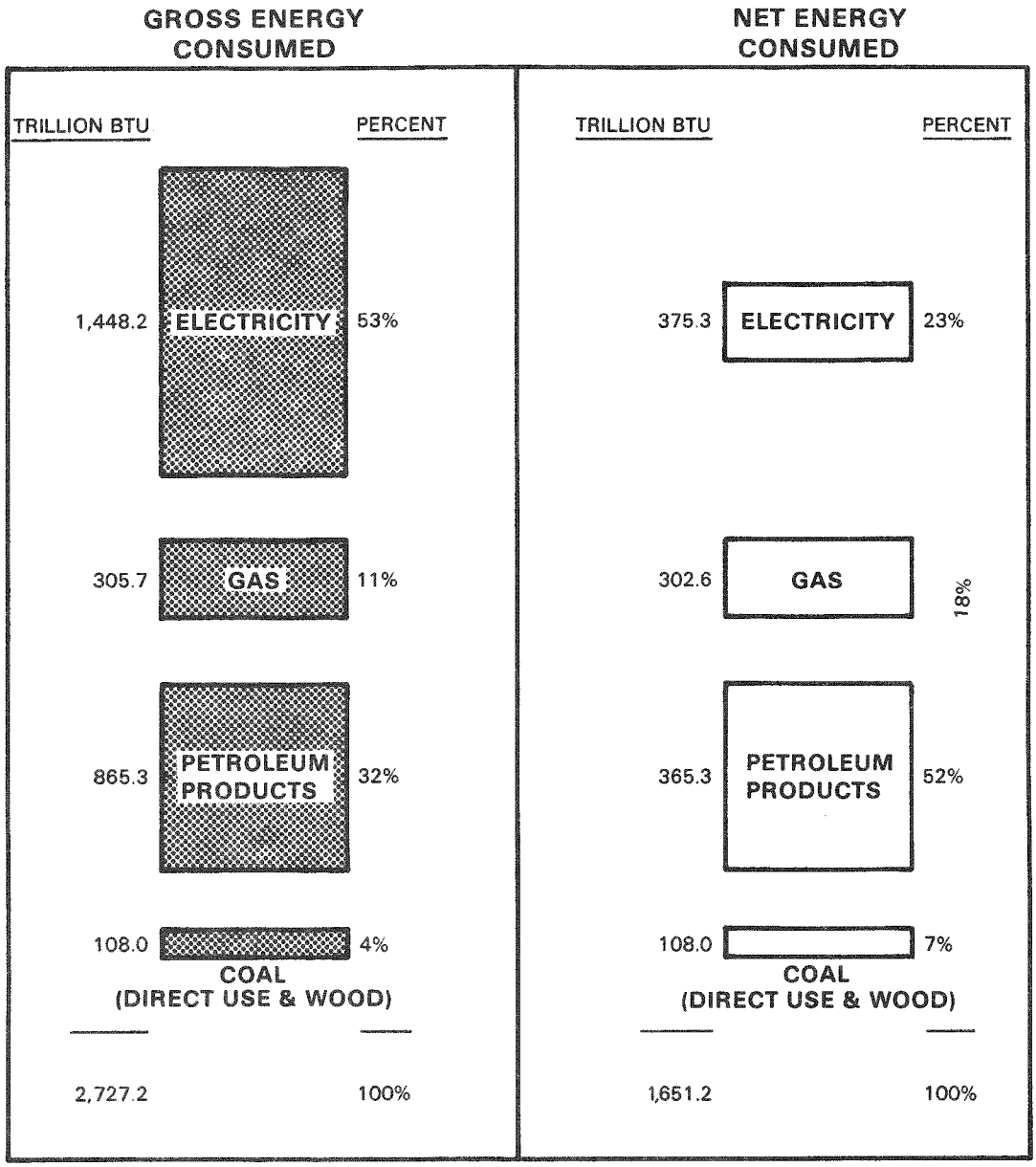
TABLE I-C-49

GROSS CONSUMPTION TOTAL, TRILLION BTU, 1975

Area	Trillion Btu	% of Total
Alaska	244.58	0.34
Idaho	307.11	0.43
Oregon	787.64	1.10
Washington	1,697.59	2.37
Region	3,036.92	4.24
U.S.	71,599.12	100.00

Data Source: Reference 2, The Impact of Increased Coal Consumption. RAP-21.

NORTHWEST ENERGY CONSUMPTION BY FUEL, 1975



1. THIS IS THE AMOUNT OF THEORETICAL ENERGY REQUIRED IF THE NORTHWESTS ELECTRICITY HAD BEEN GENERATED ENTIRELY FROM FOSSIL OR NUCLEAR FUELS. THE DIFFERENCE BETWEEN GROSS AND NET ELECTRICITY IS THE THEORETICAL CONVERSION LOSSES, TRANSMISSION LOSSES AND EXPORTS.
2. THE DIFFERENCE BETWEEN GROSS AND NET NATURAL GAS IS TRANSMISSION LOSSES.

FIGURE I-C-45. Northwest Energy Consumption by Fuel, 1975[a]

(a) This only includes ID, OR and WA.

Data Source: Ref. 3, Energy Futures of the Northwest, p. 44.

TOTAL FUEL USE

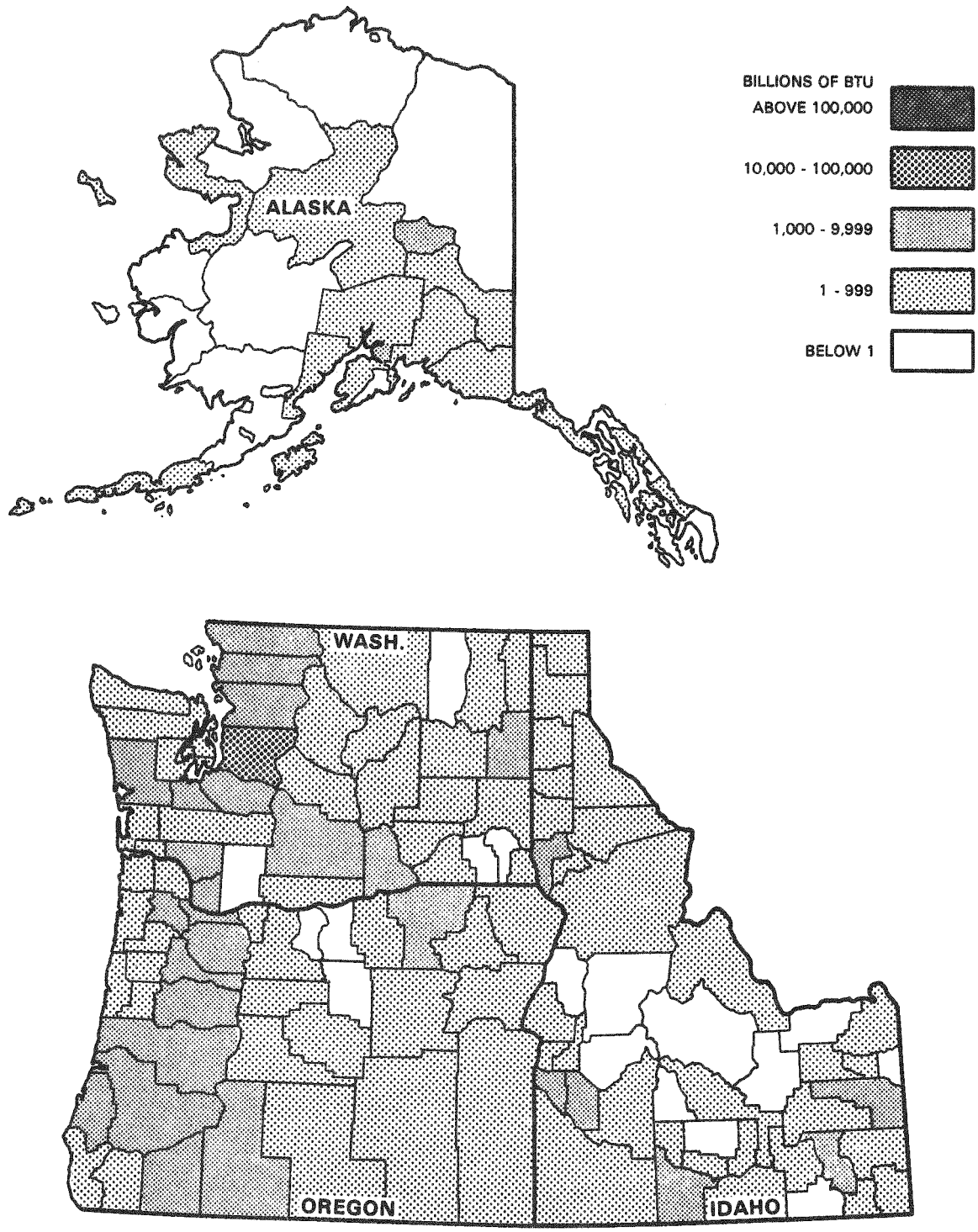


FIGURE I-C-46. Total Fuel Use

Data Source: Ref. 5, Energetics of the USA, p. 31.

TABLE I-C-50

REGIONAL ELECTRICAL ENERGY CONSUMPTION - 1974

Sector	Idaho		Oregon		Washington		Northwest	
	Billion kWh	Trillion Btu	Billion kWh	Trillion Btu	Billion kWh	Trillion Btu	Billion kWh	Trillion Btu
Residential	3.59	12.3	11.69	39.9	19.68	67.2	34.95	119.3
Commercial	1.69	5.8	6.9	20.7	9.82	32.8	17.40	59.4
Industrial	5.41	18.5	13.92	47.9	31.07	106.7	50.66	172.9
Irrigation	2.11	7.2	0.66	2.3	2.17	7.4	4.94	16.9
Total - End Use	12.80	43.7	32.46	110.8	62.73	214.1	107.99	368.6
Transmission	1.58	5.4	4.01	13.7	7.75	26.5	13.35	45.6
Generation(a)	-	68.6	-	254.9	-	663.9	-	987.4
Total - All Uses	14.38	74.0	36.47	268.6	70.48	690.4	121.34	1,033.0

(a) Energy lost in converting thermal energy (or equivalent) to electrical: Coal and hydro: 7,087 Btu/kWh; Nuclear (N-Reactor): 12,840 Btu/kWh.

Data Source: Reference 3, Energy Futures Northwest, p. 109.

TABLE I-C-51

REGIONAL NATURAL GAS CONSUMPTION - 1974

Sector	Idaho		Oregon		Washington		Northwest	
	BCF	Trillion Btu	BCF	Trillion Btu	BCF	Trillion Btu	BCF	Trillion Btu
Residential	9.36	9.65	22.16	22.85	34.30	35.36	65.82	67.86
Commercial	7.94	8.19	13.36	13.77	20.78	21.42	42.08	43.38
Industrial	32.04	33.03	57.00	58.77	111.32	114.78	200.36	206.58
Total - End Use	49.34	50.87	92.52	95.39	166.40	171.56	308.26	317.82
Transmission and Generation	4.03	4.15	7.57	7.80	5.51	5.68	17.10	17.63
Total - All Uses	53.37	55.02	100.09	103.19	171.91	177.24	325.36	335.45

NOTE: Conversion Factor to Cubic Feet: 1,031 Btu per cubic foot (CF).

Data Source: Reference 3, Energy Futures Northwest, p. 110.

TABLE I-C-52

REGIONAL PETROLEUM CONSUMPTION - 1974

Sector	Idaho		Oregon		Washington		Northwest	
	Billion bbl	Trillion Btu	Billion bbl	Trillion Btu	Billion bbl	Trillion Btu	Billion bbl	Trillion Btu
Residential	2.42	13.87	6.16	37.52	10.15	61.10	18.74	112.49
Commercial	1.51	8.51	4.94	29.73	3.35	19.93	9.85	58.17
Industrial	3.74	21.45	6.97	41.94	10.69	65.25	21.27	128.64
Transportation	13.77	73.76	37.48	201.52	55.36	297.49	106.60	572.77
Total - End Use	21.47	117.59	55.56	310.71	79.57	443.77	156.60	872.07
Transmission and Generation	0.01	0.05	0.05	0.33	0.06	0.34	0.12	0.72
Total - All Uses	21.47	117.64	55.61	311.04	79.63	444.11	156.72	872.79

Data Source: Reference 3, Energy Futures Northwest, p. 111.

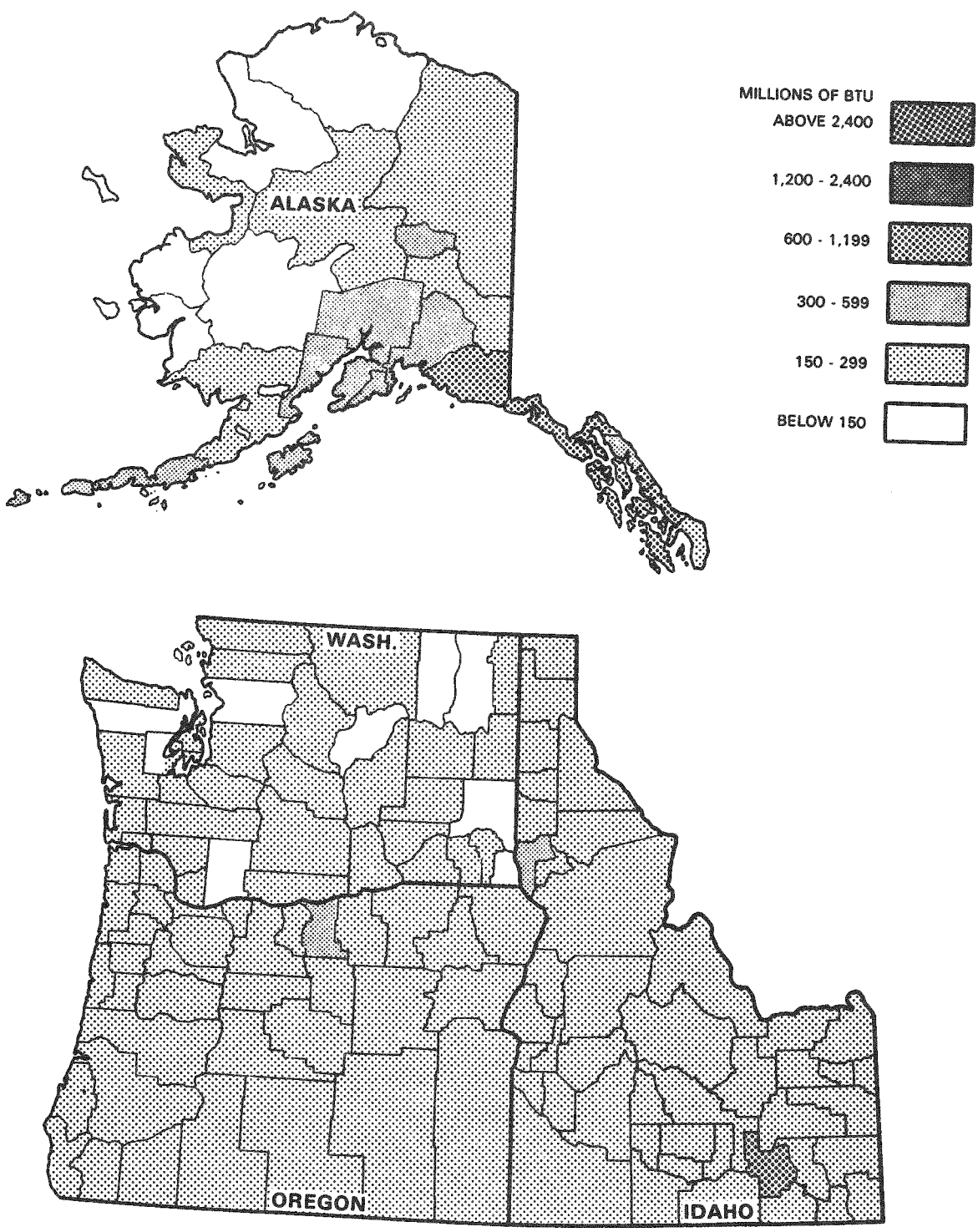


FIGURE I-C-47. Fuel Use Per Capita

Data Source: Ref. 5, Energetics of the USA, p. 33.

TABLE I-C-53

Energy Consumption Per Capita
(Net and Gross)

Year	U.S. Rank	State	Population (Thousands)	Million Btu, Net Per Capita	Million Btu, Gross Per Capita
1971	3	AK	313	520	578
	17	ID	732	266	318
	27	OR	2158	234	361
	29	WA	3449	228	391
1972	3	AK	325	542	607
	16	ID	755	285	337
	29	OR	2185	250	374
	30	WA	3418	247	425
1973	7	AK	330	476	483
	20	ID	770	279	344
	19	OR	2225	247	348
	8	WA	3429	258	464
1974	4	AK	326	486	540
	15	ID	814	280	354
	32	OR	2286	233	283
	29	WA	3491	244	462

Data Source: Ref. 20, 19, 14 and 6, Bureau of Mines.

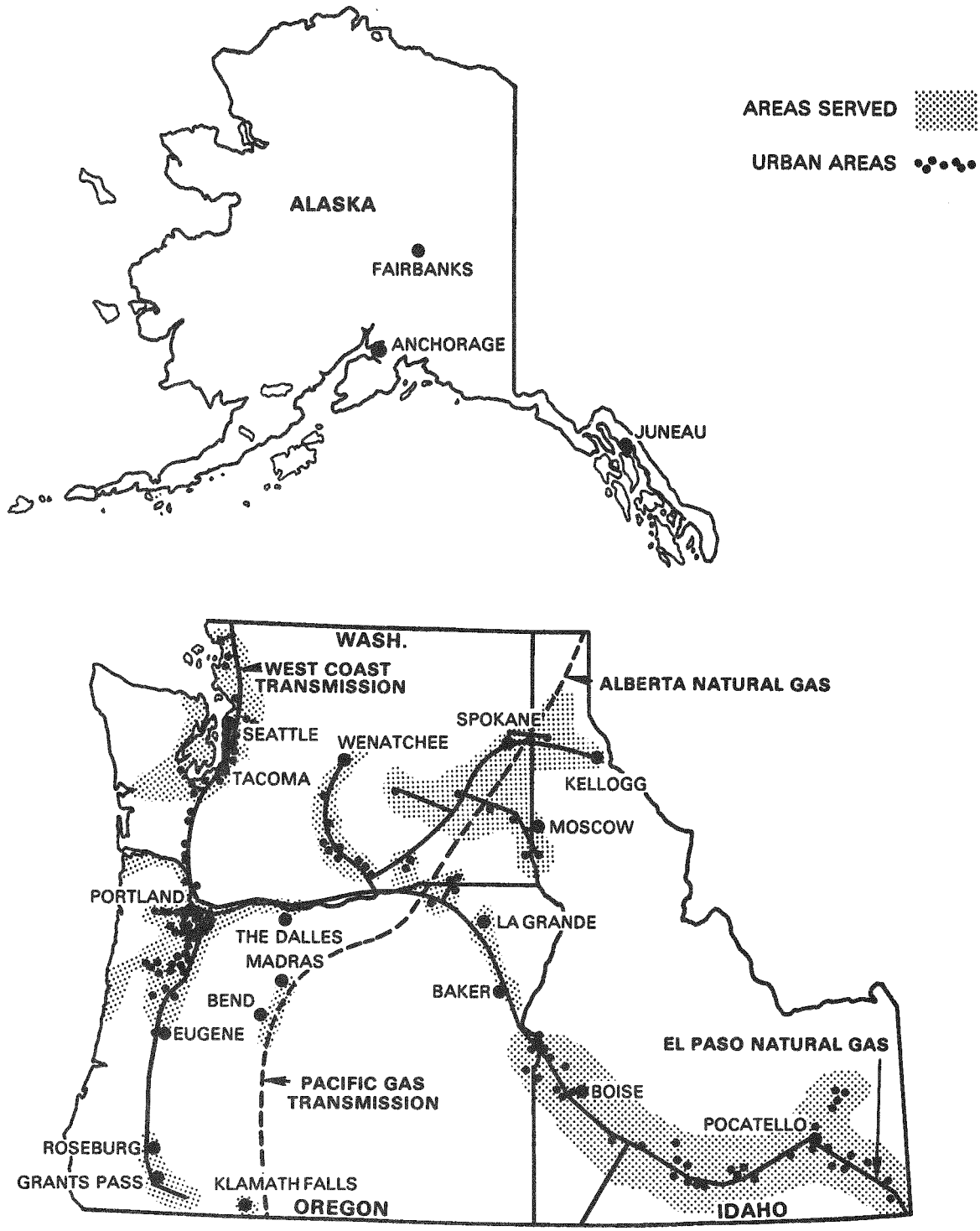


FIGURE I-C-48. Marketing Area - Cities Served by Natural Gas

Data Source: Ref. 38, Atlas of the Pacific Northwest, pl. 73, p. 114.

TABLE I-C-54

1975 RESIDENTIAL CONSUMPTION BY FUEL TYPE

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Distillate Oil and Kerosene: Trillions of Btu	5.40	12.93	16.06	24.89	59.37	2193.52
Liquid Petroleum Gas: Trillions of Btu	0.29	3.02	1.54	1.72	6.57	603.36
Natural Gas: Trillions of Btu	10.73	14.54	29.67	35.45	90.38	4978.48
Anthracite and Bituminous Coal: Trillions of Btu	0.15	1.27	9.11	9.16	1.68	111.97
Electricity Purchased: Trillions of Btu	2.85	12.92	41.78	71.69	129.24	1999.94
Total: Trillions of Btu	19.50	44.69	89.17	133.90	287.25	9887.27
Percentages: Annual Changes in Total	51.20	15.61	10.98	2.96	9.66	0.16
State Total to U.S. Total	9.20	0.45	0.90	1.35	2.91	100.00

Fuels and Units	Al	ID	OR	WA	NW	US
Distillate Oil and Kerosene: Millions of Barrels	0.95	2.22	2.76	4.28	10.21	387.11
Liquid Petroleum Gas: Millions of Barrels	3.05	31.66	16.12	17.97	68.81	6317.94
Natural Gas: Billions of Cu. Ft	10.39	14.09	28.75	34.35	87.58	4824.12
Anthracite and Bituminous Coal: Millions of Short Tons	0.01	0.08	0.01	0.01	0.10	4.35
Electricity Purchased: Billions of kWh	0.83	3.79	12.25	21.01	37.88	586.15
Total: Noncompatible Phy. Units						
Percentages: Annual Changes in Total	51.20	15.61	10.98	2.96	9.66	0.16
State Total to U.S. Total	0.20	0.45	0.90	1.35	2.91	100.00

Data Source: Ref. 38, Federal Energy Data System.

TABLE I-C-55

COMMERCIAL CONSUMPTION BY FUEL TYPE

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline:						
Trillions of Btu	2.19	0.48	1.15	1.97	5.78	94.91
Distillate Oil:						
Trillions of Btu	12.25	6.51	11.13	20.52	50.42	972.74
Residual Oil:						
Trillions of Btu	0.0	3.62	13.87	13.33	30.83	975.13
Liquid Petroleum Gas:						
Trillions of Btu	0.03	0.34	0.17	0.19	0.73	67.04
Natural Gas:						
Trillions of Btu	14.88	12.57	16.40	33.01	76.86	2588.74
Anthracite and Bituminous Coal:						
Trillions of Btu	0.08	0.68	0.06	0.09	0.91	64.25
Electricity Purchased:						
Trillions of Btu	2.76	12.16	27.16	40.50	82.58	1641.31
Asphalt and Road Oil:						
Trillions of Btu	2.17	5.98	21.90	19.75	49.79	1043.19
Total:						
Trillions of Btu	34.35	42.32	91.84	129.37	297.88	7447.30
Percentages:						
Annual Changes in Total	4.87	14.35	2.42	-1.19	2.59	-2.89
State Total to U.S. Total	0.46	0.57	1.23	1.74	4.00	100.00

TABLE I-C-55 (contd)

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline:						
Millions of Gallons	17.49	3.80	9.19	14.76	46.25	759.58
Distillate Oil:						
Millions of Barrels	2.10	1.12	1.91	3.52	8.66	166.99
Residual Oil:						
Millions of Barrels	0.0	0.58	2.21	2.12	4.90	155.10
Liquid Petroleum Gas:						
Millions of Gallons	0.34	3.52	1.79	2.00	7.65	701.99
Natural Gas:						
Billions of Cu. Ft	14.41	12.18	15.90	31.99	74.48	2508.29
Anthracite and Bituminous Coal:						
Millions of Short Tons	0.00	0.04	0.00	0.00	0.06	2.50
Electricity Purchased:						
Billions of kWh	0.81	3.56	7.96	11.87	24.20	481.04
Asphalt and Road Oil:						
Thousands of Short Tons	59.34	163.78	599.95	541.00	1364.07	28582.10
Percentages:						
Annual Changes in Total	4.87	14.35	2.42	-1.19	2.59	-2.89
State Total to U.S. Total	0.46	0.57	1.23	1.74	4.00	100.00

Data Source: Ref. 38, Federal Energy Data System.

TABLE I-C-56

1975 INDUSTRIAL CONSUMPTION BY FUEL TYPE

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline: Trillions of Btu	0.56	4.22	2.95	2.30	10.03	217.84
Distillate Oil: Trillions of Btu	4.22	6.38	11.51	14.75	36.85	510.98
Diesel Fuel: Trillions of Btu	3.35	4.85	2.24	3.31	12.75	285.29
Residual Oil: Trillions of Btu	3.81	0.80	10.61	26.86	42.09	1061.97
Liquid Petroleum Gas: Trillions of Btu	0.52	1.36	1.18	1.09	4.16	364.97
Coal (Excel. Coking Coal): Trillions of Btu	10.50	6.01	1.85	7.35	25.70	1396.54
Coking Coal and Petroleum Coke: Trillions of Btu	0.0	0.0	0.0	16.83	16.83	2836.73
Electricity Purchased: Trillions of Btu	0.67	18.90	41.61	90.12	151.29	2257.23
Feedstocks: Trillions of Btu	18.06	6.77	15.96	71.66	112.46	3822.10
Total: Trillions of Btu	89.09	78.23	151.15	332.21	650.88	21639.55
Percentages: Annual Changes in Total	21.08	0.12	-7.16	-7.67	-3.51	-10.40
State Total to U.S. Total	0.41	0.36	0.70	1.54	3.01	100.00

TABLE I-C-56 (contd)

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline:						
Millions of Gallons	4.46	33.75	23.60	18.42	80.24	1743.38
Distillate Oil:						
Millions of Barrels	0.72	1.09	1.98	2.53	6.33	87.72
Diesel Fuel:						
Millions of Barrels	0.58	0.83	0.38	0.57	2.36	48.98
Residual Oil:						
Millions of Barrels	0.61	0.13	1.69	4.27	6.69	168.92
Liquid Petroleum Gas:						
Millions of Gallons	5.47	14.20	12.39	11.46	43.51	3821.65
Natural Gas:						
Billions of Cu. Ft.	45.95	28.05	61.28	94.89	230.16	8610.39
Coal (Excl. Coking Coal):						
Millions of Short Tons	0.50	0.39	0.10	0.39	1.37	53.98
Coking Coal and Petroleum Coke:						
Noncompatible Phy. Units						
Electricity Purchased:						
Billions of kWh	0.19	5.54	12.19	26.41	44.34	661.56
Feedstocks:						
Millions of Barrels	3.09	1.17	2.70	12.00	18.96	715.91
Percentages:						
Annual Changes in Total	21.08	0.12	-7.16	-7.67	-3.51	-10.40
State Total to U.S. Total	0.41	0.36	0.70	1.54	3.01	100.00

Data Source: Ref. 38, Federal Energy Data System.

TABLE I-C-57

1975 ELECTRIC UTILITIES

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Distillate Oil:						
Trillions of Btu	3.69	0.05	1.89	0.31	5.94	379.81
Residual Oil:						
Trillions of Btu	0.0	0.0	0.25	0.0	0.25	2860.16
Natural Gas:						
Trillions of Btu	20.25	0.02	0.00	0.0	20.27	3247.57
Anthracite and Bituminous Coal:						
Trillions of Btu	4.47	0.0	0.0	58.08	62.55	9286.95
Nuclear Electricity:						
Trillions of Btu	0.0	0.0	0.01	34.73	34.74	1805.19
Hydro Electricity:						
Trillions of Btu	3.71	106.75	358.67	873.94	1343.07	3116.28
Total:						
Trillions of Btu	32.12	106.81	360.83	967.07	1466.83	20695.95
Total Electric Sales:						
Trillions of Btu	6.28	43.98	110.55	202.35	363.17	5913.04
Percentages:						
Annual Changes in Total	14.51	5.75	-4.78	1.18	0.21	4.78
State Total to U.S. Total	0.16	0.52	1.74	4.67	7.09	100.00

TABLE I-C-57 (contd)

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Distillate Oil:						
Millions of Barrels	0.63	0.01	0.33	0.05	1.02	65.20
Residual Oil:						
Millions of Barrels	0.0	0.0	0.04	0.0	0.04	454.93
Natural Gas:						
Billions of Cu. Ft.	19.62	0.02	0.00	0.0	19.64	3146.87
Anthracite and Bituminous Coal:						
Millions of Short Tons	0.26	0.0	0.0	3.72	3.97	431.16
Nuclear Electricity:						
Billions of kWh	0.0	0.0	0.00	3.31	3.31	171.92
Hydro Electricity:						
Billions of kWh	0.36	10.27	34.52	84.12	129.28	299.9[illegible]
Total Electric Sales:						
Billions of kWh	1.84	12.89	32.40	59.31	106.44	1733.01
Percentages:						
Annual Changes in Total	14.51	5.75	-4.78	1.18	0.21	4.78
State Total to U.S. Total	0.16	0.52	1.74	4.67	7.09	100.00

Data Source: Ref. 38, Federal Energy Data System.

TABLE I-C-58

1975 TRANSPORTATION

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline (Excl. Aviation Gas):						
Trillions of Btu	19.25	54.70	147.98	211.49	433.42	12505.40
Aviation Gasoline:						
Trillions of Btu	1.91	0.48	0.70	1.02	4.12	51.19
Distillate and Highway Diesel Oil:						
Trillions of Btu	12.55	13.11	35.64	34.98	96.27	2065.18
Residual Oil:						
Trillions of Btu	3.13	0.0	2.83	13.64	19.60	731.33
Liquid Petroleum Gas:						
Trillions of Btu	0.0	0.21	0.12	0.37	0.70	111.01
Natural Gas:						
Trillions of Btu	0.10	4.37	8.14	6.04	18.64	601.62
Jet Fuel:						
Trillions of Btu	38.85	6.35	9.90	70.13	125.24	1855.45
Electricity Purchased:						
Trillions of Btu	0.01	0.0	0.0	0.04	0.05	14.58
Total:						
Trillions of Btu	75.79	79.22	205.32	337.71	698.03	17935.74
Percentages:						
Annual Changes in Total	7.74	1.70	-0.12	6.66	4.12	1.47
State Total to U.S. Total	0.42	0.44	1.14	1.88	3.89	100.00

TABLE I-C-58 (contd)

Fuel Type	Consumption by Area, Trillions of Btu					
	AL	ID	OR	WA	NW	US
Gasoline (Excl. Aviation Gas):						
Millions of Gallons	154.02	437.78	1164.30	1692.58	3468.68	100080.94
Aviation Gasoline:						
Millions of Gallons	14.27	3.88	5.64	8.18	32.97	409.71
Distillate and Highway Diesel Oil:						
Millions of Barrels	2.15	2.25	6.12	6.00	16.53	354.54
Residual Oil:						
Millions of Barrels	0.50	0.0	0.45	2.17	3.12	116.32
Liquid Petroleum Gas:						
Millions of Gallons	0.0	2.19	1.30	3.84	7.33	1162.40
Natural Gas:						
Billions of Cu. Ft	0.09	4.23	7.89	5.85	18.07	582.96
Jet Fuel:						
Millions of Gallons	296.01	49.37	74.95	533.77	954.09	14145.06
Electricity Purchased:						
Billions of kWh	0.00	0.0	0.0	0.01	0.01	4.27
Percentages:						
Annual Changes in Total	7.74	1.70	-0.12	6.66	4.12	1.47
State Total to U.S. Total	0.42	0.44	1.14	1.88	3.89	100.00

Data Source: Ref. 38, Federal Energy Data System.

DISTILLATE FUEL OILS

TABLE I-C-59

SALES OF DISTILLATE FUEL OILS BY YEAR

Year	Sales by Area, Thousands of bbl					
	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	7,009	7,378	13,245	16,656	44,288	1,043,561
1974	6,270	7,176	14,724	16,345	44,515	1,077,982
1973	6,384	6,297	16,070	20,091	48,842	1,135,063
1972	6,207	5,866	15,467	19,090	46,630	1,074,870
1971	6,352	5,702	14,162	18,621	44,837	971,320
1970	5,082	5,597	12,895	18,188	41,762	927,250
1969	4,869	5,844	13,646	18,201	42,560	900,300
1968	4,757	7,748	13,298	17,792	43,595	873,100
1967	4,353	7,433	13,083	16,459	41,328	829,200
1966	4,049	4,916	13,837	17,910	40,712	809,713
1965	3,733	4,880	13,295	17,390	39,298	786,891
1964	3,482	4,501	13,855	17,997	39,835	747,551
1963	3,076	4,108	12,828	16,791	36,803	748,124
1962	2,897	4,204	11,777	17,057	35,935	729,095
1961	2,849	4,037	11,061	17,532	35,479	690,874
1960	2,616	4,055	10,920	18,045	35,636	683,325
1955		3,706	10,981	17,767	32,454	581,127
1950		1,770	7,725	12,954	22,449	395,306

Data Source: Reference 8, Basic Petroleum Data Book.

RESIDUAL FUEL OILS

TABLE I-C-60

SALES OF RESIDUAL FUEL OILS (ALL USES) BY YEAR

	Sales by Area, Thousands of bbl					
Year	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	1,101	703	4,381	8,563	14,754	895,277
1974	1,098	597	6,650	10,395	18,740	957,811
1973	1,051	243	7,439	10,986	19,719	1,030,177
1972	1,166	246	7,977	11,812	21,201	925,647
1971	1,043	276	6,538	9,288	17,145	838,044
1970	1,034	276	6,679	10,368	18,357	804,287
1969	1,056	402	6,796	11,011	19,265	722,529
1968	913	206	6,735	11,832	19,686	669,484
1967	840	137	5,517	9,370	15,864	639,539
1966	939	208	5,617	9,555	16,319	613,972
1965	863	344	4,931	8,824	14,962	574,118
1964	800	433	5,314	8,807	15,354	556,613
1963	742	260	4,930	7,625	13,557	538,522
1962	715	223	4,989	7,626	13,553	548,433
1961	641	422	4,879	7,545	13,487	542,986
1960	695	201	5,453	9,179	15,528	550,536
1955	N/A	1,421	10,152	16,405	27,978	556,983
1950	N/A	629	12,429	13,715	26,773	554,208

Data Source: Reference 8, Basic Petroleum Data Book.

GASOLINE USE BY COUNTY

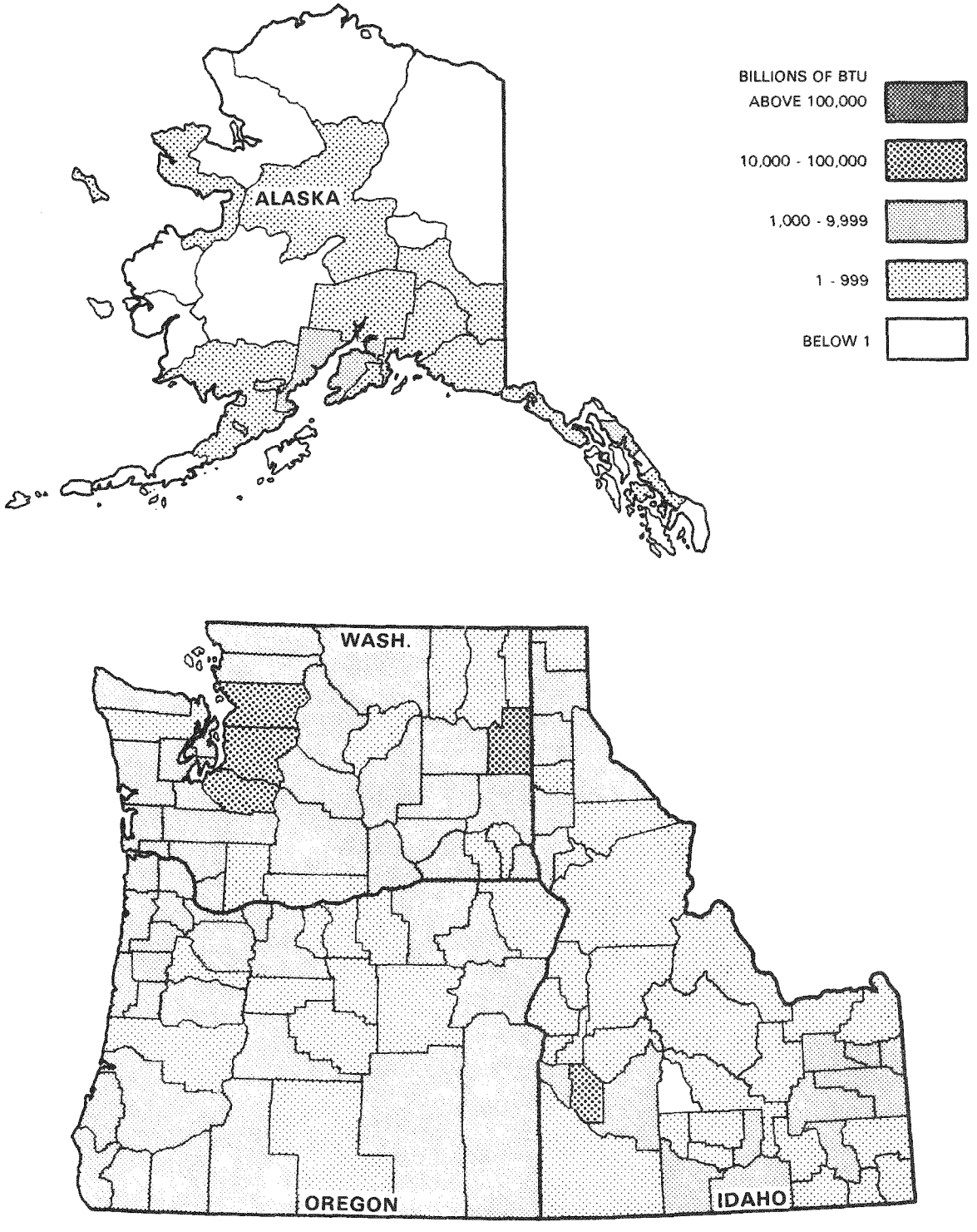


FIGURE I-C-49. Gasoline Use by County

Data Source: Ref. 5, Energetics of the USA, p. 43.

MOTOR GASOLINE

TABLE I-C-61

MOTOR GASOLINE CONSUMPTION BY YEAR

Year	Consumption by Area, Thousands of gal					
	Alaska	Idaho	Oregon	Washington	Regional	U.S.
1975	193,725	482,462	1,224,649	1,732,017	3,632,853	104,271,488
1974	163,070	457,785	1,187,671	1,666,944	3,475,470	101,855,749
1973	123,995	468,321	1,239,689	1,716,314	3,548,319	104,579,479
1972	111,594	451,315	1,191,714	1,647,546	3,402,169	100,068,575
1971	92,064	421,403	1,116,118	1,577,951	3,207,536	93,907,352
1970	90,489	400,735	1,056,737	1,534,060	3,082,021	89,405,266
1969	86,603	379,479	995,103	1,477,305	2,938,490	35,415,920
1968	77,905	353,990	943,803	1,404,704	2,780,402	80,867,012
1967	68,157	343,979	900,083	1,313,146	2,625,365	76,139,326
1966	64,478	329,895	872,869	1,232,598	2,499,840	73,638,872
1965	63,788	321,015	835,390	1,142,082	2,362,276	70,337,126
1964	56,075	308,333	793,407	1,090,828	2,248,643	67,663,848
1963	51,577	297,597	748,510	1,048,248	2,145,932	64,779,104
1962	49,644	294,826	721,548	1,040,286	2,106,304	62,531,373

Data Source: Reference 8, Basic Petroleum Data Book.

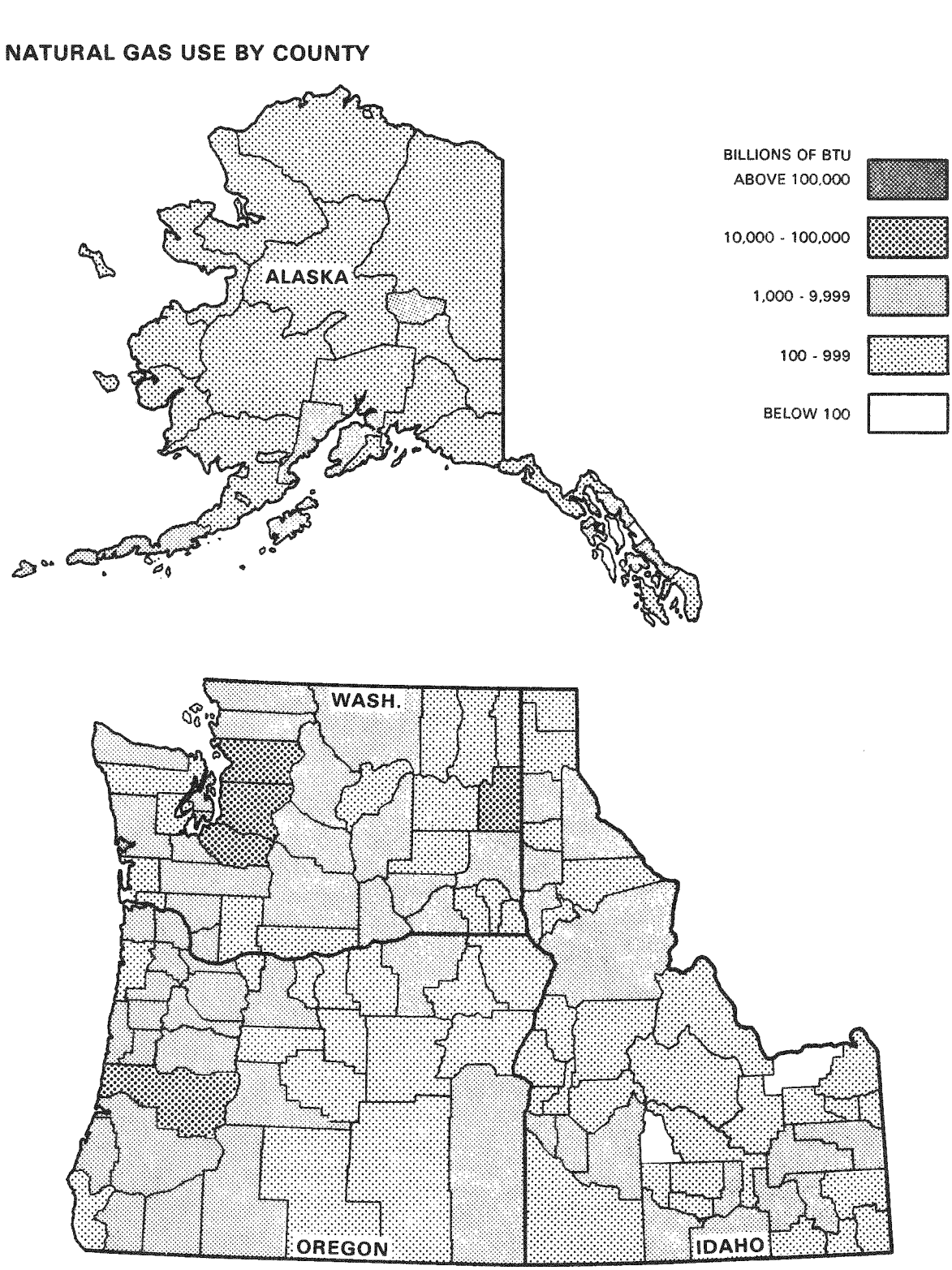


FIGURE I-C-50. Natural Gas Use by County

Data Source: Ref. 5, Energetics of the USA, p. 41.

TABLE I-C-62

REGIONAL NATURAL GAS CONSUMPTION BY YEAR

Year	Consumption Sector, MMCF					
	Residential	Commercial	Industrial	Electric	Other	Total
1975	87,580	67,526	201,760	19,640	6950	383,456
1974	71,240	60,099	208,955	17,443	7669	365,406
1973	73,710	58,270	228,489	18,907	9449	388,825
1972	81,243	55,168	205,973	13,493	9339	364,216
1971	70,499	47,146	193,859	10,600	9521	331,625
1970	65,593	40,855	194,360	9,208	9365	317,381
1969	62,539	37,451	184,744	7,082	9311	299,127
1968	50,306	32,640	172,439	6,162	2565	265,112
1967	44,724	29,427	164,489	4,639		243,279
1966	40,453	26,483	158,170	3,754		228,860
1965	34,574	23,582	144,632	2,196		204,984
1964	34,256	23,626	136,578	1,919		196,379
1963	25,954	18,020	116,480	579		161,033
1962	21,634	15,895	109,210	500		147,239
1961	18,432	13,567	96,697	572		129,268
1960	17,139	12,377	88,514	700		118,730

Data Source: Reference 13, Minerals Yearbook, Volume I, 1977.

TABLE I-C-63

ALASKA NATURAL GAS CONSUMPTION BY YEAR

Year	Consumption Sector, MMCF					
	Residential	Commercial	Industrial	Electric	Other	Total
1975	10,393	8,475	22,388	19,619	5,940	66,815
1974	4,163	7,119	13,976	17,117	5,987	48,362
1973	5,024	5,681	14,985	15,400	6,596	47,686
1972	8,394	9,106	12,328	13,085	6,905	49,818
1971	6,893	7,534	10,628	10,260	6,722	42,037
1970	6,211	6,374	14,744	8,198	6,145	41,672
1969	4,573	5,218	13,563	6,618	5,800	35,862
1968	2,293	3,057	2,677	5,625	1,656	15,308
1967	1,958	2,722	2,891	4,318		11,889
1966	1,794	2,562	2,796	3,632		10,784
1965	1,437	2,270	1,132	2,083		6,922
1964	1,045	1,925	1,213	1,598		5,781
1963	685	1,614	1,915			4,214
1962	537	18	1,582			2,137
1961	188	118	251			557
1960	170		59			229

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-64

IDAHO NATURAL GAS CONSUMPTION BY YEAR

Year	Consumption Sector, MMCF					
	Residential	Commercial	Industrial	Electric	Other	Total
1975	14,089	11,493	29,898	18	684	56,182
1974	9,652	7,219	31,322	60	821	49,084
1973	9,947	7,845	32,062		1,547	51,396
1972	10,889	8,838	30,309		1,874	51,908
1971	8,455	6,779	28,293		1,453	44,980
1970	7,711	5,851	28,805			42,367
1969	6,980	5,325	25,465		1,288	39,078
1968	6,545	5,828	24,637		546	37,556
1967	6,179	4,972	23,132			34,283
1966	5,476	4,609	26,019			36,104
1965	4,889	5,062	23,938			33,889
1964	4,767	4,080	21,978			30,825
1963	3,612	3,887	19,136			26,635
1962	3,185	4,371	18,250			25,806
1961	2,656	3,216	18,097			23,969
1960	2,181	2,794	17,031			22,006

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-65

OREGON NATURAL GAS CONSUMPTION BY YEAR

Year	Consumption Sector, MMCF					
	Residential	Commercial	Industrial	Electric	Other	Total
1975	28,749	15,896	57,332	3		101,980
1974	21,900	13,401	55,183	266		90,750
1973	22,271	13,434	59,745	3,507	288	99,245
1972	23,331	14,138	62,167	408	392	100,436
1971	21,217	12,417	58,964	340	1,146	94,084
1970	19,742	10,394	57,664	1,010	966	89,776
1969	20,507	9,965	53,271	464		84,207
1968	15,126	7,827	51,755	537	47	75,292
1967	13,427	6,912	49,217	321		69,877
1966	12,714	6,577	45,680	122		65,093
1965	10,863	5,592	39,497	113		56,065
1964	11,172	5,315	37,176	321		53,984
1963	9,084	4,179	29,508	579		43,350
1962	7,977	3,562	25,826	500		37,865
1971	7,088	3,259	23,480	572		34,399
1960	6,787	3,106	20,964	700		31,561

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-66

WASHINGTON NATURAL GAS CONSUMPTION BY YEAR

Year	Consumption Sector, MMCF					
	Residential	Commercial	Industrial	Electric	Other	Total
1975	34,349	31,662	92,142		326	158,479
1974	35,525	32,360	108,464		861	177,210
1973	36,468	31,310	121,697		1,023	190,498
1972	38,631	23,086	101,169		168	163,054
1971	33,934	20,416	95,974		200	150,524
1970	31,929	18,236	93,147		254	143,566
1969	30,479	16,943	92,335		223	139,980
1968	26,342	15,928	93,370		316	135,956
1967	23,160	14,821	89,249			127,230
1966	20,467	12,735	83,675			116,879
1965	17,385	10,658	80,065			108,108
1964	17,272	12,306	76,211			105,789
1963	12,573	8,340	65,921			86,834
1962	9,935	7,944	63,552			81,431
1961	8,500	6,974	54,869			70,343
1960	8,001	6,477	50,456			64,934

Data Source: Reference 13, Minerals Yearbook.

COAL USE BY COUNTY

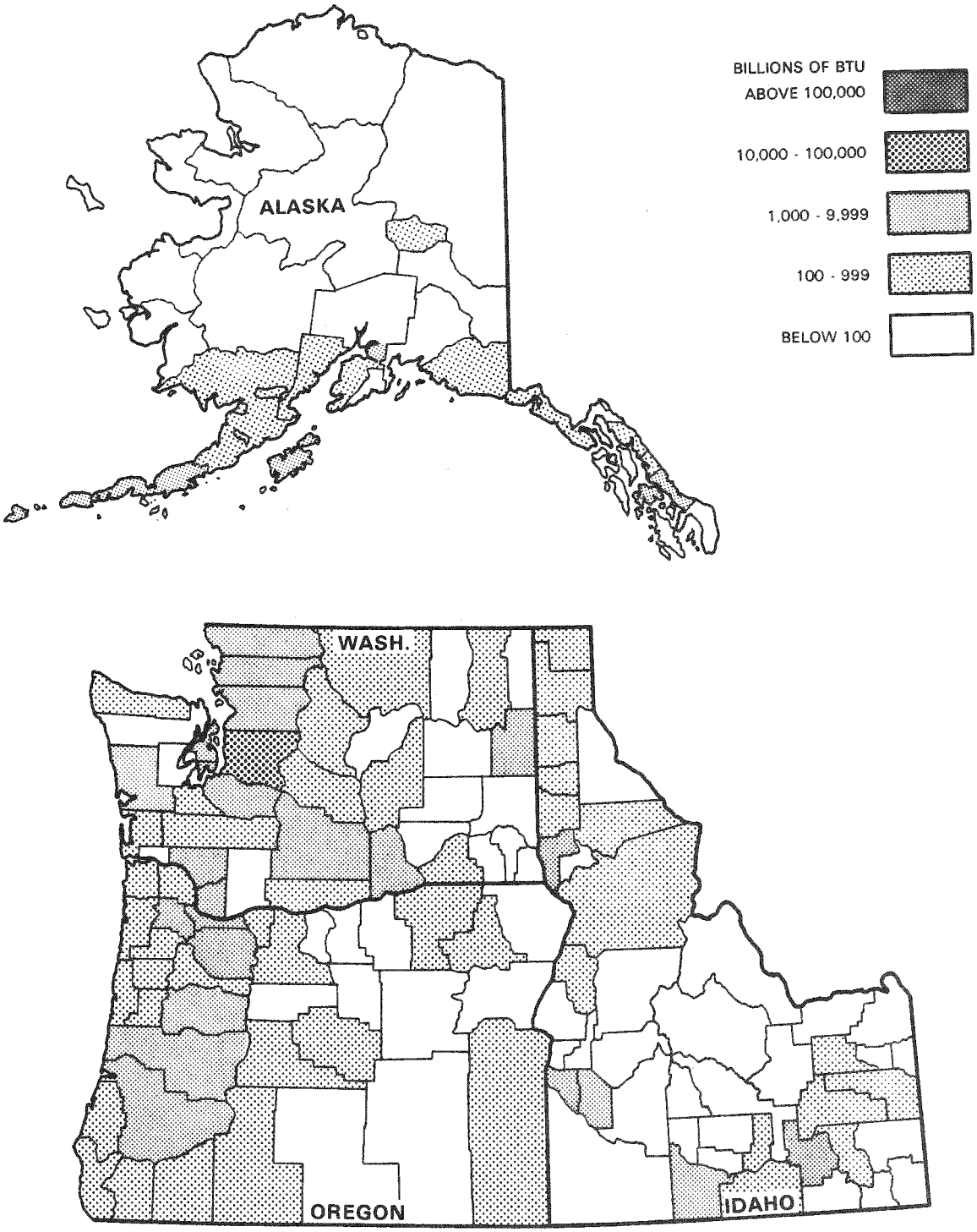


FIGURE I-C-51. Coal Use by County

Data Source: Ref. 5, Energetics of the USA, p. 37.

TABLE I-C-67

REGIONAL COAL CONSUMPTION BY YEAR

Year	Consumption Sector, Thousands of Tons			
	Electric	Retail	Other	Total
1975	3975	158	1374	5507
1974	4152	168	1158	5478
1973	3477	153.2	1029.3	4659.5
1972	2861	169.9	987	4017.9
1971	1344	209.6	1271.5	2825.1
1970	151	131	1004.7	1286.7
1969	139	174.3	1228.2	1541.5
1968	132	239.1	1509.2	1880.3
1967	135	236.3	1692.3	2063.6
1966	204	246.3	1686.1	2136.4
1965	434	274.7	1564.3	2273
1964	354	307.5	1743.4	2404.9
1963	336	289.5	1744.8	2370.3
1962	289	327.0	1957.4	2573.4
1961	206	310.3	1874.9	2391.2
1960	412	304.1	1630.8	2346.9

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-68

ALASKA COAL CONSUMPTION BY YEAR

Year	Consumption Sector, Thousands of Tons			
	Electric	Retail	Other	Total
1975	257	11	500	768
1974	262	12	416	690
1973	231	13	463	707
1972	264	27	411	702
1971	261	19	468	748
1970	151	27	434	612
1969	139	33	500	672
1968	132	37	635	804
1967	135	43	774	952
1966	204	44	610	858
1965	434	40	315	789
1964	354	44	444	842
1963	336	53	466	855
1962	289	76	528	893
1961	206	66	438	710
1960	412	66	242	720

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-69

IDAHO COAL CONSUMPTION BY YEAR

Year	Consumption Section, Thousands of Tons			
	Electric	Retail	Other	Total
1975		125	386	511
1974		137	335	472
1973		128.4	314	442.4
1972		130.9	320	450.9
1971		172.8	422.4	595.2
1970		87.3	213.4	300.7
1969		121.2	296.4	417.6
1968		182	445.3	627.3
1967		169.2	401.5	570.7
1966		171.7	419.8	591.5
1965		199.1	486.9	686
1964		229	560	789
1963		199.5	487.8	687.3
1962		208	508.4	716.4
1961		200	499.1	689.1
1960		195.6	478.3	673.9

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-70

OREGON COAL CONSUMPTION BY YEAR

Year	Consumption Sector, Thousands of Tons			
	Electric	Retail	Other	Total
1975		9	98	107
1974		9	140	149
1973		5.6	86.8	92.4
1972		5.7	88	93.7
1971		8.4	131.1	139.5
1970		7.9	122.9	130.8
1969		9.5	148.5	158
1968		9.5	147.5	157
1967		11.4	177.8	189.2
1966		14.5	225.7	240.2
1965		16.8	262.2	279
1964		16.3	254.3	270.6
1963		17.5	272.0	289.5
1962		20.3	316.8	337.1
1961		21.0	326.0	347.0
1960		20.1	313.2	333.3

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-71

WASHINGTON COAL CONSUMPTION BY YEAR

	Consumption Sector, Thousands of Tons			
Year	Electric	Retail	Other	Total
1975	3718	13	390	4121
1974	3890	10	267	4167
1973	3246	6.2	165.5	3417.7
1972	2597	6.3	168	2771.3
1971	1083	9.4	250	1342.4
1970		8.8	234.4	243.2
1969		10.6	283.3	293.9
1968		10.6	281.4	292
1967		12.7	339	251.7
1966		16.1	430.6	446.7
1965		18.8	500.2	519
1964		18.2	486.1	503.3
1963		19.5	519.0	538.5
1962		22.7	604.2	626.9
1961		23.3	621.8	645.1
1960				

Data Source: Reference 13, Minerals Yearbook.

TABLE I-C-72

REGIONAL AND U.S. ELECTRIC CONSUMPTION BY YEAR

	Consumption Sector, Millions of kWh						
Year	Domestic	Irrigation	Commercial	Industrial	Other	Total	U.S.
1975	38,857	5,002	18,140	47,438	2,267	111,704	1,733,024
1974	35,719	4,937	16,405	50,385	2,293	109,739	1,700,769
1973	34,845	4,527	16,436	46,578	2,710	105,096	1,703,203
1972	33,713	3,853	15,643	45,499	2,001	100,709	1,577,714
1971	31,865	3,542	14,491	42,361	1,744	94,004	1,466,441
1970	29,075	3,547	13,334	44,060	1,447	91,463	1,391,359
1969	27,947	3,362	12,396	44,055	1,498	89,258	1,307,178
1968	25,137	3,193	11,145	39,953	1,353	80,781	1,202,321
1967	22,939	3,101	10,322	37,561	1,271	75,194	1,107,023
1966	21,751	3,151	9,538	34,374	1,189	70,003	1,038,982
1965	20,503	2,505	8,773	32,055	1,100	64,936	953,414
1964	19,939	2,390	8,103	29,780	1,032	61,244	890,356
1963	18,505	2,147	7,489	27,228	974	56,344	830,811
1962	17,632	1,993	6,965	25,465	943	52,998	776,088
1961	16,386	1,971	6,393	24,188	892	49,830	720,728

Data Source: Reference 39, Regional totals derived from state data. U.S. total from Edison Electric Institute.

ELECTRIC

TABLE I-C-73

ALASKA ELECTRIC CONSUMPTION BY YEAR

	Consumption Sector, Millions of kWh					
Year	Domestic	Irrigation	Commercial	Industrial	Other	Total
1975	834	0	734	197	74	1,839
1974	765	0	644	154	150	1,713
1973	743	0	625	144	127	1,639
1972	562	0	486	123	108	1,279
1971	543	0	465	109	95	1,212
1970	465	0	413	100	76	1,054
1969	417	0	377	93	69	956
1968	366	0	324	87	64	841
1967	348	0	307	84	47	786
1966	303	0	273	84	34	694
1965	277	0	244	68	27	616
1964	253	0	223	61	25	562
1963	233	0	203	53	27	516
1962	215	0	173	28	24	440
1961	178	0	134	33	20	365

Data Source: Reference 36, Statistical Yearbook of the Electric Utility Industry.

Note: Transformation from EEI Consuming Sectors to BPA Sectors as: Domestic (BPA) = Residential (EEI), Irrigation = 0, Commercial = Small Light, Industrial - Large Light + Railroad, Other = Street & Highway + Other Public + Interdepartmental.

TABLE I-C-74

IDAHO ELECTRIC CONSUMPTION BY YEAR

Year	Consumption Sector, Millions of kWh					
	Domestic	Irrigation	Commercial	Industrial	Other	Total
1975	4,074	1,942	1,755	5,288	102	13,161
1974	3,591	2,108	1,779	5,241	120	12,839
1973	3,314	1,729	1,697	5,199	433	12,372
1972	3,010	1,573	1,594	5,274	134	11,585
1971	2,752	1,403	1,516	4,810	69	10,550
1970	2,485	1,332	1,410	4,784	55	10,066
1969	2,305	1,437	1,303	4,784	50	9,879
1968	2,155	1,246	1,173	4,634	49	9,257
1967	1,994	1,225	1,091	4,040	48	8,398
1966	1,900	1,330	1,023	3,831	45	8,129
1965	1,836	961	941	3,533	44	7,315
1964	1,799	923	782	3,197	35	6,736
1963	1,701	815	747	3,211	35	6,509
1962	1,650	818	698	3,066	41	6,273
1961	1,572	838	655	2,970	38	6,073
1960	1,516	735	644	2,429	41	5,365
1955	1,107	389	442	1,811	29	3,778

Data Source: Reference 39, Historical Sales Data in the Pacific Northwest Area by State: 1950, 1955, 1964-1975.

Note: This source does not cover Alaska. Only Idaho differs from Basic BPA data due to the inclusion of Utah Power and Light information.

ELECTRIC

TABLE I-C-75

OREGON ELECTRIC CONSUMPTION BY YEAR

Year	Consumption Sector, Millions of kWh					
	Domestic	Irrigation	Commercial	Industrial	Other	Total
1975	12,479	768	6,755	13,108	282	33,392
1974	11,686	663	5,870	13,920	320	32,459
1973	11,471	557	5,931	12,737	342	31,038
1972	11,086	460	5,738	11,597	333	29,214
1971	10,568	380	5,226	11,682	325	28,181
1970	9,574	394	4,808	11,342	340	26,458
1969	9,283	325	5,586	11,169	331	25,594
1968	8,394	322	4,089	10,735	296	23,836
1967	7,818	290	3,842	9,838	293	22,081
1966	7,526	255	3,571	9,330	302	20,984
1965	7,065	204	3,286	8,674	289	19,518
1964	6,918	189	3,089	7,742	276	18,214
1963	6,346	159	2,816	6,624	261	16,206
1962	5,970	155	2,555	6,601	260	15,541
1961	5,569	123	2,349	6,485	257	14,783
1960	5,348	107	2,189	6,297	212	14,153
1955	3,705	78	1,497	4,020	143	9,443
1950	2,133	20	1,007	2,779	155	6,094

Data Source: Reference 39, Historical Sales Data in the Pacific Northwest Area by State: 1950, 1960-1975.

Note: This source does not cover Alaska.

ELECTRIC

TABLE I-C-76

WASHINGTON ELECTRIC CONSUMPTION BY YEAR

	Consumption Sector, Millions of kWh					
Year	Domestic	Irrigation	Commercial	Industrial	Other	Total
1975	21,470	2,292	8,896	28,845	1,809	63,312
1974	19,677	2,166	8,112	31,070	1,703	62,728
1973	19,317	2,241	8,183	28,498	1,808	60,047
1972	19,055	1,820	7,825	28,505	1,426	58,631
1971	18,003	1,759	7,284	25,760	1,255	54,061
1970	16,551	1,821	6,703	27,884	976	53,895
1969	15,942	1,600	6,230	28,004	1,048	52,829
1958	14,222	1,625	5,559	24,497	944	46,817
1957	12,779	1,586	5,082	23,599	883	43,929
1966	12,022	1,566	4,671	21,129	808	40,196
1965	11,325	1,340	4,302	19,780	740	37,487
1965	10,969	1,278	4,009	18,780	696	35,732
1963	10,226	1,173	3,723	17,340	651	33,113
1962	9,797	1,020	3,539	15,770	618	30,744
1961	9,067	1,010	3,255	14,700	577	28,609
1960	8,710	891	2,997	14,496	549	27,643
1955	6,005	813	2,116	13,661	575	23,170
1950	3,544	86	1,463	8,063	469	13,625

Data Source: Reference 39, Historical Sales Data in the Pacific Northwest Area by State: 1950, 1955, 1960-1975.

Note: This source does not cover Alaska.

CONSUMPTION TRENDS

TABLE I-C-77

RATES OF GROWTH IN ENERGY CONSUMPTION, 1964-1974

Area; Energy Type	%/yr
Washington	
Electricity	5.79
Natural Gas	5.29
Oil	2.04
Coal	----
Wood	----(a)
Total Washington	3.52
Oregon	
Electricity	5.95
Natural Gas	5.36
Oil	2.98
Coal	----
Wood	----(a)
Total Oregon	3.96
Idaho	
Electricity	6.66
Natural Gas	4.75
Oil	4.70
Coal	----
Wood	----(a)
Total Idaho	5.08
Pacific Northwest	
Electricity	5.94
Natural Gas	5.23
Oil	2.72
Coal	----
Wood	----(a)
Total PNW	3.88

(a) Excludes coal and wood

Data Source: Reference 3, Energy Futures Northwest, p. 56.

TABLE I-C-78

RESIDENTIAL CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Distillate Oil and Kerosene:	3.87	5.32	4.30	5.13	5.46	5.49
Liquid Petroleum Gas:	0.33	0.38	0.40	0.56	0.35	0.29
Natural Gas:	6.41	7.11	8.66	5.18	4.30	10.73
Anthracite and Bituminous Coal:	0.38	0.28	0.38	0.19	0.18	0.15
Electricity Purchased:	1.59	1.85	1.92	2.54	2.61	2.85
Total:	12.58	14.94	15.65	13.60	12.90	19.50
Idaho						
Distillate Oil and Kerosene:	12.62	12.20	12.34	12.39	12.29	12.93
Liquid Petroleum Gas:	3.02	3.35	3.90	3.45	3.34	3.02
Natural Gas:	7.96	8.73	11.24	10.27	9.96	14.54
Anthracite and Bituminous Coal:	2.76	3.12	2.06	2.18	1.49	1.27
Electricity Purchased:	8.21	8.87	9.66	10.77	11.58	12.92
Total:	34.57	36.26	39.20	39.06	38.65	44.69

TABLE I-C-78

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Distillate Oil and Kerosene:	22.08	22.29	21.77	18.46	15.46	16.06
Liquid Petroleum Gas:	3.68	4.01	3.43	3.03	2.71	1.54
Natural Gas:	20.37	21.90	24.08	22.98	22.60	29.67
Anthracite and Bituminous Coal:	0.70	0.78	0.56	0.19	0.12	0.11
Electricity Purchased:	32.04	35.32	37.24	38.70	39.46	41.78
Total:	78.88	84.30	87.07	83.37	80.34	89.17
Washington						
Distillate Oil and Kerosene:	38.05	37.87	34.14	30.46	24.09	24.89
Liquid Petroleum Gas:	4.86	4.89	3.72	3.25	2.92	1.72
Natural Gas:	32.95	35.02	39.87	37.63	36.66	35.45
Anthracite and Bituminous Coal:	0.78	0.87	0.62	0.21	0.13	0.16
Electricity Purchased:	55.36	60.42	63.68	64.21	66.25	71.69
Total:	132.01	139.07	142.03	135.78	130.05	133.90

TABLE I-C-78
(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Distillate Oil and Kerosene:	76.63	77.68	72.55	66.44	57.30	59.37
Liquid Petroleum Gas:	11.90	12.64	11.45	10.30	9.32	6.57
Natural Gas:	67.69	72.75	83.84	76.07	73.52	90.38
Anthracite and Bituminous Coal:	4.62	5.04	3.61	2.78	1.91	1.68
Electricity Purchased:	97.19	106.47	112.49	116.22	119.90	129.24
Total:	258.03	274.57	283.95	271.80	261.94	287.25
United States						
Distillate Oil and Kerosene:	2592.24	2561.72	2596.93	2520.09	2261.27	2193.52
Liquid Petroleum Gas:	650.53	69.09	709.37	674.36	621.50	603.36
Natural Gas:	4992.22	5130.78	5290.00	5035.49	4939.27	4978.48
Anthracite and Bituminous Coal:	316.04	253.22	205.20	184.86	155.69	111.97
Electricity Purchased:	1527.88	1634.62	1744.97	1890.83	1893.52	1999.94
Total:	10078.91	10078.91	10546.46	10304.62	9871.25	9887.27

Data Source: Reference 38, Federal Energy Data System.

TABLE I-C-79

COMMERCIAL CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Gasoline:	1.30	0.60	2.38	2.11	2.16	2.19
Distillate Oil:	9.47	13.21	10.74	12.92	12.51	12.25
Residual Oil:	0.22	0.14	0.13	0.08	0.07	0.0
Liquid Petroleum Gas:	0.04	0.04	0.04	0.06	0.04	0.03
Natural Gas:	12.92	14.71	16.52	12.67	13.53	14.88
Anthracite and Bituminous Coal:	0.21	0.15	0.20	0.10	0.09	0.08
Electricity Purchased:	1.67	1.91	2.03	2.57	2.71	2.76
Asphalt and Road Oil:	1.93	2.05	2.26	1.68	1.65	2.17
Total:	27.76	32.81	34.31	32.19	32.76	34.35
Idaho						
Gasoline:	0.34	0.36	0.36	0.40	0.43	0.48
Distillate Oil:	6.10	5.86	5.71	5.76	5.93	6.51
Residual Oil:	0.74	0.96	1.06	1.04	3.03	3.62
Liquid Petroleum Gas:	0.34	0.37	0.43	0.38	0.37	0.34
Natural Gas:	6.04	8.50	11.05	9.69	8.30	12.57
Anthracite and Bituminous Coal:	1.49	1.68	1.11	1.17	0.80	0.68
Electricity Purchased:	8.69	9.21	9.84	10.81	11.88	12.16
Asphalt and Road Oil:	7.98	7.09	8.44	7.59	6.27	5.98
Total:	31.72	34.02	38.01	36.84	37.01	42.32

TABLE I-C-79

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Gasoline:	1.31	1.26	1.21	1.12	1.12	1.15
Distillate Oil:	15.73	16.15	15.92	13.53	10.58	11.13
Residual Oil:	20.79	24.70	28.37	23.93	22.24	13.87
Liquid Petroleum Gas:	0.41	0.45	0.38	0.34	0.30	0.17
Natural Gas:	11.72	14.00	14.99	14.16	13.83	16.40
Anthracite and Bituminous Coal:	0.38	0.42	0.30	0.10	0.06	0.06
Electricity Purchased:	19.59	20.91	22.95	24.34	24.12	27.16
Asphalt and Road Oil:	15.27	18.88	21.75	19.62	17.41	21.90
Total:	85.20	96.76	105.88	97.14	89.67	91.84
Washington						
Gasoline:	1.61	1.69	1.71	1.77	1.93	1.97
Distillate Oil:	32.54	32.38	29.53	26.46	19.62	20.52
Residual Oil:	23.44	23.71	27.81	22.31	18.87	13.33
Liquid Petroleum Gas:	0.54	0.54	0.41	0.36	0.32	0.19
Natural Gas:	19.08	21.27	24.00	33.37	34.28	33.01
Anthracite and Bituminous Coal:	0.42	0.47	0.33	0.12	0.07	0.09
Electricity Purchased:	32.92	34.64	36.78	38.63	37.33	40.50
Asphalt and Road Oil:	16.48	16.33	20.67	22.93	18.49	19.75
Total:	127.04	131.02	141.25	145.94	130.92	129.37

TABLE I-C-79

(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Gasoline:	4.56	3.90	5.67	5.39	5.64	5.78
Distillate Oil:	63.83	67.60	61.91	58.68	48.65	50.42
Residual Oil:	45.20	49.50	57.37	47.35	44.22	30.83
Liquid Petroleum Gas:	1.32	1.40	1.27	1.14	1.04	0.73
Natural Gas:	49.76	58.48	66.57	69.89	69.94	76.86
Anthracite and Bituminous Coal:	2.49	2.71	1.95	1.50	1.03	0.91
Electricity Purchased:	62.87	66.67	71.60	76.35	76.04	82.58
Asphalt and Road Oil	41.67	44.34	53.12	51.81	43.83	49.79
Total:	271.71	294.60	319.45	312.11	290.37	297.88
United States						
Gasoline:	96.47	93.62	96.50	95.47	89.48	94.91
Distillate Oil:	987.52	997.18	1054.78	1054.53	976.62	972.74
Residual Oil:	1168.32	1144.62	1201.51	1208.69	1087.00	975.13
Liquid Petroleum Gas:	72.28	73.23	78.82	74.93	69.06	67.04
Natural Gas:	2475.25	2589.26	2691.43	2680.14	2637.39	2588.74
Anthracite and Bituminous Coal:	176.91	143.07	114.90	104.75	88.52	64.25
Electricity Purchased:	1250.18	1331.10	1441.17	1561.36	1542.61	1641.31
Asphalt and Road Oil:	1148.42	1152.09	1185.87	1305.06	1178.37	1043.19
Total:	7374.34	7524.17	7865.98	8084.92	7669.04	7447.30

Data Source: Reference 38, Federal Energy Data System.

TABLE I-C-80

INDUSTRIAL CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Gasoline:	0.56	1.03	4.44	0.61	0.50	0.56
Distillate Oil:	4.78	4.10	3.08	3.12	5.72	4.22
Diesel Fuel:	3.64	3.68	2.42	1.88	1.16	3.35
Residual Oil:	5.30	4.94	5.66	4.41	4.69	3.81
Liquid Petroleum Gas:	0.24	0.28	0.33	0.25	0.30	0.52
Natural Gas:	23.55	23.39	31.67	33.52	30.79	47.42
Coal (Excl. Coking Coal):	9.51	10.54	8.94	10.46	9.34	10.50
Coking Coal and Petroleum Coke:	0.0	0.0	0.0	0.0	0.0	0.0
Electricity Purchased:	0.34	0.37	0.42	0.49	0.52	0.67
Feedstocks:	18.20	18.21	18.89	20.14	20.56	18.06
Total:	66.13	66.54	75.85	74.86	73.58	89.09

TABLE I-C-80

(contd)

Area	Consumption, Trillions of Btu					
Idaho	1970	1971	1972	1973	1974	1975
Gasoline:	3.30	4.38	2.90	5.02	3.54	4.22
Distillate Oil:	4.01	4.51	5.00	5.60	3.39	6.38
Diesel Fuel:	3.82	4.02	3.94	4.21	4.39	4.85
Residual Oil:	0.98	0.78	0.49	0.49	0.72	0.80
Liquid Petroleum Gas:	0.87	0.96	1.27	0.93	1.21	1.36
Natural Gas:	31.01	30.70	35.24	32.73	32.37	28.94
Coal (Excl. Coking Coal):	3.15	3.92	4.39	4.29	5.59	6.01
Coking Coal and Petroleum Coke:	0.0	0.0	0.0	0.0	0.0	0.0
Electricity Purchased:	16.89	16.93	18.64	18.42	18.96	18.90
Feedstocks:	6.99	7.01	7.24	7.80	7.95	6.77
Total:	71.03	73.20	79.12	79.49	78.14	78.23

TABLE I-C-80

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Gasoline:	3.81	3.19	3.34	3.19	3.06	2.95
Distillate Oil:	7.60	8.61	10.59	11.78	9.97	11.51
Diesel Fuel:	3.10	3.22	5.73	6.26	2.69	2.24
Residual Oil:	13.99	12.95	19.95	20.92	17.48	10.61
Liquid Petroleum Gas:	0.90	0.93	1.03	0.98	1.43	1.18
Natural Gas:	63.05	62.85	69.02	68.86	63.17	63.24
Coal (Excl. Coking Coal):	2.97	3.17	1.95	1.56	2.76	1.85
Coking Coal and Petroleum Coke:	0.0	0.0	0.0	0.0	0.0	0.0
Electricity Purchased:	37.51	38.28	36.60	40.15	44.22	41.61
Feedstocks:	16.02	16.60	18.26	18.31	18.02	15.96
Total:	148.95	149.79	166.47	165.01	162.80	151.15

TABLE I-C-80

(contd)

Area	Consumption, Trillions of Btu					
Washington	1970	1971	1972	1973	1974	1975
Gasoline:	2.91	2.70	2.80	2.50	2.21	2.30
Distillate Oil:	10.02	9.52	12.38	16.12	13.29	14.75
Diesel Fuel:	3.66	3.92	6.48	6.96	3.64	3.31
Residual Oil:	28.98	27.30	39.92	39.11	37.81	26.86
Liquid Petroleum Gas:	1.10	1.15	1.29	0.99	1.29	1.09
Natural Gas:	98.41	101.84	113.41	126.70	113.61	97.93
Coal (Excl. Coking Coal):	5.66	6.04	3.71	2.98	5.27	7.35
Coking Coal and Petroleum Coke:	9.89	9.76	10.51	12.40	12.12	16.83
Electricity Purchased:	86.17	82.85	88.38	84.38	92.95	90.12
Feedstocks:	70.21	73.12	81.38	78.63	77.61	71.66
Total:	317.08	318.22	360.27	370.77	359.82	332.21

TABLE I-C-80

(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Gasoline:	10.59	11.29	13.48	11.32	9.32	10.03
Distillate Oil:	26.41	26.74	31.04	36.63	32.37	36.85
Diesel Fuel:	14.22	14.84	18.58	19.31	11.89	13.75
Residual Oil:	49.25	45.98	66.02	64.93	60.71	42.09
Liquid Petroleum Gas:	3.21	3.31	3.91	3.14	4.24	4.16
Natural Gas:	216.03	218.79	249.35	254.81	239.94	237.53
Coal (Excl. Coking Coal):	21.28	23.66	18.99	19.30	22.96	25.70
Coking Coal and Petroleum Coke:	9.89	9.76	10.51	12.40	12.12	16.83
Electricity Purchased:	140.92	138.42	144.04	143.44	156.65	151.29
Feedstocks:	111.42	114.94	125.79	124.88	124.15	112.46
Total:	603.20	607.75	681.71	690.14	674.34	650.68

TABLE I-C-80

(contd)

Area	Consumption, Trillions of Btu					
United States	1970	1971	1972	1973	1974	1975
Gasoline:	279.85	269.79	251.13	252.36	226.75	217.84
Distillate Oil:	376.93	436.71	493.05	568.92	522.44	510.98
Diesel Fuel:	276.53	290.81	292.33	329.35	282.20	285.29
Residual Oil:	1164.72	1099.94	1229.08	1332.52	1272.90	1061.97
Liquid Petroleum Gas:	237.41	238.17	285.05	300.86	328.91	364.97
Natural Gas:	9819.36	10233.50	10269.10	10769.20	10394.40	8885.92
Coal (Excl. Coking Coal):	2488.19	2120.74	1952.70	1845.28	1779.12	1396.54
Coking Coal and Petroleum Coke:	2880.48	2405.54	2708.45	2827.08	2725.20	2836.75
Electricity Purchased:	1953.44	2022.29	2181.86	2344.84	2352.35	2257.23
Feedstocks:	3830.33	3781.27	4131.10	4313.48	4267.79	3822.10
Total:	23307.23	22978.55	23793.83	24883.88	24152.04	21639.55

Data Source: Reference 38, Federal Energy Data System.

TABLE I-C-81

ELECTRIC UTILITIES CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Distillate Oil:	2.21	2.63	2.79	3.37	2.41	3.69
Residual Oil:	0.13	0.03	0.01	0.04	0.02	0.0
Natural Gas:	8.46	10.59	13.50	15.89	17.66	20.25
Anthracite and Bituminous Coal:	2.58	4.50	4.59	5.02	4.56	4.47
Nuclear Electricity:	0.0	0.0	0.0	0.0	0.0	0.0
Hydro Electricity:	3.80	3.74	3.59	2.97	3.40	3.71
Total:	17.18	21.49	24.49	26.29	28.05	32.12
Total Electric Sales:	3.60	4.14	4.37	5.60	5.85	6.28
Idaho						
Distillate Oil:	0.01	0.01	0.01	0.01	0.29	0.05
Residual Oil:	0.0	0.0	0.0	0.0	0.0	0.0
Natural Gas:	0.0	0.0	0.0	0.0	0.06	0.02
Anthracite and Bituminous Coal:	0.0	0.0	0.0	0.0	0.0	0.0
Nuclear Electricity:	0.0	0.0	0.0	0.0	0.0	0.0
Hydro Electricity:	74.27	78.26	81.41	85.42	100.65	106.75
Total:	74.27	78.27	81.42	85.42	101.00	106.81
Total Electric Sales:	33.79	35.02	38.14	40.00	42.41	43.98

TABLE I-C-81

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Distillate Oil:	0.0	0.01	0.01	1.76	5.05	1.89
Residual Oil:	0.50	0.59	0.11	0.09	0.0	0.25
Natural Gas:	1.04	0.35	0.42	3.62	0.27	0.00
Anthracite and Bituminous Coal:	0.0	0.0	0.0	0.0	0.0	0.0
Nuclear Electricity:	0.0	0.0	0.0	0.0	0.0	0.01
Hydro Electricity:	313.10	359.45	378.51	292.34	373.63	358.67
Total:	314.64	360.40	379.05	297.81	378.95	360.83
Total Electric Sales:	49.14	94.51	96.79	103.19	107.79	110.55
Washington						
Distillate Oil:	0.0	0.0	0.0	2.64	0.05	0.31
Residual Oil:	0.06	0.01	0.38	0.34	0.43	0.0
Natural Gas:	0.0	0.0	0.0	0.0	0.0	0.0
Anthracite and Bituminous Coal:	0.0	24.40	58.63	49.03	59.45	58.08
Nuclear Electricity:	27.43	27.21	31.12	47.23	40.83	34.73
Hydro Electricity:	728.18	748.43	785.85	715.22	855.02	873.94
Total:	755.66	800.05	875.98	814.46	955.78	967.07
Total Electric Sales:	174.52	177.96	188.89	187.28	196.57	202.35

TABLE I-C-81

(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Distillate Oil:	2.21	2.65	2.81	7.78	7.80	5.94
Residual Oil:	0.69	0.62	0.50	0.47	0.45	0.25
Natural Gas:	9.50	10.94	13.92	19.51	18.00	20.27
Anthracite and Bituminous Coal:	2.58	28.90	63.22	53.05	64.01	62.55
Nuclear Electricity:	27.43	27.21	31.12	47.23	40.83	34.74
Hydro Electricity:	1119.34	1189.88	1249.37	1095.94	1332.70	1343.07
Total:	1161.75	1260.21	1360.94	1223.98	1463.79	1466.83
Total Electric Sales:	301.05	311.62	328.19	336.06	352.63	363.17
United States						
Distillate Oil:	144.28	205.79	398.04	354.06	493.15	379.81
Residual Oil:	1964.18	2337.63	2737.02	3202.95	2987.61	2860.17
Natural Gas:	4018.63	4120.75	4105.98	3720.70	3538.96	3247.57
Anthracite and Bituminous Coal:	7484.96	7452.36	8387.46	8315.75	8510.82	9286.95
Nuclear Electricity:	228.74	404.00	575.97	888.34	1194.13	1805.19
Hydro Electricity:	2546.80	2790.50	2830.70	2822.00	3126.34	3116.28
Total:	16437.59	17311.03	19035.16	19403.79	19751.00	20695.95
Total Electric Sales:	4747.29	5003.45	5383.11	5811.30	5802.98	5913.04

Data Source: Reference 38, Federal Energy Data System.

TABLE I-C-82

TRANSPORTATION CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Gasoline (Excl. Aviation Gas):	11.97	13.52	12.91	14.35	15.86	19.25
Aviation Gasoline:	1.28	1.07	1.16	1.34	1.65	1.91
Distillate and Highway Diesel Oil:	5.82	8.25	12.95	10.88	11.72	12.55
Residual Oil:	0.85	1.45	1.53	2.07	2.12	3.13
Liquid Petroleum Gas:	0.01	0.01	0.0	0.0	0.0	0.0
Natural Gas:	17.86	17.76	8.07	0.18	0.11	0.10
Jet Fuel:	38.20	40.82	42.09	38.86	38.88	38.85
Electricity Purchased:	0.0	0.0	0.00	0.00	0.00	0.01
Total	75.98	82.88	79.71	67.68	70.35	75.79
Idaho						
Gasoline (Excl. Aviation Gas):	47.48	48.61	53.31	53.57	51.87	54.70
Aviation Gasoline:	0.43	0.41	0.45	0.54	0.52	0.48
Distillate and Highway Diesel Oil:	7.35	7.92	8.90	10.42	15.02	13.11
Residual Oil:	0.01	0.0	0.0	0.0	0.0	0.0
Liquid Petroleum Gas:	0.10	0.12	0.21	0.17	0.20	0.21
Natural Gas:	4.34	5.28	4.87	4.80	4.10	4.37
Jet Fuel:	6.55	6.72	6.45	6.23	6.19	6.35
Electricity Purchased:	0.0	0.0	0.0	0.0	0.0	0.0
Total:	66.25	69.06	74.20	75.72	77.89	79.22

TABLE I-C-82

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Gasoline (Excl. Aviation Gas):	126.64	134.77	144.07	150.34	143.36	147.98
Aviation Gasoline:	0.86	0.48	0.54	0.64	0.71	0.70
Distillate and Highway Diesel Oil:	27.84	33.10	36.74	42.32	41.12	35.64
Residual Oil:	6.71	2.86	1.72	1.84	2.08	2.83
Liquid Petroleum Gas:	0.20	0.19	0.20	0.16	0.15	0.12
Natural Gas:	5.68	7.03	10.24	8.99	7.53	8.14
Jet Fuel:	10.78	10.18	10.06	11.44	10.62	9.90
Electricity Purchased:	0.0	0.0	0.0	0.0	0.0	0.0
Total:	178.71	188.60	203.57	215.73	205.57	205.32
Washington						
Gasoline (Excl. Aviation Gas):	185.90	191.47	199.16	208.64	203.46	211.49
Aviation Gasoline:	0.88	0.54	0.82	0.94	0.98	1.02
Distillate and Highway Diesel Oil:	23.03	26.14	29.50	35.01	36.48	34.98
Residual Oil:	12.71	7.37	6.15	7.31	8.05	13.64
Liquid Petroleum Gas:	0.42	0.41	0.41	0.37	0.38	0.37
Natural Gas:	6.63	6.34	7.63	7.60	5.69	6.04
Jet Fuel:	57.52	60.56	54.53	59.59	61.54	70.13
Electricity Purchased:	0.06	0.05	0.05	0.05	0.05	0.05
Total:	287.15	292.89	298.24	319.50	316.62	337.71

TABLE I-C-82

(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Gasoline (Excl. Aviation Gas):	371.99	388.37	409.46	426.91	414.54	433.42
Aviation Gasoline:	3.45	2.50	2.96	3.46	3.85	4.12
Distillate and Highway Diesel Oil:	64.03	75.41	88.09	98.62	104.34	96.27
Residual Oil:	20.28	11.69	9.41	11.22	12.26	19.60
Liquid Petroleum Gas:	0.72	0.73	0.82	0.70	0.73	0.70
Natural Gas:	34.51	36.41	31.81	21.57	17.44	18.64
Jet Fuel:	113.05	118.27	113.12	116.11	117.23	125.24
Electricity Purchased:	0.06	0.05	0.05	0.05	0.04	0.05
Total:	608.10	633.43	655.71	678.63	670.42	698.03
United States						
Gasoline (Excl. Aviation Gas):	10770.20	11323.40	12149.00	12664.20	12145.50	12505.40
Aviation Gasoline:	40.11	44.93	44.38	49.36	49.33	51.19
Distillate and Highway Diesel Oil:	1567.86	1681.19	1912.73	2132.21	2126.50	2065.18
Residual Oil:	749.31	868.57	651.90	732.56	708.23	731.33
Liquid Petroleum Gas:	127.57	126.45	141.26	134.59	125.08	111.01
Natural Gas:	745.27	766.35	790.67	751.48	690.19	601.62
Jet Fuel:	1931.90	1932.77	1919.73	1944.84	1817.29	1855.45
Electricity Purchased:	15.81	15.48	15.15	14.28	14.53	14.58
Total	15967.03	16577.13	17624.81	18423.50	17676.65	17935.74

Data Source: Reference 38, Federal Energy Data System.

TABLE I-C-83

GROSS ENERGY CONSUMPTION BY AREA, 1970-1975

Area	Consumption, Trillions of Btu					
Alaska	1970	1971	1972	1973	1974	1975
Gasoline:	15.12	16.22	20.89	18.41	20.16	23.90
Distillate Oil and Kerosene:	24.71	31.82	32.01	33.49	35.71	33.82
Diesel Fuel:	5.08	5.36	4.26	3.80	3.27	7.73
Residual Oil:	6.50	6.56	7.33	6.61	6.90	6.94
Liquid Petroleum Gas:	0.61	0.70	0.77	0.88	0.69	0.85
Jet Fuel:	38.20	40.82	42.09	38.86	38.88	38.85
Natural Gas:	69.20	73.57	79.43	67.44	66.39	93.36
Anthracite and Bituminous Coal:	12.68	15.46	14.12	14.77	14.17	15.20
Nuclear and Hydro Electricity:	3.80	3.74	3.59	2.97	3.40	3.71
Other Fuels:	20.14	20.26	21.15	21.81	22.22	20.22
Total:	196.03	214.52	225.64	209.04	211.79	244.58
Electricity Purchased:	3.60	4.14	4.37	5.60	5.85	6.28

TABLE I-C-83

(contd)

Area	Consumption, Trillions of Btu					
Idaho	1970	1971	1972	1973	1974	1975
Gasoline:	51.55	53.75	57.02	59.52	56.35	59.88
Distillate Oil and Kerosene:	26.77	26.47	26.84	28.12	28.46	32.56
Diesel Fuel:	7.14	8.05	9.06	10.25	12.87	11.27
Residual Oil:	1.74	1.74	1.55	1.53	3.75	4.42
Liquid Petroleum Gas:	4.24	4.70	5.64	4.79	4.95	4.75
Jet Fuel:	6.55	6.72	6.45	6.23	6.19	6.35
Natural Gas:	49.35	53.20	62.41	57.48	54.79	60.43
Anthracite and Bituminous Coal:	7.40	8.71	7.55	7.64	7.88	7.96
Nuclear and Hydro Electricity:	74.27	78.26	81.41	85.42	100.65	106.75
Other Fuels:	14.97	14.09	15.69	15.40	14.23	12.75
Total:	243.97	255.70	273.62	276.38	290.12	307.11
Electricity Purchased:	33.79	35.02	38.14	40.00	42.41	43.98

TABLE I-C-84

(contd)

Area	Consumption, Trillions of Btu					
Oregon	1970	1971	1972	1973	1974	1975
Gasoline:	132.62	139.69	149.16	155.29	148.26	152.78
Distillate Oil and Kerosene:	59.07	64.95	67.01	65.02	58.95	56.20
Diesel Fuel:	17.28	18.42	23.75	29.11	25.92	22.26
Residual Oil:	41.99	41.10	50.15	46.77	41.81	27.56
Liquid Petroleum Gas:	5.02	5.42	5.87	4.37	4.46	2.91
Jet Fuel:	10.78	10.18	10.06	11.44	10.62	9.90
Natural Gas:	101.88	106.12	118.76	111.62	107.41	117.46
Anthracite and Bituminous Coal:	4.04	4.37	2.81	1.86	2.94	2.02
Nuclear and Hydro Electricity:	313.10	359.45	378.51	292.34	373.63	358.68
Other Fuels:	31.29	35.48	40.01	37.93	35.43	37.86
Total:	717.07	784.17	845.09	755.73	809.42	787.65
Electricity Purchased:	89.14	94.51	96.79	103.19	107.79	110.55

TABLE I-C-83

(contd)

Area	Consumption, Trillions of Btu					
Washington	1970	1971	1972	1973	1974	1975
Gasoline:	191.30	196.40	204.49	213.84	208.58	216.79
Distillate Oil and Kerosene:	90.25	90.68	90.65	92.65	72.92	77.87
Diesel Fuel:	17.05	19.15	21.38	25.00	24.25	20.89
Residual Oil:	65.18	58.39	74.26	69.07	65.16	53.84
Liquid Petroleum Gas:	6.66	6.65	5.49	4.67	4.60	3.06
Jet Fuel:	57.52	60.56	54.53	59.59	61.54	70.13
Natural Gas:	157.07	164.48	184.91	205.30	190.25	172.43
Anthracite and Bituminous Coal:	6.85	31.77	63.30	52.34	64.91	65.68
Nuclear and Hydro Electricity:	755.61	775.65	816.96	762.45	895.86	908.68
Other Fuels:	96.58	99.22	112.55	113.95	108.22	108.24
Total:	1444.07	1502.95	1628.53	1598.86	1696.29	1697.59
Electricity Purchased:	174.52	177.96	188.89	187.28	196.57	202.35

TABLE I-C-84

(contd)

Area	Consumption, Trillions of Btu					
Northwest	1970	1971	1972	1973	1974	1975
Gasoline:	390.59	406.05	431.56	447.07	433.35	453.34
Distillate Oil and Kerosene:	200.80	213.93	216.52	219.28	196.04	200.45
Diesel Fuel:	46.54	50.99	58.45	68.16	66.31	62.15
Residual Oil:	115.41	107.79	133.29	123.97	117.63	92.76
Liquid Petroleum Gas:	16.54	17.47	16.77	14.70	14.71	11.57
Jet Fuel:	113.05	118.27	113.12	116.11	117.23	125.24
Natural Gas:	377.50	397.37	445.50	441.84	418.83	443.68
Anthracite and Bituminous Coal:	30.97	60.31	87.77	76.61	89.90	90.85
Nuclear and Hydro Electricity:	1146.77	1217.09	1280.49	1143.18	1373.53	1377.81
Other Fuels:	162.97	189.05	189.41	189.09	180.09	179.08
Total:	2601.14	2758.33	2972.89	2840.02	3007.62	3036.92
Electricity Purchased:	301.05	311.62	328.19	336.06	352.63	363.17

TABLE I-C-84

(contd)

Area	Consumption, Trillions of Btu					
United States	1970	1971	1972	1973	1974	1975
Gasoline:	11195.50	11731.70	12540.90	13061.40	12511.00	12869.30
Distillate Oil and Kerosene:	4802.11	4927.41	5354.30	5466.74	5100.73	4857.01
Diesel Fuel:	1143.27	1246.00	1393.58	1592.41	1561.44	1550.51
Residual Oil:	5056.55	5268.78	5819.53	6476.74	6055.73	5628.60
Liquid Petroleum Gas:	980.63	990.73	1095.84	1071.68	1039.48	1053.14
Jet Fuel:	1931.90	1932.77	1919.73	1944.84	1817.29	1855.45
Natural Gas:	22050.70	22840.60	23147.20	22956.90	22200.10	20302.10
Anthracite and Bituminous Coal:	13027.60	12139.70	13030.70	12877.80	12768.30	13153.40
Nuclear and Hydro-electricity:	2825.54	3194.50	3406.67	3710.34	4320.47	4921.47
Other Fuels:	5297.74	5248.36	5655.97	6018.54	5837.15	5408.29
Total:	68311.44	69520.44	73364.25	75177.25	73211.50	71599.12
Electricity Purchased:	4747.29	5003.45	5303.11	5811.30	5802.98	5913.04

Data Source: Ref. 38, Federal Energy Data System.

TABLE I-C-84

Underground Storage Statistics
December 31, 1975

State	Stocks of Crude Petroleum (1000 Barrels)	Number of Reservoirs	Total Stored Gas in Underground Reservoirs	Total Reservoir Capacity
Alaska	4,502	--	--	--
Idaho	--	--	--	--
Oregon	--	--	--	--
Washington	--	2	21,784	23,438

Data Source: Ref. 13, Minerals Yearbook, Vol. I., p. 961.

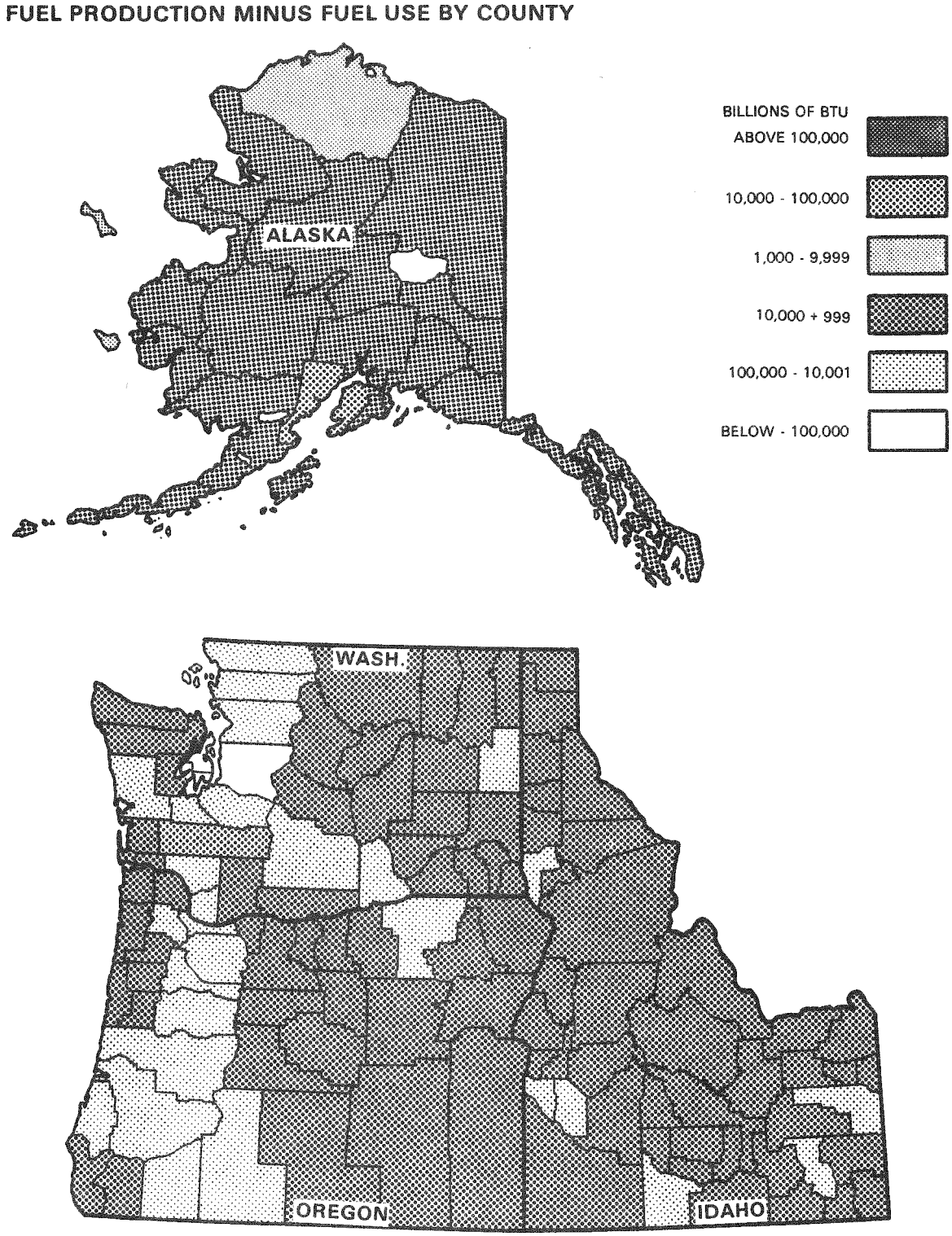


FIGURE I-D-52. Fuel Production Minus Fuel Use By County

Data Source: Ref. 5, Energetics of the USA, p. 63.

TABLE I-D-85

Energy Imports by State

State	Export	Units in Trillions of Btu 1974	1975
Alaska	Natural gas	--	--
	Oil and NGL	--	--
	Coal	--	0.1
Idaho	Natural gas and LPG	54	62.2
	Oil and NGS	104	127.5
	Coal	11	2.7
	Hydro (electric)	14	(12.7)
Oregon	Natural gas and LPG	93	118.3
	Oil and NGL	270	303.5
	Coal	3.5	2.3
	Hydro (electric)	--	(2.8)
Washington	Natural gas and LPG	190	174.0
	Oil and NGL	330	513.9
	Coal	--	6.4
	Hydro (electric)	--	--
	Nuclear	41	35.3

Data Source: Ref. 40 and 41, 1974 Data: RAP-1, Annual Report 1975; 1975 Data: Energy Flow Patterns 1975.

TABLE I-D-86

Energy Exports by State

State	Import	Units in Trillions of Btu 1974	1975
Alaska	Natural gas and storage	64	53.3
	Oil and NGL	360	286.2
Idaho	Natural gas and LPG	--	--
	Oil and NGL	--	--
	Coal	--	--
	Hydro (electric)	--	--
Oregon	Natural gas and LPG	--	--
	Oil and NGL	--	--
	Coal	--	--
	Hydro (electric)	1.1	--
Washington	Natural gas and LPG	--	--
	Oil and NGL	--	--
	Coal	--	--
	Hydro (electric)	80	82.6

Data Source: Ref. 40 and 41, 1974 Data: RAP-1, Annual Report 1975; 1975 Data: Energy Flow Patterns 1975.

TABLE I-D-87

Foreign Imports Between 1973 and 1975

		Annual Volume (1000 bbl/day)			
	Source	1972	1973	1974	1975
Puget Sound	Canada	97,340	90,690	70,749	61,982
	Australia				5
	Venezuela	721	1,189	347	286
	Ecuador	202	1,199	1,604	1,057
	Iran		7,353	15,244	18,156
	Indonesia	1,750	2,344	8,501	12,364
	Saudi Arabia	2,655	2,957	1,860	1,190
	Arab Emirates	640	176	739	6,003
	Nigeria	0	0	199	0
	Bolivia	0	0	0	269
Total		103,308	105,908	99,273	101,912
		Annual Volume (million bbl/day)			
Oregon	Venezuela	0	0	2,650	2,494
Alaska	Canada	N/A	0	0	17
	Indonesia	0	0	0	218
Total					235

Data Source: Ref. 9, Petroleum Supply System (draft).

TABLE I-D-88

Product (Finished and Unfinished Oils) Imports
Into the Puget Sound (Annual Volumes in bbl)

Product	Source	1973	1974	1975
Propane	Canada	1,317,412	777,450	664,225
	United Kingdom	0	0	2,760
Total		1,317,412	777,450	666,985
LPG n.e.c.	Canada	4,436,128	3,442,475	3,823,407
	Gaza Strip	0	0	25,821
	United Kingdom	0	0	775
	France	0	0	25
Total		4,436,128	3,442,475	3,850,028
Gasoline	Brazil	0	0	148,140
	Canada	294,179	285,252	570,145
	Saudi Arabia	0	0	74,648
Total		294,179	285,252	792,933
Jet Fuel	Canada	69,663	137,336	0
	Bahamas	111,569	100,513	228,547
	Trinidad/Tobago	101,788	250,861	263,212
	Netherland Antilles	179,483	106,681	38,582
	Venezuela	890,238	454,458	482,889
	Jamaica	83	0	0
	Italy	175	0	0
	Saudi Arabia	125,753	0	69,269
	Singapore	40,711	0	132,970
	Iran	264,075	0	47,823
	Japan	0	0	4,843
Total		1,683,538	1,049,849	1,268,135
Motor fuels n.e.c.	Canada	30,000	47,953	0
	Trinidad/Tobago	0	0	70,392
Total		30,000	47,953	70,392
Naphtha	Canada	0	400	0
	Panama	0	0	71,623
	Venezuela	70,511	292,312	0
	Trinidad/Tobago	0	0	56,707
Total		70,511	292,712	128,330
Residual	Canada	58,032	2,847	12,302
	Iran	0	122,490	0
	Trinidad/Tobago	0	102,253	0

TABLE I-D-88 (contd)

Product	Source	1973	1974	1975
	Netherland Antilles	74,026	0	0
	Venezuela	68,613	0	0
	Japan	1,409	0	654
	Hong Kong	11,581	0	0
	Singapore	1,463	0	0
	Saudi Arabia	26,529	0	0
Total		241,653	227,590	12,956
Unfinished oils	Canada	0	202,347	0
	Venezuela	0	134,957	0
Total		0	337,304	0
Middle distillates	Canada	160,370	48,272	269,272
	Bahamas	18,245	0	0
	Iran	440,000	0	0
Total		618,615	48,272	269,272
Lubricating oil	Canada	0	2,868	1,051
	Panama	0	0	2
	United Kingdom	0	0	210
Total		0	2,868	1,263
Lubricating greases, lb	Canada	0	420	2,450
Total		0	420	2,450
Lubricating greases other, lb	Canada	0	0	1,055
	Japan	0	160	529
Total		0	160	1,584
Liquid derivitives for further refining	Canada	353	0	641,655
Total		353	0	641,655
Liquid derivitives (Other)	Canada	1,651	372	935
Total		1,651	372	935

TABLE I-D-88 (contd)

Product (Finished and Unfinished)
Import to Portland

Product	Source	1973	1974	1975
Gasoline	Canada	0	0	30,226
Total		0	0	30,226
Residual	Venezuela	165,000	0	0
Total		165,000	0	0
Lubricating oil	Panama	0	11,357	0
Total		0	11,357	0
Lubricating greases other	West Germany	0	0	134
Total		0	0	134

Data Source: Ref. 9, Petroleum Supply System, (draft).

TABLE I-D-89

Yearly Alaskan Production of Coal and Oil and Gas

Year	Coal ($ Thousands)	Oil and Gas ($ Thousands)
1970	4,059	279,132
1971	5,710	286,977
1972	5,696	239,736
1973	6,230	281,300
1974	7,325	369,114
1975	7,810	377,143
Total	156,952	2,553,591

Data Source: Ref. 22, Alaska Regional Profiles.

TABLE I-D-90

Physical Volume of Alaskan Coal, Crude Petroleum, and Natural Gas Production

Mineral	Units	Quantity
Coal, 1951-75	Tons, thousands	25,675
Crude petroleum, 1958-75	42-gal bbl, thousands	686,274[(a)]
Natural gas, 1948-75	MMCF	1,010,173

(a) The only other crude petroleum production recorded was the Katalla area (about 154,000 bbl of oil, 1901-32).

Data Source: Ref. 22, Alaska Regional Profiles.

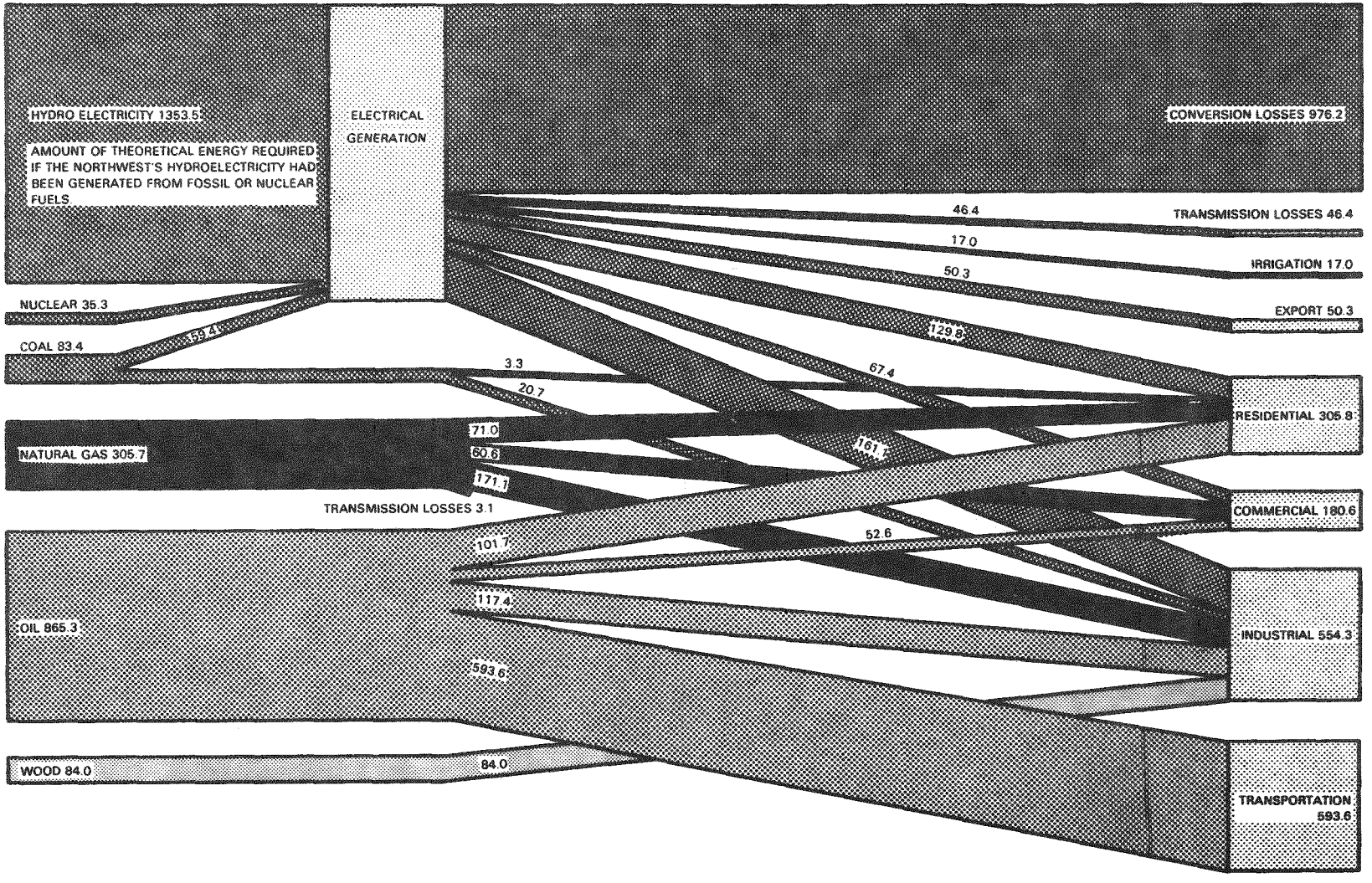


FIGURE I-D-53. Northwest Energy Reference System, 1975 (10^{12}Btu)
Northwest = Idaho, Oregon and Washington

Data Source: Ref. 3, Energy Futures Northwest.

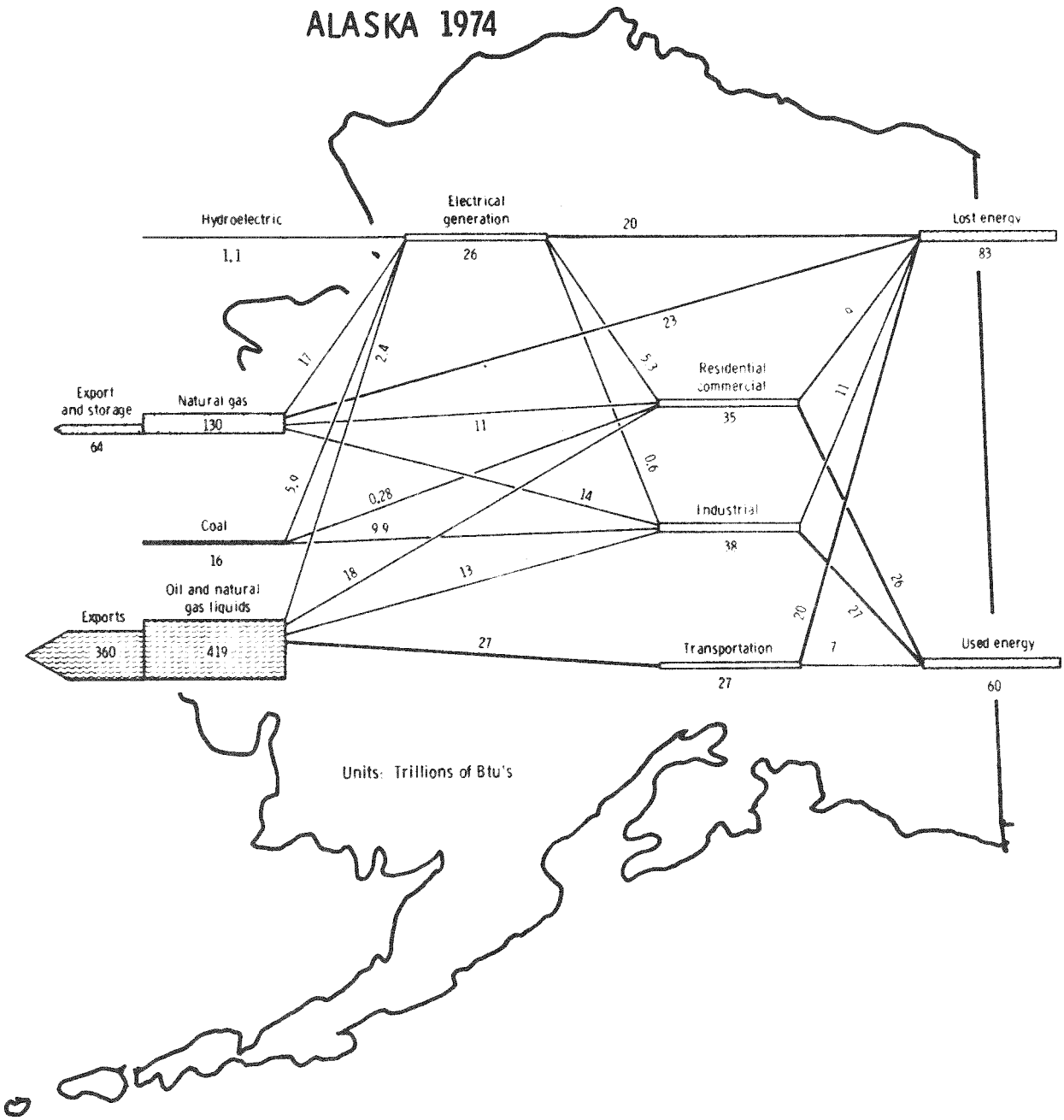


FIGURE I-D-54. Preliminary Energy Balance - Alaska 1974

Data Source: Ref. 40, Regional Assessment Program 1975 - Annual Report.

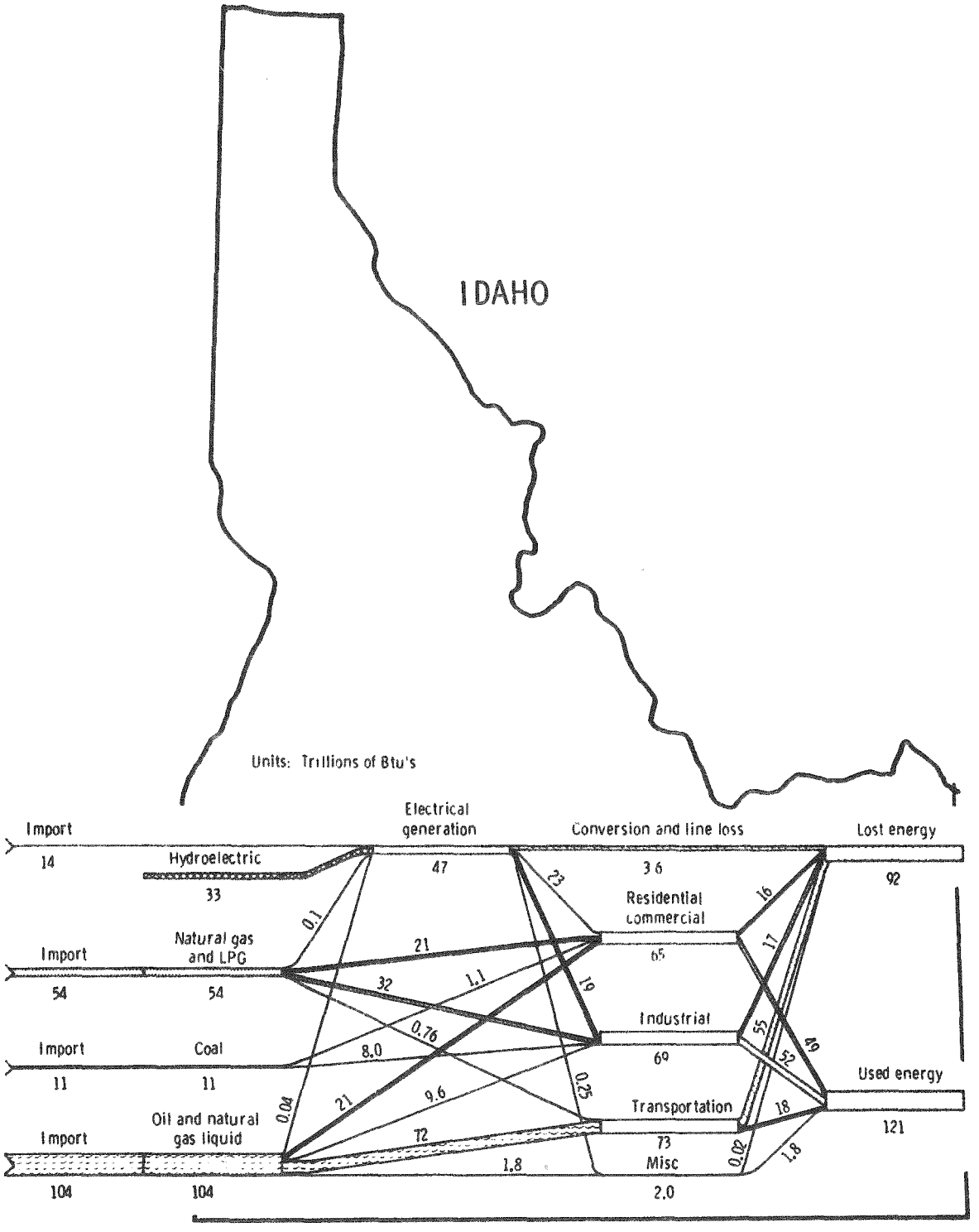


FIGURE I-D-55. Preliminary Energy Balance - Idaho 1974

Data Source: Ref. 40, Regional Assessment Program 1975 - Annual Report.

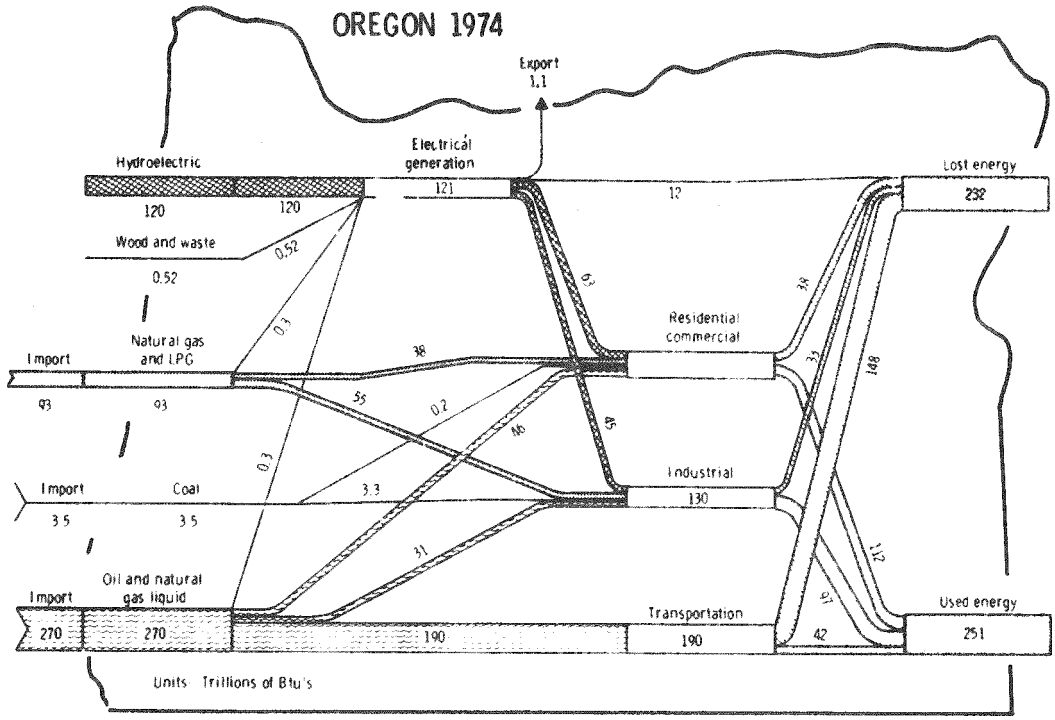


FIGURE I-D-56. Preliminary Energy Balance - Oregon 1974

Data Source: Ref. 40, Regional Assessment Program 1975 - Annual Report.

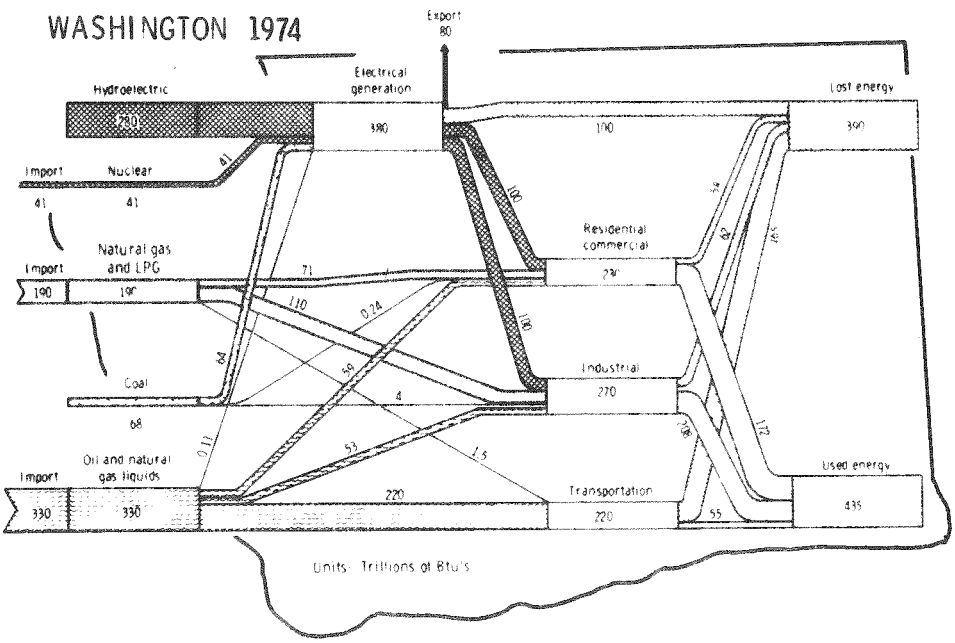


FIGURE I-D-57. Preliminary Energy Balance - Washington 1974

Data Source: Ref. 40, Regional Assessment Program 1975 - Annual Report.

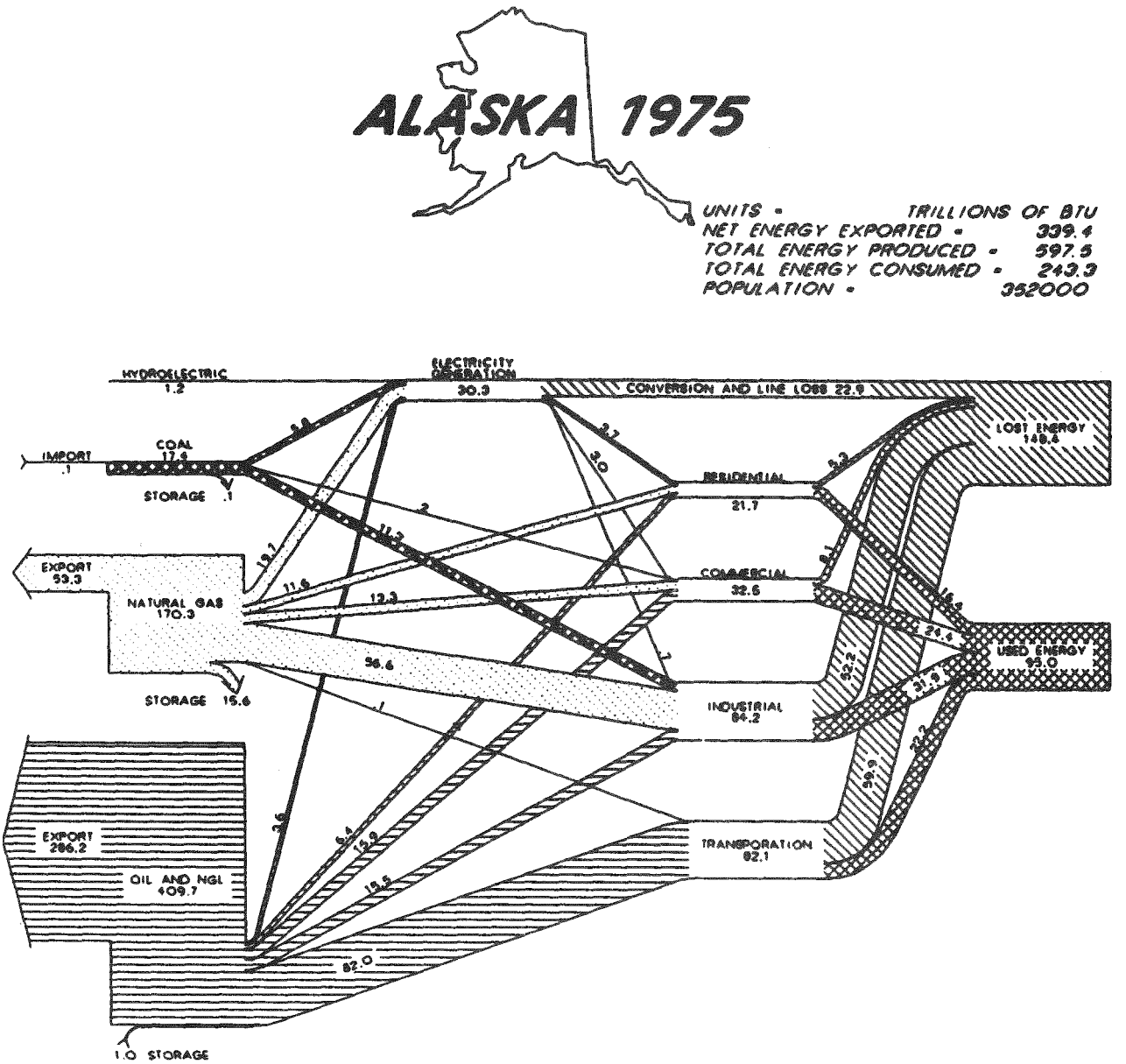
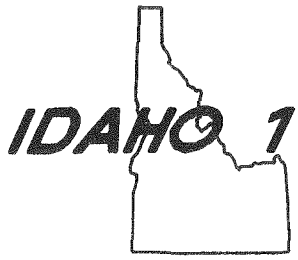


FIGURE I-D-58. Energy Balance - Alaska 1975

Data Source: Ref. 41, Energy Flow Patterns for 1975.



IDAHO 1975

UNITS - TRILLIONS OF BTU
NET ENERGY IMPORTED - 205.1
TOTAL ENERGY PRODUCED - 35.1
TOTAL ENERGY CONSUMED - 239.8
POPULATION - 820000

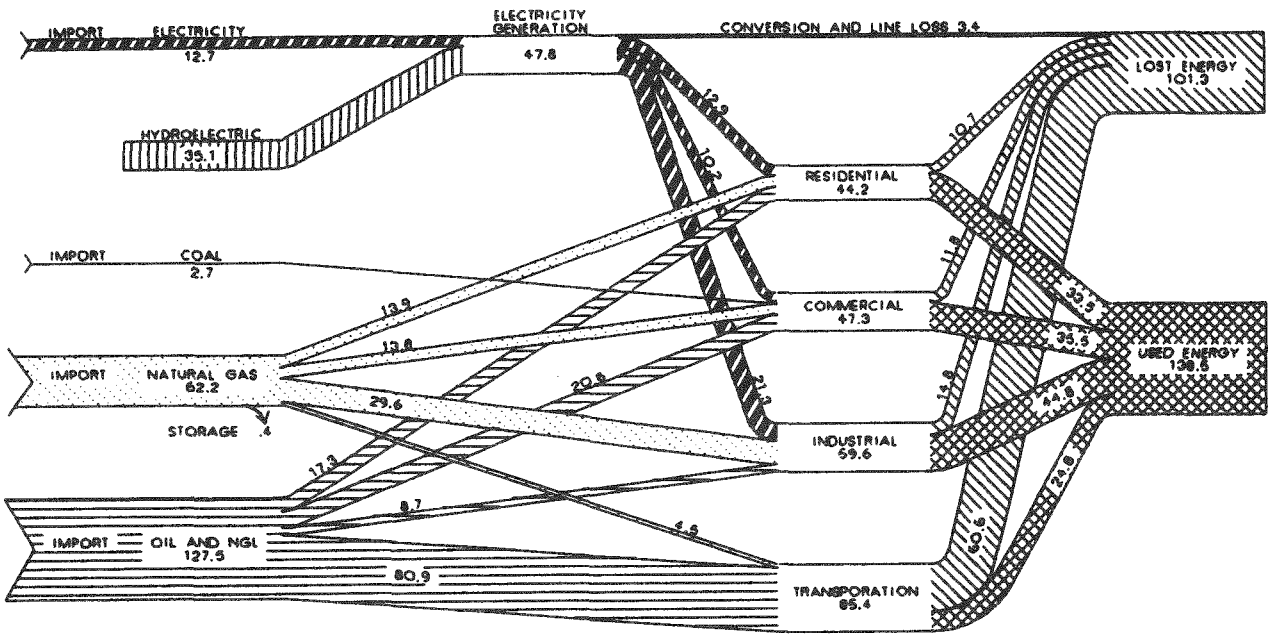


FIGURE I-D-59. Energy Balance - Idaho 1975

Data Source: Ref. 41, Energy Flow Patterns for 1975.

OREGON 1975

UNITS - TRILLIONS OF BTU
NET ENERGY IMPORTED - 426.9
TOTAL ENERGY PRODUCED - 117.8
TOTAL ENERGY CONSUMED - 542.3
POPULATION - 2288000

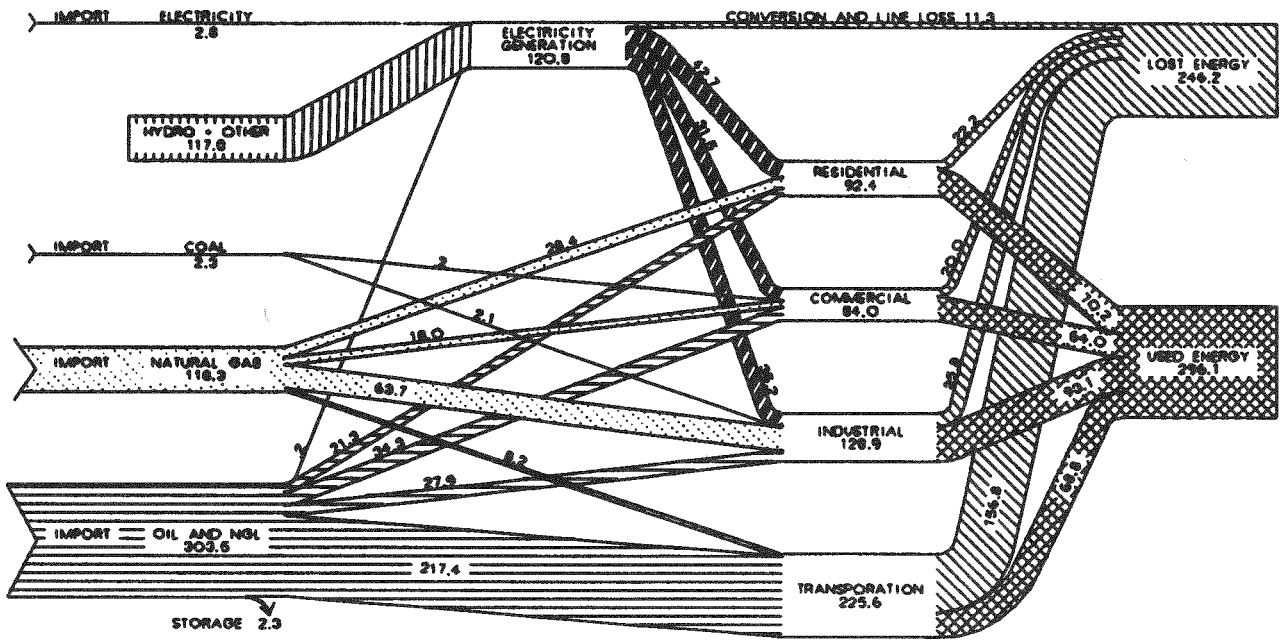


FIGURE I-D-60. Energy Balance - Oregon 1975

Data Source: Ref. 41, Energy Flow Patterns for 1975.

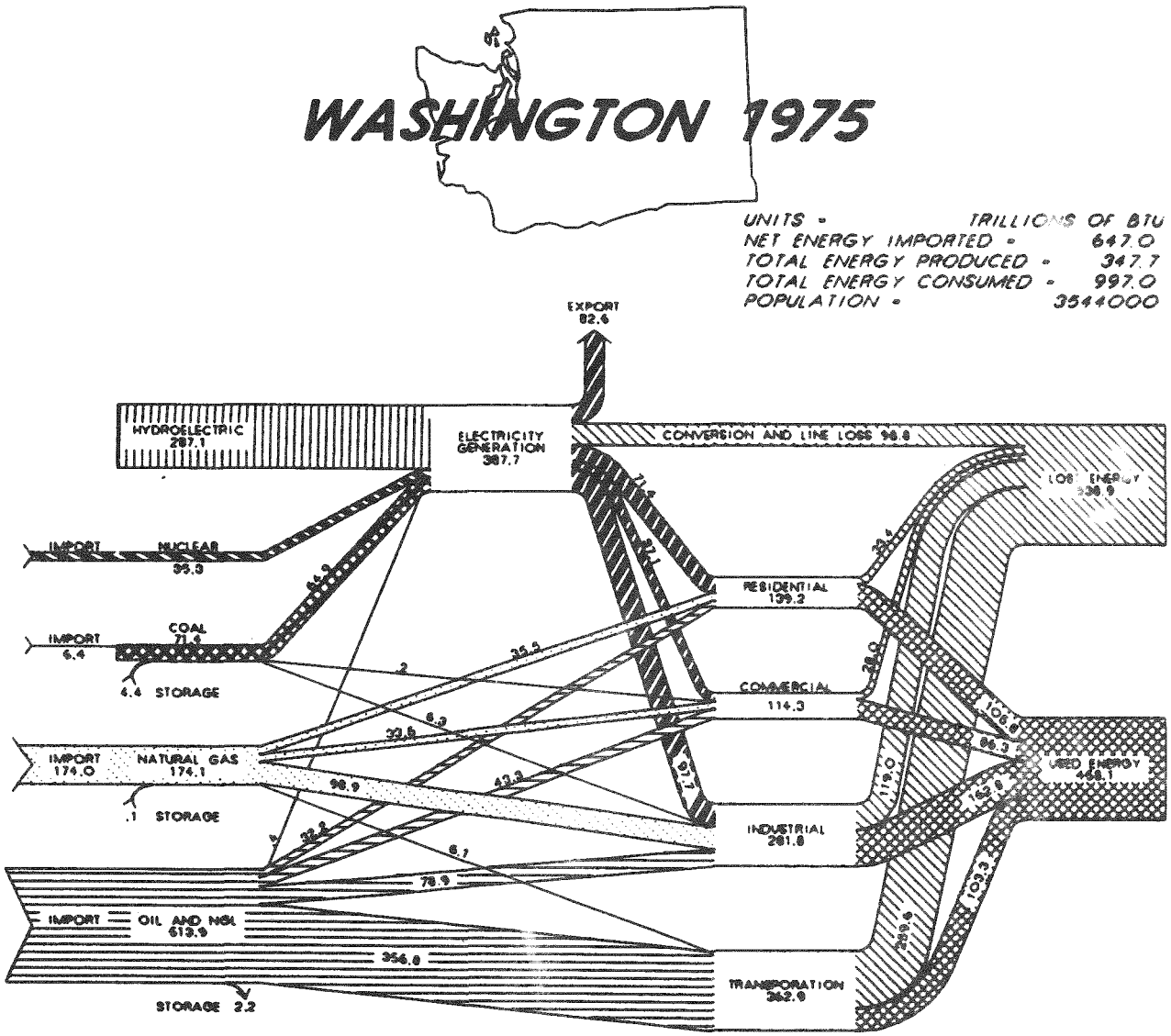


FIGURE I-D-61. Energy Balance - Washington 1975

Data Source: Ref. 41, Energy Flow Patterns for 1975.

TRANSPORTATION

Physical distance between the Northwest (especially Alaska) and the rest of the U.S. makes transportation highly significant to the Region. The Northwest's circulation system determines the availability of consumer goods and the potential for export markets. Geographic location, physical features and economics have all had decisive effects upon the development of the Region's transportation systems. The rugged topography of the four states has posed a formidable barrier to highway, rail and pipeline construction; the three coastal states have consequently turned to the ocean and inland waterways.

Spokane, Portland and Puget Sound serve as major railroad convergence points. Alaskan rail service runs from Fairbanks to Seward and from Whitehorse to Skagway. The Columbia and Snake River gorges contain east-west rail routes, while the remainder of Oregon State is served mainly by north-south routes. Railroad growth in the lower three states is not expected, but rail expansion may be forthcoming in Alaska to facilitate the state's resource development.

Unequal distribution of freight carriers among shipping centers, the high cost of building, operating and maintaining carriers and systems, and a costly freight volume-per-mile ratio keep freight rates high. Raw resource shipments of high-weight, low-value materials to the east of the Region have also proved to be costly.

The Region is served by a network of state and interstate highways. Many of the state roads, however, are the twisting, winding coastal and mountain passages that are known for their scenic beauty — not for their freight traffic.

Waterways in the Northwest constitute an important transportation mode. The major water routes involve the Pacific Ocean, the Columbia River, Puget

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Information Source: Reference 42, Atlas of the Pacific Northwest, pp. 39 and 40.

Sound, Bristol Bay and the Gulf of Alaska. The lower three states contain approximately 600 miles of navigable inland waterways; however, river traffic is concentrated within the Columbia River system. The line dividing barge traffic and ocean-going vessels stretches between Portland, Oregon and Vancouver, Washington; the farthest river traffic travels inland to Lewiston, Idaho. In the Alaska region, ocean-going vessels carry freight to the coast, and barges serve the inland areas.

The Region's large air terminals are found in Seattle, Portland and Anchorage. Passenger and freight air traffic has increased in reaction to employment and recreational opportunities in Alaska.

The Northwest consumes a great deal of motor fuel, primarily because of the relatively low population density and the great distances between commercial and urban market centers. The small number of urban centers in the Region inherently represent a lack of substantial mass transit systems, and unless significant price or policy changes are forthcoming, the private automobile will continue to be the major transportation mode. At this time there is no indication that the Region's motor fuel consumption will decrease, nor that mass transit systems are experiencing significant growth.

Employment connected with automotive and other transportation modes is substantial throughout the Northwest. This high level of employment may serve as an indicator of the transportation systems' significance in moving the Region's raw materials, fuels, and people.

Northwest transportation will play a major role in determining the Region's resource utilization. The important transportation systems for the lower three states' resource movement are already established; the ultimate development of pipeline, rail and shipping systems will surely dictate Alaska's ability to make cost-competitive energy resources available.

Information Source: Ref. 42, Atlas of the Pacific Northwest, pp. 39 and 40.

A major concern in the development or increased utilization of transportation systems is of course the increased accident potential. The farther the energy resources are transported, the higher the risk of accidents. The same goes for increased usage of existing systems. Transportation is consequently a leading factor in determining whether development and utilization of remote resource reserves will be feasible.

Information Source: Reference 42, Atlas of the Pacific Northwest, pp. 39 and 40.

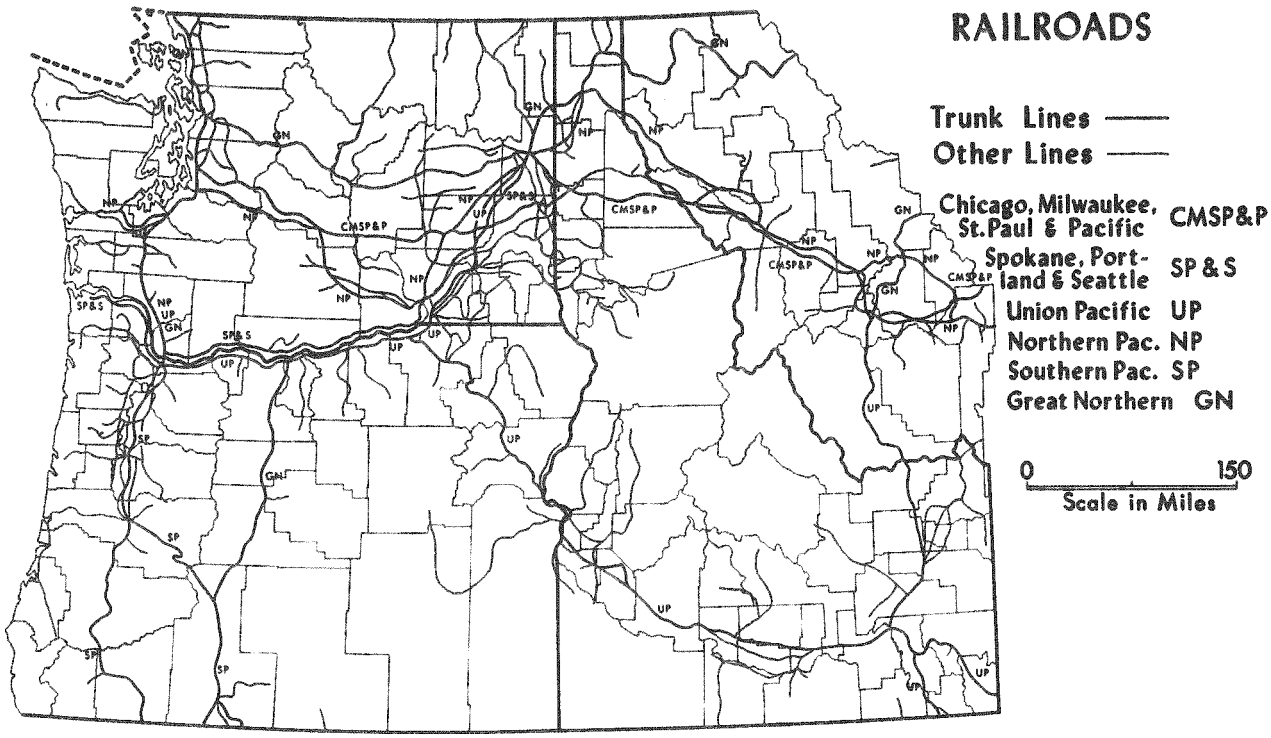

FIGURE I-E-62. Railroads

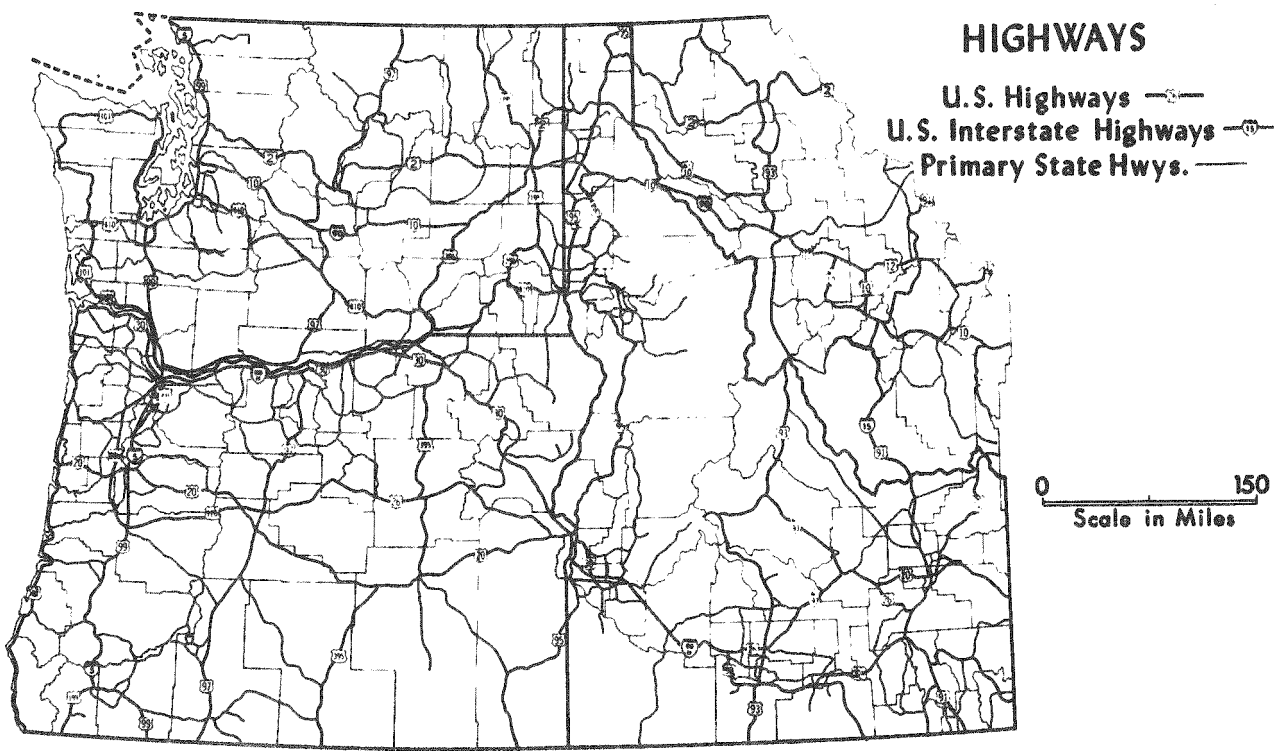

FIGURE I-E-63. Highways

Data Source: Ref. 42, Atlas of the Pacific Northwest, plate 89 and 90.

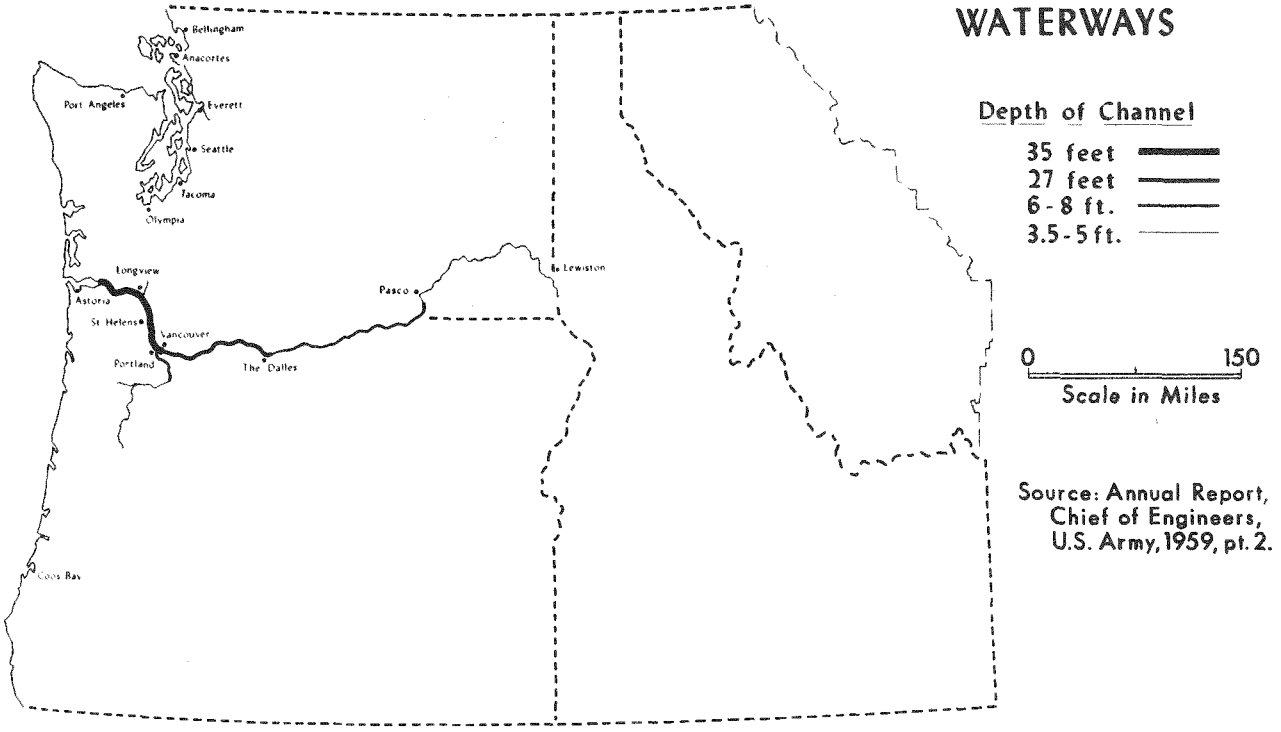

FIGURE I-E-64. Waterways

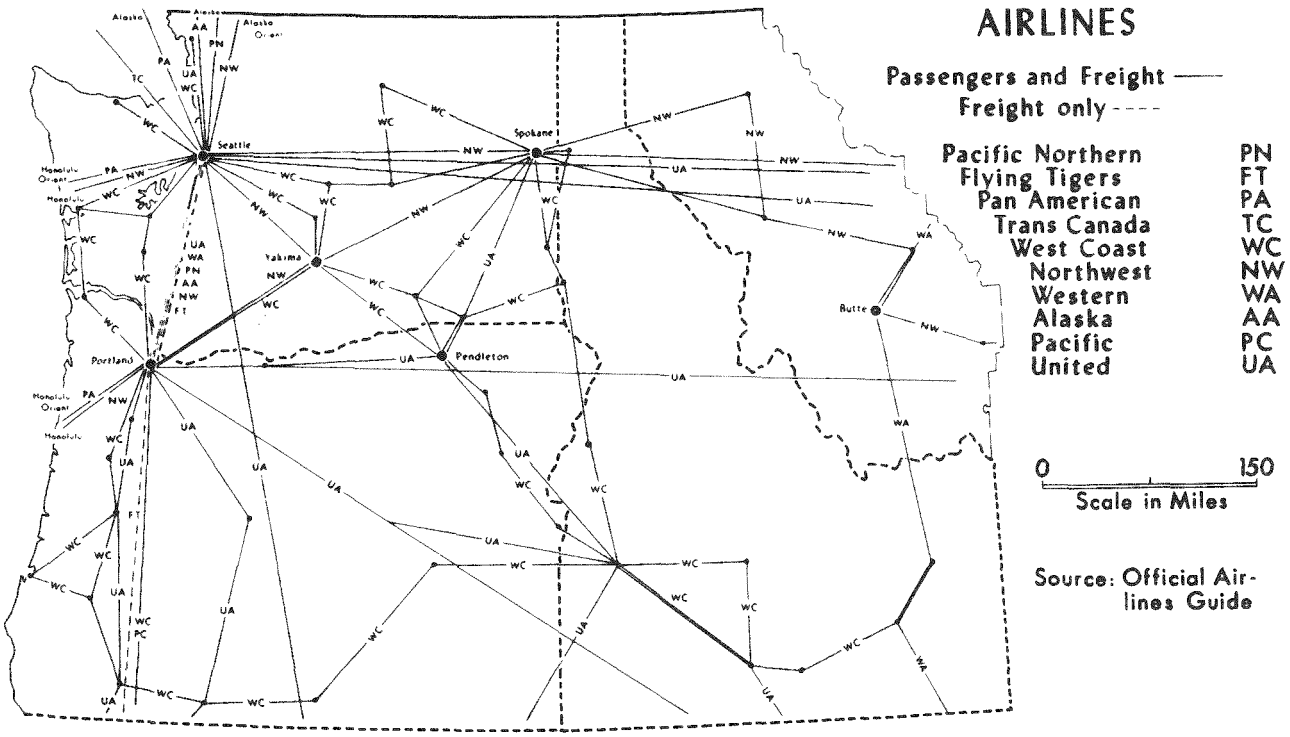

FIGURE I-E-65. Airlines

Data Source: Ref. 42, Atlas of the Pacific Northwest, plates 91 and 92.

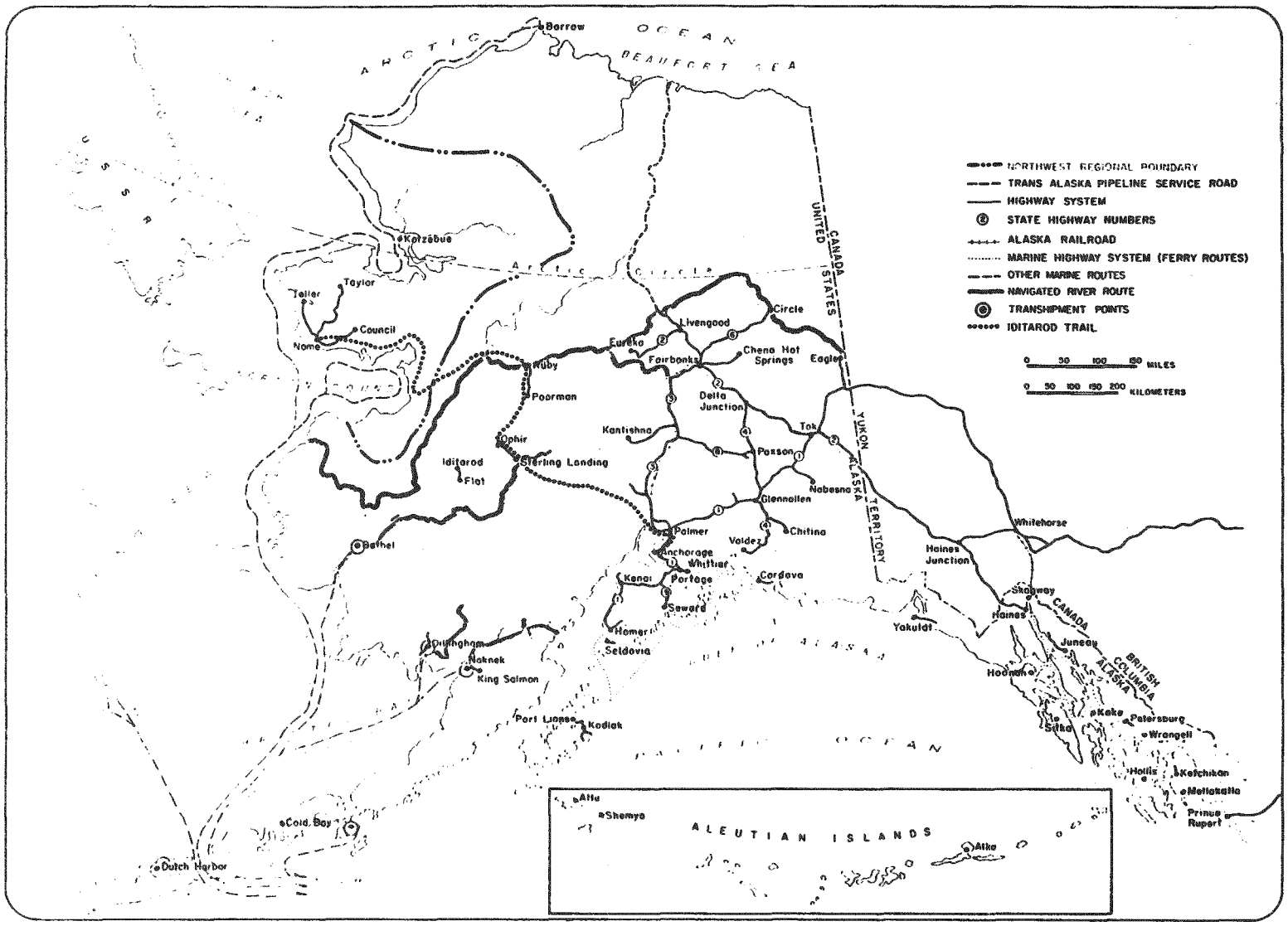

FIGURE I-E-66. Existing Transportation System of Alaska

Data Source: Ref. 22, Alaska Regional Profiles.

TABLE I-E-91

Motor Fuel Consumption - 1975

Area	Gross Amount Reported	Net Amount Taxed at Prevailing Rates				Net Amount Taxed at Other Rates Net Gallons
		Net Gallons	Gasoline	Special Fuels	All Motor Fuels	
Alaska	227,075	217,272	153,918	34,603	188,521	28,751
Idaho	534,926	495,361	438,866	52,618	491,484	3,877
Oregon	1,398,157	1,362,657	1,182,687	174,332	1,357,019	5,638
Washington	1,888,594	1,826,755	1,690,275	136,093	1,826,368	387
Region	2,160,158	3,902,045	3,465,746	397,646	3,863,392	38,653

Data Source: Ref. 43, Highway Statistics, pg. I-5.

TABLE I-E-92

Transportation to Work by State, 1970

Area	Private Vehicle			Taxi, Percent	Public Transit, Percent(a)	Other Percent(b)
	Driver, Total Percent	Passenger, Total Percent	Total Percent			
Alaska	51.4	9.0	60.4	0.2	1.2	38.2
Idaho	68.9	7.9	76.8	0.1	2.0	21.1
Oregon	73.0	9.4	82.4	0.1	3.3	14.2
Washington	75.0	8.8	83.8	0.1	0.9	15.2
Region	67.1	8.8	75.8	0.1	1.8	22.175
U.S. Total	66.0	11.7	77.7	0.4	8.5	13.4

(a) Public transit includes bus, streetcar, subway, elevated train and railroad.
(b) Other includes walked only, worked at home, and other means.

Data Source: Ref. 44, Motor Vehicle Facts and Figures, p. 61.

TABLE I-E-93

1975 Existing Mileage of Streets, Railroads and Pipelines

Area	Total Rural Roads[a]	Total Municipal Mileage[a]	Railroad[b]	Pipeline[c]
Alaska	8,344	1,597	670	79
Idaho	54,108	3,381	2,631	633
Oregon	98,193	6,284	3,043	408
Washington	73,872	10,443	4,723	783
Region	234,517	16,727	11,067	1,903
U.S. Total	3,198,596	639,550	199,420	172,680

(a) Data Source: Ref. 43, Highway Statistics, 1973, Section 4.
(b) Data Source: Ref. 45, Economic and Finance Department, AAR.
(c) Data Source: Ref. 46, National Energy Transportation, Vol. 1, Pub. 95-15.

TABLE I-E-94. Motor Fuel Use - 1975

Area	Private and Commercial Use	Public Use	Total Use	Losses Allowed for Evaporation, Handling, etc.	Total Quantity Consumed
Alaska	214,293	12,190	226,483	1,944	228,427
Idaho	511,432	18,184	529,616	5,310	534,926
Oregon	1,349,510	47,550	1,397,060	12,339	1,409,399
Washington	1,818,301	63,006	1,881,307	4,337	1,885,644
Region	3,893,536	171,304	4,034,466	23,930	40,583,396
Total U.S.	110,262,585	2,364,071	112,626,656	922,127	113,548,783

Data Source: Ref.43 , Highway Statistics, p. I-6.

TABLE I-E-95. Private and Commercial Nonhighway Use of Gasoline - 1975 (Thousands of Gallons)

Area	Classified					Total Classified and Unclassified
	Agricultural Use	Aviation	Industrial and Commercial	Marine	Total	
Alaska	569	15,275	3,895	5,734	25,473	40,367
Idaho	31,482	3,877	2,267	3,876	41,502	41,502
Oregon	14,723	5,638	8,877	11,905	41,143	41,143
Washington	12,469	8,184	5,954	17,488	45,734	45,734
Region	59,243	32,974	20,993	39,003	153,852	168,746
Total U.S.	1,564,882	409,713	178,503	729,718	3,016,283	3,161,183

Data Source: Ref. 43, Highway Statistics, p. I-9.

TABLE I-E-96

Total Mileage[a] of Natural Gas Pipelines and Utility Mains

Area	1970	1972
Alaska	667	635
Idaho	3,226	3,482
Oregon	8,014	8,409
Washington	9,815	10,499
Region	21,722	23,025
Total U.S.	914,830	951,223

(a) Includes field, gathering, underground storage, transmission and distribution main, but excludes service pipe. Data not adjusted to common diameter equivalent. Mileage shown as of end of year.

Data Source: Ref. 47, Energy Statistics, p. 15.

TABLE I-E-97

Vehicle Miles by Area, Federal-Aid Highway System, 1975

Area	Miles, in Millions						
	Interstate Rural	Interstate Urban	Total Interstate	Other Primary	Other Secondary	Federal Aid Urban	Federal Aid Total
Alaska	--	--	--	1,178	407	--	1,585
Idaho	1,111	164	1,275	1,512	1,147	682	4,616
Oregon	2,110	1,356	3,466	4,314	3,319	--	11,099
Washington	2,096	3,674	5,770	5,339	4,880	1,686	17,674
Region	5,317	5,194	10,511	12,343	9,753	2,368	34,975

Data Source: Ref. 43, U.S. Department of Transportation, Highway Statistics, Section 1. 1975 p. III-4

TABLE I-E-98

Vehicle Miles of Travel, 1975

Area	Miles, in Millions		
	Rural	Urban	Total
Alaska	1,508	1,052	2,560
Idaho	4,051	1,822	5,873
Oregon	10,506	5,432	15,938
Washington	10,200	13,823	24,023
Region	26,265	22,129	48,394
Total U.S.	600,631	729,433	1,330,074

Data Source: Ref. 44, Motor Vehicles Facts and Figures, p. 69

TABLE I-E-99

Motor Vehicle Registrations by Area, 1975

Area	Automobiles	Trucks and Buses	Total Motor Vehicles
Alaska	142,717	82,858	225,575
Idaho	406,593	240,853	647,446
Oregon	1,320,294	307,298	1,627,592
Washington	1,883,271	656,493	2,539,764
Region	3,752,875	1,287,502	5,040,377

Data Source: Ref. 44, Motor Vehicle Facts and Figures. p. 24

TABLE I-E-100

U.S. Motor Bus Registrations by Area - 1975

Area	Private and Commercial		Publicly Owned		Total School Buses	Total Buses
	Commercial Buses[a]	School and Other[b]	Federal	School[c]		
Alaska	551	392	25	33	425	1,001
Idaho	341	351	141	1,906	2,257	2,739
Oregon	758	1,514	37	4,229	5,743	6,538
Washington	416	3,677	112	6,902	10,579	11,107
Region	2,066	5,934	315	13,070	19,004	21,385
Total U.S.	93,833	135,503	2,329	230,479	365,982	462,144

(a) Includes municipal-owned transit buses.
(b) In some instances church, industrial and other private buses are included here; and in other instances privately-owned school buses could not be segregated from commercial buses, and are included with the latter.
(c) This column consists primarily of publicly-owned school buses but include a few privately-owned school institutional and industrial buses registered free or at a reduced rate.

Data Source: Ref. 44, Motor Vehicle Facts and Figures, p. 27.

TABLE I-E-101

Commercial Jet Aircraft Departures[a]

Place Name	Total Departures	Fuel Use Gallons	Fuel Use, Billion Btu	Percent of County Gasoline
Alaska				
Anchorage	6,760	2,739,979	356	3.1
Fairbanks	3,691	1,375,973	179	4.7
Total	10,451	4,115,952	535	2.3
Idaho				
Ada	8,950	2,911,801	379	3.7
Bannock	2,158	564,791	73	1.3
Bonneville	2,120	554,736	72	1.9
Total	13,228	4,031,328	524	0.9
Oregon				
Jackson	2,949	773,891	101	1.3
Lane	4,058	1,063,299	138	0.9
Multnomah	36,643	14,450,670	1,879	4.1
Total	43,650	16,287,860	2,117	1.3
Washington				
Benton	2,180	570,436	74	1.7
King	44,913	21,026,012	2,733	3.5
Spokane	13,269	4,870,000	633	3.8
Total	60,362	26,466,448	3,441	1.6
Region	127,691	50,901,588	6,617	6.1

(a) Idle, taxiing, takeoff, climbout.

Data Source: Ref. 5, Energetics of the USA, Table 10.

TABLE I-E-102

Regional Domestic Oceanborne Commerce Tonnage Received and Shipped by Regional Ocean Ports, Carried by All Type Vessels - 1976

Area	Receiving		Shipping	
	Tonnage	Percent of Total	Tonnage	Percent of Total
Alaska				
Southeastern ports	436,587	0.18	206,141	0.09
Anchorage	3,312,823	1.38	418,850	0.17
Fairbanks	278,015	0.12	44,623	0.02
Kodiak	212,447	0.09	126,506	0.05
Petersburg	9,119	0.00	9,382	0.00
Sitka	121,198	0.05	19,750	0.01
Idaho				
Sandpoint	539,443	0.22	9,600,229	4.00
Oregon				
Coos Bay	443,207	0.18	681,675	0.28
Newport	5,344	0.00	80,843	0.03
Portland	3,492,104	1.46	293,278	0.12
Salem	785,803	0.33	89,511	0.04
Washington				
Aberdeen-Hoquiam	142,470	0.06	--	--
Anacortes	661,629	0.28	914,083	0.38
Bellingham	--	--	1,792,205	0.75
Everett	11,285	0.00	--	--
Port Angeles	34,118	0.01	51,825	0.02
Port Townsend	14,951	0.01	--	--
Seattle	2,150,636	0.90	1,707,941	0.71
Tacoma	361,853	0.15	435,436	0.18
Vancouver	3,239	0.00	55,514	0.02

Data Source: Ref. 48, Domestic Water Trade of U.S.

TABLE I-E-103. Domestic Oceanborne Commerce Between the Region and Other Geographical Areas - by Type of Vessel, Calendar Year 1975 (Short Tons)

Area of Shipping	Total Tons	Area of Receiving: North Atlantic	South Atlantic	Gulf	California	Pacific Northwest	Hawaiian Islands	Alaska	Other Pacific Island Trust Territories
Self-Propelled Vessels									
Alaska	192,568	--	--	--	90	136,514	--	55,964	--
Pacific Northwest	1,306,452	111,190	16,089	--	338	60	348,204	830,571	--
U.S. Total Dry	14,889,018	3,404,724	444,825	1,310,904	2,117,313	547,545	2,670,666	886,535	136,695
Alaska	9,527,122	--	--	33,581	7,769,932	605,922	75,320	1,042367	--
Pacific Northwest	3,096,006	39,264	16,036	21,188	2,440,860	218,483	181,043	179,132	--
U.S. Total Tanker	159,027,203	84,096,849	16,597,853	16,781,677	29,521,909	5,824,183	1,608,359	2,299,435	--
Nonself-Propelled Vessels									
Alaska	464,096	--	--	--	37,276	285,505	--	141,315	--
Pacific Northwest	2,145,773	32,127	--	--	500,835	522,990	175,686	913,057	1,078
Total Dry	21,332,503	3,941,845	317,309	10,664,132	595,800	860,158	2,207,906	1,104,288	2,015
Alaska	761,954	--	--	--	7,664	26,450	--	727,840	--
Pacific Northwest	398,165	--	--	--	307,239	39,761	7,355	43,810	--
Total Tank	39,228,908	24,146,302	5,209,509	7,230,365	1,238,958	191,376	251,591	776,822	--

Data Source: Ref. 48, Domestiuc Water Trade of U.S.

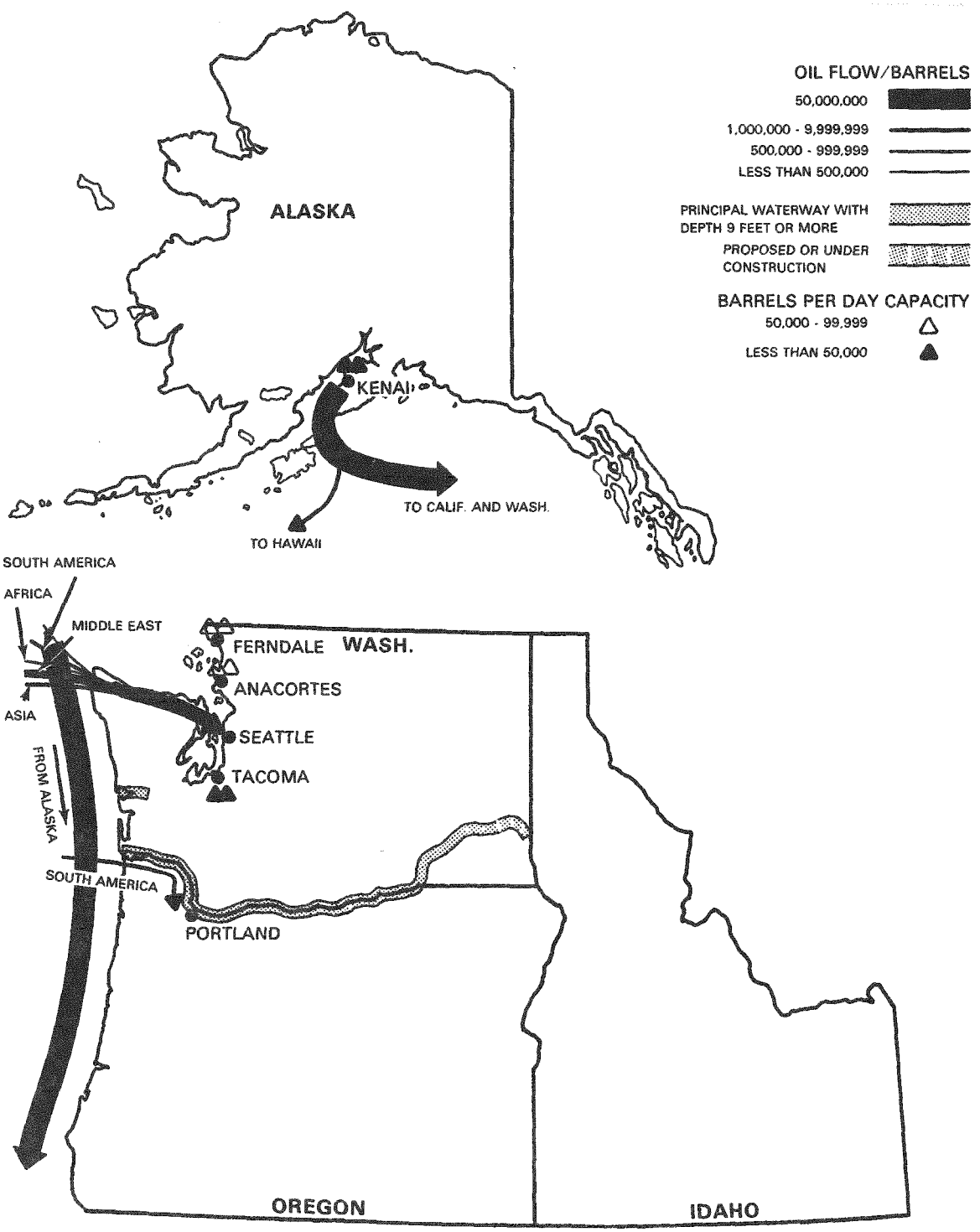

FIGURE I-E-67. Crude Oil Movement by Water - 1974

Data Source: Ref. 46, National Energy Transportation, Map no. 8.

PETROLEUM PRODUCTS MOVEMENT BY WATER: 1974

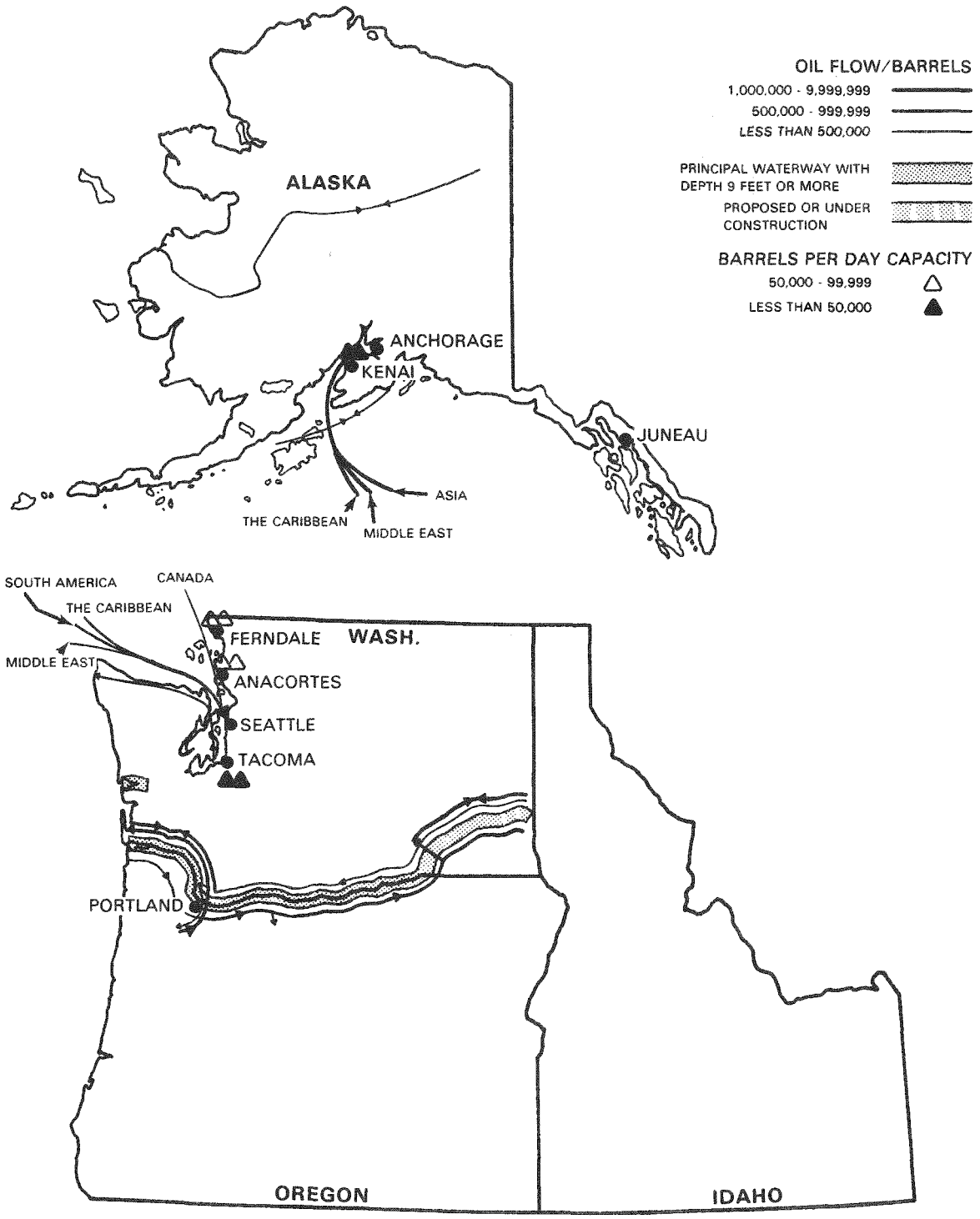

FIGURE I-E-68. Petroleum Products Flow by Water - 1974

Data Source: Ref. 46, National Energy Transportation, Map no. 10.

TABLE I-E-104. Motor Vehicle-Related Employment by Area

Area	Motor Vehicle-Related Industries Employment						Total Motor Vehicle-Related Industries	
	Motor Vehicle and Parts Manufacturers 1974	Automotive Sales and Servicing 1972	Road Construction and Maintenance 1974	Truck Drivers and Other Employees 1975	Petroleum Refining and Wholesaling 1974	Passenger Transportation 1974[a]	Employment	Percent of Total State Employment
Alaska	5,238	45,928	19,808	162,500	442	2,345	236,261	26.0
Idaho	206	12,010	3,857	49,400	678	619	66,770	35.3
Oregon	4,184	37,119	6,957	120,400	1,589	3,416	173,665	27.4
Washington	2,451	47,346	15,377	194,200	1,517	(c)	260,891	29.0
Region	12,079	142,403	45,999	526,500	4,226	6,380	737,587	
Total U.S.	773,695[b]	2,858,425	755,976[b]	9,059,800	217,728[b]	296,520[b]	13,961,695[b]	22.0

(a) Includes some local rail and subway employees.
(b) Partial total.
(c) Withheld to avoid disclosure.
Note: Individual states may not add to "U.S. Total" due to rounding.
Data Source: Ref. 44, Motor Vehicle Facts and Figures, p.61.

TABLE I-E-105

Estimated Average Number of Employees in Important Segments of the Regional Petroleum Industry in 1975 and 1976

Area	Pipeline Transportation of Crude and Refined Petroleum		Gas Production and Distribution	
	1975	1976	1975	1976
Alaska	79	N/A	215	237
Idaho	10[a]	14	520	494
Oregon	(b)	19	1,247	1,220
Washington	91	85	1,350	1,356
Region	180	118	3,332	3,307
Total U.S.	16,459	16,052	161,956	144,069

(a) Estimated.
(b) Averages based on less than one year's data.
N/A: Not available.

Data Source: Ref. 49, Oil Producing Industry in Your State, pp. 97 and 101.

TABLE I-F-106

ENERGY FUEL PRICES BY SECTOR AND UNITS, 1975

Fuel Type and Units	Fuel Prices, Current $			
	Alaska	Idaho	Oregon	Washington
Distillate Oil:				
Residential (dollars/mill, Btu)	2.94	2.87	2.87	3.00
Commercial (dollars/mill, Btu)	2.68	2.62	2.62	2.74
Industrial (dollars/mill, Btu)	2.66	2.62	2.62	2.74
Residential Oil:				
Commercial (dollars/mill, Btu)	2.57	2.59	2.51	2.63
Industrial (dollars/mill, Btu)	2.57	2.50	2.51	2.62
Kerosene:				
Residential (dollars/mill, Btu)	2.93	2.86	2.86	2.99
Commercial (dollars/mill, Btu)	2.67	2.60	2.60	2.72
Industrial (dollars/mill, Btu)	2.67	2.60	2.60	2.72
Liquid Petroleum Gas:				
Residential (dollars/mill, Btu)	2.74	2.67	2.67	2.79
Industrial (dollars/mill, Btu)	2.50	2.44	2.44	2.55
Natural Gas:				
Residential (dollars/mill, Btu)	1.58	2.11	2.13	2.20
Commercial (dollars/mill, Btu)	0.94	1.50	1.81	1.76
Industrial (dollars/mill, Btu)	0.58	1.13	0.93	1.30
Electricity:				
Residential (dollars/mill, Btu)	9.29	4.82	4.82	3.60
Commercial (dollars/mill, Btu)	10.01	4.52	4.81	3.80
Industrial (dollars/mill, Btu)	6.31	2.51	1.98	1.27

Data Source: Reference 50, Federal Energy Data System, Preliminary State Energy Prices, Table 7.

TABLE I-F-107

RATES OF GROWTH ON RETAIL ENERGY PRICES, 1964-1974

Area and Fuel Type	% Increase Per Year[a]
Washington	
Electricity	-4.94
Natural Gas	-0.08
Oil: Nontransportation	1.18
Transportation	0.60
Oregon	
Electricity	-3.18
Natural Gas	-0.17
Oil: Nontransportation	2.11
Transportation	0.17
Idaho	
Electricity	-4.74
Natural Gas	-0.46
Oil: Nontransportation	1.29
Transportation	-0.62
Pacific Northwest	
Electricity	-4.31
Natural Gas	-0.17
Oil: Nontransportation	1.53
Transportation	0.28

(a) These rates of growth in prices are projected to occur over and above the general rate of inflation. The electricity, natural gas and oil price increases are based on average prices of energy sources computed as a weighted average of the price and 1974 consumption level in each sector. Transportation uses of oil include gasoline and diesel used in the transportation sector; nontransportation uses of oil include fuel oil and residual oil used in the residential, commercial and industrial sectors.

Data Source: Reference 3, Energy Futures Northwest, p. 65.

TABLE I-F-108

Rates of Growth in Price and Consumption
of Natural Gas and Petroleum Products
1964 to 1974

Product	Percent of Increase per Year	
	Consumption	Average Price[a]
Natural Gas		
Washington		
Industrial	3.59	2.41
Commercial	8.24	-2.84
Residential	8.96	-1.78
Total	5.29	--
Oregon		
Industrial	3.82	2.61
Commercial	9.59	-3.79
Residential	7.02	-2.17
Total	5.36	--
Idaho		
Industrial	3.61	0.20
Commercial	6.19	-1.61
Residential	7.06	-0.82
Total	4.75	--
Petroleum Products		
Washington	2.04	1.62[b]
Oregon	2.98	3.92[b]
Idaho	4.70	2.66[b]

(a) Computed from real prices expressed in 1967 dollars.
(b) Rate of growth in price for commercial delivery.

Data Source: Ref. 51, Energy Demand Modeling and Forecasting, p. 113.

TABLE I-F-109

Rates of Growth in Price and Consumption of Electricity, 1964 to 1974

State	Percent of Increase per Year	
	Consumption	Average Price[a]
Washington		
Industrial	5.16	-4.87
Commercial	7.30	-6.00
Residential	6.02	4.77
Total	5.79	--
Oregon		
Industrial	6.04	-2.31
Commercial	6.63	-2.78
Residential	5.38	-1.27
Total	5.95	--
Idaho		
Industrial	5.07	-4.41
Commercial	8.57	-5.78
Residential	7.16	-4.83
Total	6.66	--

(a) Computed from real prices expressed in 1967 dollars.

Data Source: Ref. 51, Energy Demand Modeling and Forecasting, p. 112.

REFERENCES

1. M. Riley (Ed.), "Alternative Scenarios Facing the Region," Background Paper 8, Washington Commission for the Humanities, Department of Health, Education, and Welfare, University of Washington, (1977).

2. The Impact of Increased Coal Consumption in the Pacific Northwest, Regional Assessment Program - Report 21, Battelle, Pacific Northwest Laboratories, Richland, WA 99352, (March 1978).

3. Energy Futures Northwest, Northwest Energy Policy Project, Pacific Northwest Regional Commission, (May 1978).

4. Energy Northwest, Battelle, Pacific Northwest Laboratories, Richland, WA 99352, (1977).

5. F. Drysdale and C. Caley, Energetics of the U.S.A.: An Atlas, Brookhaven National Laboratory, BNL-50501-R, (revised October 1977).

6. Fuels and Energy Data: U.S. by States and Census Divisions, 1974, Washington, Bureau of Mines Information, Circular/1977-IC-8739, U.S. Department of the Interior, (1977).

7. D. Lange, "Forecast Review," Oil and Gas Journal, p. 119-149, (January 30, 1978).

8. Basic Petroleum Data Book, American Petroleum Institute, Washington, API, (October 1975).

9. C. L. Chase, Petroleum Supply System, (draft), Federal Energy Administration, (October 1976).

10. W. W. Eaton, Oil, ERDA, (1977).

11. The Nation's Renewable Resources, An Assessment, U.S. Department of Agriculture, U.S. Forest Service, Forest Resource Report No. 21, (June 1977).

12. Mineral Industry Survey: Bituminous Coal and Lignite Distribution Calendar, Year 1975, U. S. Department of the Interior, Bureau of Mines, Washington, DC (May 1975, April 12, 1976).

13. Mineral Yearbook, U. S. Department of the Interior, Bureau of Mines, Washington, DC, (1972-1977).

14. Fuel and Enery Data: U.S. by States and Census Division, 1973, Information Circular 1973-IC-8722, U.S. Department of the Interior, Bureau of Mines, Washington, DC, (1976).

15. Coal-Bituminous and Lignite, 1974, U.S. Department of the Interior, Bureau of Mines, Washington, DC.

16. 1976 Keystone Coal Industry Manual, McGraw-Hill, Inc., New York, NY, (1976).

17. National Uranium Resource Evaluation - Preliminary Report, Energy Research and Development Administration, (June 1976).

18. National Energy Transportation, Vol. I, Pub. No. 95-15, Table 2 and 3, Congressional Research Service, (April 1976).

19. Fuel and Energy Data: U.S. by States and Regions, 1972, Bureau of Mines Information Circular 1974-IC-8647, U.S. Department of the Interior, Bureau of Mines, (1974).

20. U.S. Energy Fact Sheets, U. S. Department of the Interior, Washington, DC, (February 1973).

21. Review of Power Planning in the Pacific Northwest, Power Planning Commission, (May 1977).

22. Alaska Regional Profiles, Office of the Governor, State of Alaska, Arctic Environmental and Information Data Center, six volumes, (1974).

23. Solar Energy for Pacific Northwest Residential Heating, Department of Energy, (May 1978).

24. The National Atlas of the U.S., U. S. Department of the Interior, Washington, DC, (1970).

25. The Role of the BPA in the Pacific Northwest Power Supply System; Part 1, "The Regional Electric Power Supply System,", Bonneville Power Administration, U.S. Department of the Interior, (1977).

26. D. L. Elliott, "An Overview of the National Wind Energy Potential," presented at Conference on Climate and Energy: Climatological Aspects and Industrial Operations, Asheville, NC, (May 8-12, 1978).

27. A. M. McRae and J. L. Dudis, The Energy Source Book, Center for Compliance Information, Aspen Systems Corporation, Germantown, MD, (1977).

28. Fuels from Biomass Program - Summary, DOE/ET-002/1, No. 6, UC-71, U.S. Department of Energy, Division of Solar Technology, Washington, DC, (January 1978).

29. Effective Utilization of Solar Energy to Produce Clean Fuel, Project 2643, Stanford Research Institute, Menlo Park, CA (June 1974).

30. Forestry and Manure Residue Inventory, - Continental U.S., SRI Project 5093, Vol. 7 and 8, Stanford Research Institute, (June, 1976).

31. Energy Potential from Organic Wastes: A Review of the Quantities and Sources, U.S. Department of Interior, Bureau of Mines, (1972).

32. Crop Forestry and Manuare Residue Inventory, Stanford Research Institute, Menlo Park, CA, (July 1977).

33. The Potential of Wood as an Energy Resource, Federal Region Council, (September 1977).

34. Pumped-Storage in the Pacific Northwest, Report No. 26, U.S. Army Corps of Engineers, (1976).

35. Edward Kaufman, et al., Environmental Control Technology R&D Requirements for Energy Storage Systems, Los Alamos Scientific Laboratory, LA-6979-MS, (September 1977).

36. Statistical Yearbook, Edison Electric Institute, No. 43, (October 1975); No. 42, (1975); No. 40, (1971-72); Second Edition, (1961-1970).

37. FPC News, Vol. 9, No. 23, Federal Power Commission, U.S. Printing Office, (June 4, 1976).

38. Federal Energy Data System, U.S. Department of Energy, Energy Information Administration, Washington, DC, (February 1978).

39. Historical Sales Data in the Pacific Northwest by State, 1950, 1955, 1964-1975, Bonneville Power Administration and Urah Power and Light.

40. Regional Assessment Program 1975 - Annual Report, RAP-2084, Report No. 1, Battelle, Pacific Northwest Laboratories, (June 1976).

41. Kidman, Barrett, and Koenig, Energy Flow Patterns for 1975, Los Alamos Scientific Laboratory, LA-6770, Los Alamos, NM, (June 1977).

42. B. Highsmith, Jr. (Ed.), Atlas of the Pacific Northwest: Resources and Development, Fourth Edition, Oregon State University Press, (1968).

43. Highway Statistics, Section 1, Report No. FHWA-HP-HS-75-OIR, U.S. Department of Transportation, (1975).

44. Motor Vehicle Facts and Figures, 1977, Detroit Motor Vehicle Manufacturers Association, (1977).

45. County Business Patterns, "Number of Employees Based on Class I Railroads," Economics and Finance Department, Reports to AAR, Annual Reports to the I.C.C., Statement A-300, U.S. Department of Commerce, Bureau of Census, Washington DC, Tables 1A, 1B, 1C and 1D.

46. National Energy Transportation, U.S. Printing Office, Committee on Energy and Natural Resources, Vol. I, Publication No. 95-15, Washington, DC, (May 1977).

47. Energy Statistics, NTIS, Report No. PB-238-767, U.S. Department of Commerce, Transportation Systems Center, (August 1974).

48. Domestic Water Trade of U.S., U.S. Department of Commerce, Maritime Administration, Office of Domestic Shipping, USGPO, Washington, DC, (1972- 1976).

49. "The Oil Producing Industry in Your State," Independent Petroleum Association of America, (1977).

50. Preliminary State Energy Prices in Current Dollars Stated in Both Physical and Calorific Units, U.S. Department of Energy (FEA), Federal Energy Data System, EIA - Consumption Studies Division, Office of Energy Data Development.

51. Energy Demand Modeling and Forecasting, Northwest Energy Policy Project, Mathematical Sciences Northwest, Inc., Washington, DC, (1977).

ENVIRONMENT: A REGIONAL OVERVIEW

The Northwest Region is large: Alaska, Idaho, Oregon and Washington cover more than 835,000 square miles -- nearly one-quarter of the total United States. Yet, the Region contains less than 4% of the national population. The four-state Region had an estimated 1975 population of more than 7 million, with about half living in Washington. Oregon is the next most populous state, followed by Idaho and Alaska. During the period from 1970 to 1975, the population in the Northwest generally grew at a rate significantly above the national average; while the nation grew 5.1% during the period, these states had population increases of 20.8% in Alaska, 14.9% in Idaho, 9.5% in Oregon, and 4.5% in Washington.

Idaho, Oregon and Washington have five distinct topographical areas:

1) coastal lowlands and mountains along the Oregon-Washington coast, including Washington's rugged Olympic Mountains;

2) the Willamette Valley in Oregon, and the lowlands of Puget Sound in Washington -- the Region's most densely populated area, containing about four million people;

3) the Cascade Mountains of Oregon and Washington, supporting a large wood products industry, recreation, and orchards on the lower slopes;

4) a broad basin-plains area through eastern Oregon, eastern Washington and southern Idaho, best known for argriculture and the food products industry;

5) the Rocky Mountains in extreme northeastern Washington and central Idaho.

The Pacific Northwest's economy is based on mining, logging and tourism. The Region is markedly different from others in the United States. Alaska is divided by climate, physical features, population density, distance, and other factors. Except for hydropower, Idaho, Oregon and Washington are not blessed with significant resources, yet they support significant industrial

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Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, Appendix A.

and agricultural economies. Alaska, however, is endowed with vast resources in the initial stages of development. These contrasting features unify the Region through future energy and economic interdependencies.

Regional employment projections expect nearly 3.2 million workers by 1980, up from the current level of 2.8 million. The largest increase in workers is expected in government -- more than 19% between 1974 and 1980. Commerce and trade are expected to increase more than 18% during the same time. Energy-intensive industries such as transportation, utilities, paper and pulp, primary metals, food processing, and petroleum refining also expect significant gains in the next 10 years. Meeting the energy requirements of this expected growth entails significant energy planning.

Alaska is heterogeneous in terms of economic activity, climate, population, and energy resources or supplies. Southeastern Alaska is best characterized by industries centered around forest products and fishing, by high precipitation, by small isolated communities linked only by air and marine transporation, and by a large dependence upon imported domestic oil and hydroelectric energy. With the exception of hydropower, no significant energy sources exist in this part of the state.

Southcentral Alaska contains Anchorage, the major population center ($\sim$200,000); it also contains the major trade, transportation and service industries in the state, the major port facilities, and a sizeable energy-related industrial base associated with the Cook Inlet oil and gas reserves. The relatively cold climate is modified by marine influences.

Central Alaska contains the second largest city in the state, Fairbanks, with economic activity centered around the service industries. Fairbanks is linked by rail and highway to Anchorage, to the port of Whittier in the south-central region, and to the "lower 48" via the Alaska Highway; hence, it serves as the distribution center for interior and northern Alaska. The climate exhibits wide seasonal variations. Fairbanks is subject to atmospheric inversions and occasionally severe air pollution in the winter months resulting from windblown glacial silt.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, Appendix A.

The two most rapidly growing regions are the Southcentral (primarily the Anchorage-Kenai Peninsula area) and to a lesser extent, the Yukon (interior) region with the Fairbanks load center. Both regions have been heavily impacted by the North Slope oil field and pipeline developments. The compound annual energy growth rate between 1960 and 1976 has been 11.4% for the Interior region, 12.6% for the Southcentral, and 11.5% for all of Alaska. For the period 1970 to 1975, the time of significant petroleum development, the growth for the whole state was 12.2%/yr.

The availability of low-cost electricity has caused many energy-intensive processing plants to locate in the Pacific Northwest. As of January 1976, the Pacific Northwest chemical processing industry included: 5 electrochemical plants for production of chlorine and caustic soda; 24 pulp and paper mills; a glass-making furnace plant; and 10 electric furnace plants for production of calcium carbide, elemental phosphorous and silicon, abrasives, refractory metals, and ferroalloys. The Region also hosts ten large electrolytic reduction plants; these account for 31% of the total U.S. production capacity for aluminum metal.(1)

Although there are isolated problem areas, the Region's air and water qualities are generally excellent; where there are problems, qualities are in some respects improving as national and state standards become progressively stricter and better enforced.

For the most part, federal ambient sulfur dioxide standards are met in the Northwest. The only exceptions are Salem, Oregon and a few sites in southeastern Idaho. The most severe carbon monoxide problems, due almost entirely to motor vehicle emissions, are in Seattle, Spokane, Portland and Boise. In Boise, standards were exceeded 115 days in 1976 and 40 days in the first nine months of 1977; in Seattle and Spokane standards are exceeded 100 days a year; in Portland, which has had a significant decrease in carbon monoxide values since 1967, standards are still exceeded 50 days a year. Most areas of the Northwest meet federal standards for photo-chemical oxidants

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(1) Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, Appendix A.

and hydrocarbons, although monitoring stations in Seattle and Spokane report some violations and the photochemical oxidant standard was violated in downtown Portland for the first time in 1975.(1)

Lax emissions abatement efforts and haphazard siting would make the Region's natural environment potentially more vulnerable to effects of energy production and consumption growth than it would otherwise be. Potential hazards to the environment are spread throughout the energy system from points of production (as at surface coal mines and thermal powerplants) through transportation (as in the case of oil tankers in Puget Sound and transmission lines across forest lands) and on to the points of end use (as at the tailpipe of automobiles and the chimneys of homes and factories). Some of these risks to health and to the environment are commonly acknowledged with certainty, and some are susceptible to abatement with perfected technologies and at acceptable costs. Still others are not as well understood, and ways to alleviate them are problematical or exorbitantly costly.

For example, thermal pollution to waterways from the discharge of waste heat at thermal powerplants is a problem that is fairly well understood. And although its solution--recycled water through cooling towers or cooling ponds--reduces powerplant efficiency and results in higher costs, it is a developed technology that is accepted as part of the cost of thermal power production in the Pacific Northwest. Potential impacts of nuclear power, however, are not as well understood. Although there is no combustion involved in nuclear energy production--and that is a clearcut advantage--the issues of reactor safety, radioactive waste disposal, and theft of nuclear materials are highly charged and controversial, both among the public at large and within the scientific community. There is uncertainty about the magnitude of the damages that might result from a serious reactor accident and about the probability of such an event actually occurring.(2)

There are four basic ways in which public policies can diminish or eliminate potential damage to the environment from energy production and consumption:

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(1) Information Source: Ref. 2, Energy Futures Northwest, p. 52.
(2) Information Source: Ibid. p. 54.

1) reduction in energy use (conservation);

2) reduction in impacts per unit of energy produced or used (abatement);

3) shifting of impacts from more sensitive to less sensitive locations siting); and

4) shifting from high-pollution energy sources, such as coal, to lower-pollution energy sources, such as wind or solar (fuel substitution).

The best environmental protection is likely to include a mixture of all four types of policies and will also recognize that each alternative involves benefits, costs and consequences that are not fully understood at present.

Information Source: Ref. 2, Energy Futures Northwest, p. 54.

DATA QUALITY

FOR

CHAPTER II - PERSPECTIVES AND DATA ON ENVIRONMENTAL CONDITIONS

Outline	Resolution (temporal spacial) of Data Available and Included	Finer Resolution Available to Laboratory But Not Included
B. Water		
1. Surface		
a. Sources	ASR areas, major rivers, river basins, length of rivers	More detailed maps and data for sub-regional river basins
	No shoreline data	
b. Quantity	Streamflow, seasons of highest and lowest flow, runoff	Available by month
	No virgin flow information	Modifications have altered data for calculation
c. Non-available flow	Critical surface supply, the month and 95% flow, water competition, inadequate supply	Lab is involved in researching data in this area for the lower 3 states
d. Water consumption	Withdraw and consumption by state and ASR's	Available by ASA
	Consumption by energy, public, irrigation, industry and per capita	
e. Identification of pollutants	Concentrations of major pollutants, location of recording stations	1976 National Water Quality Inventory
	Major pollution sources	
2. Groundwater	Contamination	
a. Importance	Use as compared to total water use and significance of depletion	Has been qualitatively assessed
b. Location	Aquifer distribution volume, and stream aquifers	Detailed information uses
c. Consumption	Groundwater withdrawal by river basin subregion (tabulated with surface water use)	Withdrawal by ASA

d. Quantity	Amount of storage and recharge by subregion (tabulated with surface water use)	
e. Quality	Contaminates and sources	
3. Water Management	Dams and reservoirs	Detailed data for subregion and for dams used for power generation
C. Air & Climatology		
1. Air Quality Status		
a. Criteria Pollutants	AQMA households affected in areas	
	State of compliance w/standards PSD attainment status	
b. Class I Areas	Mandatory Class I area and acreage within lower 3 states	
c. Emissions	TSP, SO_2, CO_2, NO_2, and ozone by air quality control region	Annual concentrations by state and county
	Pollutant concentrations by county	Annual average by state and county
		Ambient air quality available from upgrade
2. Climatology		
a. Precipitation	Normal annual minimum and maximum	
b. Temperatures	Mean annual, minimum, maximum January and July	
c. Heating/ cooling degree days	Total heating degree days annual solar and by quarter	
	Mean annual cooling degree days	
d. Potential evaporation	Annual average for surface water and lakes (only lower 3 states)	
e. Wind	Direction and speed annual and quarters summer and winter windflows	
f. Storms, flood, drought	Wind, tornadoes, thunderstorms, flood potential, fog, hail, drought potentials	

g. Mixing heights	Annual morning and afternoon and wind speeds	
3. Man-induced	Potential air pollution acid rain, sulfate, particulate, SO_2 and noise pollution	
D. Solid waste	Radioactive waste sites and characteristics	
	Resource recovery systems and characteristics	Area and site specific data for region being updated w/new developments
	Solid waste disposal sites, state management planning	More data being collected for methane production
	Offshore and marine disposal, types, amounts and sources	
E. Land		
1. Natural landscape	Physiography and topography soils and geology erosion and wetlands, seismic risk, and suitability for nuclear	More detailed data by state
2. Land use	Land capabilities, land use, acreage and by type, croplands and production, range, flood damages	More detailed data by state and county
	No data on amount of floodplains	
3. Land ownership	Land ownership by government type, federal management areas, national forest, recreation, national parks, wilderness, scenic rivers	More detailed data from each agency
4. Land use programs	Coastal zone, wetlands, shoreline programs	Information from each state
F. Biota		
1. Flora	Bailey's ecoregions, potential vegetation, forest types	More detailed flora data for each physiographic area
2. Fauna	Flyway, fisheries, game, wildlife areas, Alaska's vegetative types and related fauna	

3. Threatened and Endangered species	Endangered species by major type for each county Complete list of species by state	
G. Socioeconomic		
1. Population	Distribution, composition, population change and urban density by state	Data available at county level
2. Employment	Income structure by state, employment by SIC code and public assistance by state	County and SMSA level available
3. Housing	Age breakdown of stock and housing conditions by state	Adequate up-to-date data not readily available
4. Health	Data available by state, not related effectively to energy or environmental manipulation	

WATER

Water resources are unusually important to the Region's economy, having a role in every major activity. Hydropower plants provide the basic source of electric energy; irrigation makes agriculture possible on about one-fourth of the present croplands; the Columbia River provides a transportation artery to the heart of the Region; and Puget Sound, a long arm of the sea that reaches 200 miles east and south into Washington, provides 2000 miles of coastline with excellent deep-water harbors and industrial sites. In addition, water resources in the Region provide the basis for substantial fishing activities, supply large urban and industrial needs, and offer recreation values that are increasingly being utilized.(1)

SURFACE WATERS

The water supply in the Columbia-North Pacific Region arrives as precipitation (mostly from eastward-moving air masses off the Pacific Ocean) and as streamflow from Canada. Much of the water is stored temporarily as snow and ice on the ground, in groundwater reservoirs, and in lakes and surface reservoirs. The water ultimately discharges into the Pacific Ocean, or returns to the atmosphere by evaporation or transpiration.(2)

Streams reaching the Oregon and Washington Coast discharge an average annual aggregate of 289 million acre-feet into the Pacific Ocean. The principal waterway of the region, the Columbia River, draining an area of 259,000 square miles (39,500 square miles in British Columbia), discharges a yearly total of 183 million acre-feet (1938-1952 average) at its mouth, or over 60% of the region's runoff.

Although the stream and lake resources are great, they are unequally distributed over the region. In terms of average equivalent depth of water,

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(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.
(2) Information Source: Ref. 4, Columbia North Pacific Region Comprehensive Framework Study, Appendix II, p. 6.

yearly runoff is as much as 150 in. along the west-facing slopes of the Coast Ranges, diminishing to 20 to 30 in. in the Puget-Willamette trough, and increasing again to 120 in. on the west slopes of the Cascade Range. East of the crest, runoff decreases to less than 0.5 in. in the arid portions of central Washington, central Oregon, and on the plains of south Idaho. Nearly 55% of the Columbia River's total volume is derived from the Northern Rocky Mountains; 27% originates in the main stem above the international boundary.

Streams of the region seasonally have an alternation of high and low flows. West of the Cascades, in response to heavy winter rains, streams are at bankful capacity during the cool season, whereas their flows decrease greatly during dry summers. The Columbia River and its tributaries east of the Cascades somewhat reverse this pattern of runoff, with great outpourings from melting snow causing high flows during the early part of the warm season, and a long low-water period during the dry autumn that continues through winter when termperatures are below freezing in the mountains. Also, runoff varies from year to year. Records extending back to 1878 indicate the instantaneous flow of the Columbia River near the Dalles has ranged from a maximum 1.24 MMCF/second (June 7, 1894) to a minimum of 35,000 CF/second (January 12, 1937). Yearly runoff of the Columbia River has ranged between 225 million acre-feet (water year 1893-94) and 85.9 million acre-feet (1925-26)[1]

Precipitation varies considerably throughout the region. Western Washington averages 70 in. and boasts of having the wettest spot in the conterminous United States, the Olympic Mountains, where precipitation exceeds 200 inches. East of the Cascade Range in Washington, the average is 19 in., and for the entire state it is 40 inches. Oregon is a little drier, with averages of 53 in. for western Oregon, 15 in. for the east side, and 27 in. for the state. Idaho has an average of 22.5 in. of precipitation. Although amounts of precipitation and streamflow differ greatly from time to time and from place to place, available data do not indicate either an upward or downward long-term trend, or a long-term cycle of either precipitation or river discharge. Average discharge in the future, except for increases in depletion

(1) Information Source: Ref. 3., Atlas of the Pacific Northwest.

by consuming uses, is expected to remain about the same. East of the Cascade Range most of the runoff occurs during the snowmelt period--April-July; west of these mountains, runoff closely follows the winter rainfall pattern--high in winter and low in summer. During late summer and early autumn, streamflow consists principally of groundwater discharge to the stream channels.(1)

Quantity

Average discharge from the region, including 69,000 CFS (cubic feet per second) inflow from Canada, is about 356,000 CFS, or 257 million acre-feet/yr for the period 1929-58. Approximately 20% of the average flow originates in Canada. Much of this discharge can be made available for use, but additional storage is necessary because of great runoff variability involving both time and place.

Water availability may be defined as the water available on a percentage basis, such as 80%, 90% or 95% of the time. Including water originating in Canada, the Columbia-North Pacific region would have about 245,000 CFS available 80% of the time, 203,000 CFS 90% of the time, and 180,000 CFS 95% of the time.

Records show that the average discharge of 178,000 CFS in the base period 1929-58 for the Columbia River at the Dalles, Oregon, is 91% of the long-term (87-yr) average. For streams west of the Cascade Range, the base-period average discharges are nearly 100% of the long-term means. These figures indicate that the long-term average discharge for the region may be 5% greater than the base-period average of 353,000 CFS.(2)

Surface water runoff for the lower part of the region averages 278 million acre-feet annually, which equals a continuous flow of 384,000 CFS. Of that, 54 million acre-feet (74,000 CFS) are inflow from Canada and 224 million acre-feet (310,000 CFS) originate within the lower region; 54% (167,000 CFS) of the latter occur within the Columbia River System.

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 62.

(2) Information Source: Ref. 4, Ibid.

Coastal outflow (88,000 CFS), represents the combined average outflow rate for all Oregon and Washington coastal streams, exclusive of Puget Sound. In actuality, each coastal stream collects the runoff from an independent watershed, not having a natural hydraulic link with the others except for small amounts of groundwater interchange. Other than for minor water diversions, the coastal subregion does not receive inflow from other subregions.

For the Columbia River system, the largest contribution (74,000 CFS) comes from Canada. Within the U.S. portion of the Columbia River system, the Snake River watershed contributes the largest average runoff rate (46,000 CFS) after adjustments for consumptive use; and the Yakima watershed contributes the least (3,000 CFS).(1)

Variation

In spite of the apparent large total supply, water is not always available where and when it is needed. Extreme variation occurs in the distribution of annual runoff. In the western part of the region, large amounts of precipitation generate an average annual runoff that exceeds 100 in. in a substantial area of the Coast and Cascade Ranges. In contrast, runoff averages less than 1 in./yr in much of eastern Washington, eastern Oregon, and southern Idaho. Annual runoff greater than 40 in. is rare in any area east of the Cascade Range. In addition to the uneven distribution of runoff, large variations in stream flow occur on a monthly, yearly, and long-term basis.

West of the Cascade Range the major part of the runoff occurs in winter, and is closely related to precipitation. High water in winter results from rain at lower elevations and rain on snow at higher elevations. At these higher elevations, low flows occur in winter because of snow accumulation, and high flows come in summer as a result of snowmelt.(2)

East of the Cascade Range various conditions such as melting snow on lower elevation plateaus in early Spring, melting mountain snowpacks in

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(1) Information Source: Ref. 5, Water Today and Tomorrow, pp. 23-24.
(2) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 63.

summer, or local thunderstorms in summer cause the greater part of the annual stream discharge to occur in spring and early summer.(1)

A wide variance in annual annual runoff through the region is evident, ranging from 120 in. or more in the Coast and Cascade Ranges to less than 1/2 in. in parts of the Columbia and Snake Plateaus and in the Oregon Closed Basin.

Seasonal variance between high and low flows causes water supply dependability to be much lower than would be deduced from annual runoff rates. The extreme condition, a negative runoff rate, occurs in the Upper Columbia subregion during an average April/May/June low-flow season. That means that as early as 1970 the water use rate exceeded runoff originating in that subregion during the low-flow season. Consequently, some of the Columbia subregion's water use depends upon inflow from Canada--a dependency that is increasing as water use increases.(2)

A pronounced low-flow season exists throughout most of the region. It defines an upper limit of possible increased use with existing levels of water control and with existing water management practices. Those low-flow periods generally coincide with periods of highest water use and lowest precipitation.

High flows caused by spring (April/May/June) snowmelt is evident in many interior subregions. In contrast, high flows in subregions west of the Cascades reflect winter (January/February/March) rainstorms.

Once the watershed soils are saturated, usually by mid-November, most rainfall immediately runs off into the stream system. Consequently, a series of major winter rainstorms in westside watersheds will result in a series of runoff peaks and in flooding at various locations.

During the annual summer drought (July/August/September), streamflow in the Willamette and other stream systems with similar characteristics consists mainly of groundwater base flow, augmented at some locations by releases from storage.

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 63

(2) Information Source: Ref. 5. Water Today and Tomorrow, pp. 23-24.

Glaciers assist in maintaining summer flows in some streams heading in the Cascade Range. The Pacific Northwest has about 83% of the glacier-covered area in the conterminous United States. Annual glacial runoff in the region amounts to about 1.4 million acre-feet, two-thirds of which is released during the summer months.

The Columbia River at the Dalles illustrates the predominant influence of spring snowmelt east of the Cascades. Maximum peaks are seasonable and much less "flashy" than for westside streams. A sustained high streamflow occurs during the summer when most streams west of the Cascades are experiencing their lowest flows. The lowest Columbia River flows usually occur during the fall and winter months.(1)

To show the variance in streamflow for major stream systems in each subregion, Table II-B-8 lists data for 35 representatiave sites. Shown are annual maximum, mean, and minimum flows, and the flow level that is equaled or exceeded 80% of the time. Extreme conditions are further illustrated by the momentary maximum and minimum flows observed at each location during the period upon which Table II-B-8 is based. Minimum year runoff in most streams is only about 60% of the annual average; for some large streams it is only 25%.

Nonavailable Flow

Annual runoff varies considerably from year to year. It is a fallacy to assume that the average discharge of a large stream or a subregion is the available supply. Even with storage, the total mean discharge cannot be obtained for use because of natural losses and year-to-year variations. In most streams, the minimum year of discharge provided only about 60% of the average annual flow; also the mean of the minimum five consecutive years supplied only about 75% of average. There are some large streams in a few subregions that produce minimum year flows as low as 25% of the long-term average.

A large amount of water is lost by evaporation from exposed water surfaces, although the magnitude of the loss may not be obvious because it is

(1) Information Source: Ref. 5, Water Today and Tomorrow, Vol. II, p. 324-326.

usually small when compared to total precipitation. Its toll is not taken directly from precipitation, however, but from the smaller quantity of water that finds its way to the streams, lakes, and surface reservoirs, the principal sources for man's needs in many localities. Evaporation losses attain special importance in the arid portion where evaporation alone from the closed-basins area has been estimated to average 770,000 acre-feet annually. Studies by the Geological Survey indicate that in 1960 about 3.3 million acre-feet evaporated from principal reservoirs and regulated lakes.(1)

The production of fish in streams is determined by the quantity and quality of water. The amount of streamflow, especially during the summer low-flow period, is frequently the most important factor limiting their abundance. Regulation of run-off by dams can be important in supplementing flows during the low-flow period and in protecting the aquatic habitat from damage by floods. On the Willamette River, for example, the release of cool, clean water from reservoirs in the headwater has aided in breaking the pollution barrier during the late summer and fall months in the Portland Harbor area, thus permitting the upstream migration of fall Chinook salmon.

Water is also essential for wildlife--especially waterfowl; its distribution influences the distribution, and hence the abundance, of all species.

Navigation is generally limited to the coastal areas of Washington and Oregon, the Columbia River below Richland, Washington, the lower Snake and lower Willamette Rivers, and Puget Sound. The deep-water ports on the lower Columbia and Willamette Rivers. in Puget Sound, and along the coast handle all types of cargo for national and international trade. A slack water channel 14 ft deep now exists on the Columbia River up to the head of McNary Pool near Richland, and it will soon extend up the Snake River to Lewiston, Idaho. The Columbia and Willamette Rivers, several of the larger lakes and reservoirs, and many tidal streams are used in transporting log rafts.(2)

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, pp. 63-64.

(2) Information Source: Ref. 4, Ibid.

Consumption

The main consuming uses of water are rural, domestic, municipal, industrial, and agricultural. The principal nonconsuming uses, usually instream, are hydroelectric power, recreation, fish and wildlife, dilution of wastes, quality control, and navigation.

Most of the 7.3 million acres of irrigated land have an adequate supply of water, except for during the critically dry periods. However, at least 1.7 million acres of land, usually along smaller tributary streams, suffer perennial late-season water shortages. In many areas, an adequate irrigation supply has required the use of all the natural streamflow during the summer, as well as the use of regulatory and hold-over storage. There are almost 200 reservoirs with an individual active storage capacity greater than 5,000 acre-feet and a total active irrigation capacity of 17 million acre-feet. More than 1 million acres of the total irrigated area are partially or totally dependent upon groundwater. The average annual withdrawal of water for irrigation is 5 acre-feet per acre, of which about 1.9 acre-feet per acre is consumed. Some additional water is lost to nonbeneficial consumptive uses. The water not consumed becomes a return flow contribution or recharges groundwater.(1)

Water is reused many times in producing hydroelectric power. It is estimated that 1,300,000 CFS are continually in use for this purpose. During much of the year, most of the flow of the Columbia River is used in power generation. With few exceptions, all of the flow used in power generation is returned, unimpaired in quality, to the rivers.

The annual withdrawal of water for municipal use is estimated to be 1 million acre-feet annually, for industrial use 1.75 million acre-feet, and for rural domestic and livestock over 0.25 million acre-feet. The major water demand for these uses is in the area west of the Cascades. The pulp and paper industry is the largest industrial consumer, using 60% of the industrial total.(2)

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 64.

(2) Information Source: Ref. 4 , Ibid, p. 67.

Annual precipitation averages about 28 in. over the region. About 12 of the 28 in. return directly to the atmosphere through evaporation and transpiration; 16 in. become runoff. Of the runoff, about 2 in. are withdrawn by man for domestic, industrial, and agricultural uses and, of this, less than 1 in. is consumed. The remaining 15 in. of runoff are used for recreation, fish and wildlife, power production, navigation, waste transportation, and dilution of waste discharge. Stream inflow from Canada, equivalent to another 3 in. of water over the region, is also available for use.

New techniques for finding, developing, or using water supplies will make additional supplies available that may be needed to help meet the increasing demand for water. More efficient use of available supplies is expected through multiple-use projects, re-use and recycling of water, improved efficiency in the transport and application of irrigation supplies, and improved hydrometeorologic forecasting.

Additional firm supplies of fresh water probably will be made available through improved use of the water resources, including conjunctive use of surface and subsurface supplies, improved construction and use of wells to develop ground water that is not now considered to be an economic supply, and greater use of salt water in place of fresh water for some industrial requirements. Additional economically competitive supplies possibly can be developed by means of weather modification, vegetative management, and desalination; however, the practical utility of these methods in the Columbia-North Pacific Region has not yet been proved.(1)

IDENTIFICATION OF POLLUTANTS

Regionally, water quality is very good, with large quantities of relatively unpolluted surface water available; there are, however, significant water-quality problems in some parts of the region. Average dissolved-solids concentrations are less than 300 mg/ℓ (milligrams per liter) in major surface-water supply sources, and only in a few small areas does the dissolved-solids content exceed 1000 mg/ℓ.

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II. p. 62

The extent of salt water intrusion in streams discharging into Puget Sound or the Pacific Ocean has not been precisely determined. Recent measurements, however, indicate that at times salt water in the Columbia River estuary extends about 23 miles upstream, passing Astoria and nearly reaching Harrington Point.

Mountain streams generally have a dissolved-solids concentration of less than 100 mg/ℓ, and many have less than 50 mg/ℓ. In contrast, concentrations landlocked in lakes in the Oregon Closed Basins range from around 1,000 mg/ℓ to more than 70,000 mg/ℓ. The dissolved-solids content of these closed-lake waters is dependent upon amount of inflow, lake volume, evaporation, seepage loss, and soil type.

Return flow from irrigation is a major factor in increasing the dissolved-solids content of the receiving surface water. An extreme example is in the lower Malheur River in Oregon, where the concentration increases from less than 250 mg/ℓ to more than 1200 mg/ℓ during the irrigation season--an increase largely attributable to irrigation return flow mixing with a relatively small amount of receiving water. Another serious local pollutant is the sulfite waste material produced by the pulp and paper industry.(1)

Most surface water in the region is chemically suitable for domestic use, and for most industrial, agricultural, and other uses. Manufacturers requiring low concentrations of silica would need to treat the water, however, because many streams have silica concentrations greater than 10 mg/ℓ. The presence of nitrate and phosphate from both natural and man-made sources causes excessive algal growth in several areas east of the Cascade Range. Low dissolved-oxygen concentration is a seasonal problem in segments of some streams. Bacterial concentrations seasonally exceed desirable levels in the lower Willamette and Columbia Rivers and in reaches of many other streams below major communities. During the summer months, water temperatures in many streams rise to levels undesirable for native and anadromous fish life.

The areas of greatest sediment yield are those of windblown soil in the Palouse River-Walla Walla River areas of Washington and, to a lesser degree,

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(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 65.

in the Umatilla River basin of Oregon. There is a considerable range in the quantity of fluvial sediment transported; streams draining the more arid lands generally transport more sediment per square mile of drainage area than those draining the humid, forested parts. Sediment concentrations as large as 383,000 mg/ℓ have been measured in streams in the high-sediment-yield area of southeastern Washington. Streams originating from glaciers transport a rock material called "glacial flour" during the summer months, whereas streams that have low flow derived from ground water remain relatively free of fluvial sediment during the summer.(1)

WATER QUALITY

Total square-mile area of the seven aggregated subareas (ASRs) of the Pacific Northwest are shown in Table II-B-2.

Existing water quality in each ASR is described below. Summary comparisons of production residuals--biochemical oxygen demand (BOD), and total suspended solids (TSS)--generated in the subareas are shown in Table II-B-16. All data are taken from a technical memorandum prepared by the Pacific Northwest River Basins Commission.

Data indicating total dissolved solids (TDS) and bicarbonate ion (HCO_3) concentrations at gauging stations on the Columbia and Snake Rivers are presented in Table II-B-17. These data represent observed ranges between October 1974 and September 1975. They are not averages and should only be regarded as illustrative examples.

ASR 1701: Clark Fork-Kootenai-Spokane

Generally, the surface and ground waters of this ASR are of good quality. The exceptions relate to organic waste generated by municipalities and industry, and to sediment and biologically toxic concentrations of heavy metals from mining and milling of primary metals. One-half of this ASR's current BOD discharge to water is attributable to point sources. With best practicable treatment, the current load of 189 MMlb BOD/yr could be reduced by 40%.

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(1) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study, Appendix II, pp. 65-66.

This ASR produces 39% of the region's total TSS load (44,883 MMlb TSS/yr). Nearly 60% of the TSS production comes from point sources, principally mining. Best practicable treatment could reduce the total current discharge to water from 44,883 to 21,510 MMlb TSS/year.(1)

ASR 1702: Upper Columbia-Yakima-Mid-Columbia

The quality of waters of ASR 1702 is generally adequate for all uses. In some areas, however, water quality has deteriorated through either natural or man-made pollution, and this deterioration has impaired the use of certain waters. Existing problems relate to bacterial and biological contamination, temperature, and dissolved gases. High levels of dissolved nitrogen in the Columbia River pose a severe problem to anadromous fish. High water temperatures in the Columbia River and tributary streams adversely affect fish life and reduce the capacity of streams to assimilate pollutants. Localized water quality problems consist of: contamination of groundwater in certain areas of the Columbia Basin Project; bacterial problems on the Yakima, Lower Okanogan, Colville, Entiat, and other streams; and lake and stream enrichment problems, particularly in Moses Lake. The food processing industry is the principal source of industrial wastes. Irrigation return flows and feedlot drainage are significant sources of organic wastes. Low summer flows aggravated by irrigation withdrawals impair the capacity of many streams to assimilate these wastes.

Adoption of best practical treatment could reduce the BOD load by 24%, from 96.6 to 73.4 MM lb/yr. Total suspended solids could be reduced by 4.3%, from 34,701 to 19,890 MM lb/yr.(1)

ASR 1703: Upper Snake-Central Snake

Heavy algal production is a problem in lower main-stem reservoirs and in the lower reaches of some tributaries. Significant sediment and mineral loads also occur in some Snake River tributaries. Bacterial concentrations are above recommended limits for recreation near a number of populated areas, and dissolved oxygen deficiencies have occurred at several points. High

(1) Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, p. D.1.

water temperatures are also a problem in some downstream areas. At present, 39.5 MM lb of BOD are discharged to water annually. This figure could be reduced by 51% if the best practicable treatment were used, since 83% of the BOD load originates from point sources. The current release of 2697 MM lb/yr of TSS to water could be reduced by 11% with best practicable treatment.(1)

ASR 1704: Lower Snake

Water quality in this ASR is generally good; however, some problems exist with low dissolved oxygen content: turbidity, nuisance algal growth, and nitrogen super-saturation. The Snake River and streams in the Palouse drainage system suffer the most serious water quality degradation. Dissolved-oxygen-deficient water in lower levels of Brownlee and Oxbow Reservoirs (located in ASR 1703) caused by decomposing algae and residual waste loadings is passed downstream through low-level turbine intakes. In recent years, floating aquatic slimes, stimulated by nutrient concentration, have appeared in the Snake River throughout this ASR. High water temperatures in the Snake River in late summer adversely affect fish life.

Two-thirds of the 81.1 MM lb/yr of BOD discharged to water are from non-point sources. Therefore, only a 21% decrease could be achieved by applying best practicable treatment. Less than 1% of the 15,456 MM lb/yr of TSS discharged to water are from point sources.(2)

ASR 1705: Lower Columbia-Willamette-Coastal

Water quality of the lower Columbia River is generally good, but problems have been created by slime growth attributable mostly to the pulp and paper industry, and by bacterial pollution resulting from municipal effluents. High water temperatures have also been a cause for concern. Coastal streams are generally of good quality and suitable for all uses. The most common problems include high coliform bacterial counts, high temperatures, and high nutrient levels. A few instances of low dissolved oxygen levels are found, and high turbidities and sedimentation are encountered during some periods of the year.

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(1) Information Source: Ref. 1, p. D.5.
(2) Information Source: Ref. 1, Ibid., p. D.5.

BOD discharged to water could be reduced by 53%, from 319 to 149 MM lb/yr, by using best practicable treatment. Since only about 10% of the TSS load is attributable to point sources, the possible reduction is only 3%, from 15,325 to 14,900 MM lb/yr.(1)

ASR 1706: Puget Sound

The major rivers in the ASR contain high-quality water suitable for nearly all uses. However, in the lower reaches near the Sound, urban and industrial build-up has had a measurable effect upon water quality. In several streams bacterial counts are higher and oxygen levels lower than desirable levels. In addition, some bays, harbors and inlets have shown water quality degradation. Municipalities and industries are the largest source of organic wastes in the Puget Sound area. The pulp and paper industry is the major source of oxygen-demanding wastes. Other significant waste results from navigation and dredging operations, recreation, and land use and management practices.

Point sources account for 98% of the BOD and 40% of the TSS discharged into the water. Possible BOD reductions are, therefore, 85% under best practicable treatment, from 220 to 32.7 MM lb BOD/yr. A 29% reduction in TSS is achievable, from 904 to 644 MM lb TSS/yr.(2)

ASR 1707: Oregon Closed Basin

This ASR is sparsely populated and is essentially in a natural condition, relatively undisturbed by man's activities. As a result, the streams are uniformly of high water quality. However, evaporation in the numerous shallow lakes with large surface areas has resulted in brackish water conditions in the terminal water bodies. Ground water quality is generally poorer than in the rest of the region.

Biochemical oxygen demand discharged to water is estimated at 3.77 MM lb/yr. Total suspended solid discharges are estimated at 1597 MM lb/yr. Since these are of nonpoint origin, no reductions through application of best practicable treatment are possible.

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(1) Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, p. D.5.
(2) Information Source: Ref. 1, Ibid, p. D.5.

GROUND WATER

Major aquifers capable of yielding moderate-to-large volumes of water underlie about one-fourth of the Columbia-North Pacific Region. In most of the remainder of the area, small-to-moderate supplies of ground water can be obtained. The major ground-water reservoirs are generally located in three kinds of geologic terrains: predominantly volcanic, predominantly sedimentary, and combined volcanic and sedimentary. Many wells that tap the major aquifers yield several thousand gallons per minute. Thus, the aquifers must be considered economic sources of supplies for irrigation, industrial, and municipal uses. In only a few local areas is use approaching the limit of available supply.

Some large bodies of saturated permeable rocks are at such high altitudes or great depths, or in such rugged terrain, that immediate development is unlikely. At many places, as in the Cascade Range in Oregon and southern Washington, these remote aquifers supply large quantities of water to streams. Ground water generally contributes from 15% to 40% of the water discharged by streams, but may provide nearly 100% in some streams.

Glaciers are of practical importance to the water resources both because of their volume and because of the time of year when they produce stream flow. About 83% of the glacier-covered area in the conterminous United States lies in the Columbia-North Pacific Region. The estimated volume of these glaciers is 46 million acre-feet, of which about 96% is in Washington--mostly in the northern part of the Cascade Range. Glaciers retain a large portion of the precipitation that falls on them during the wet winter season, and release the water during the hot, late-summer season when it is most needed. Also, during wet, cold years when not as much water is required by irrigators and other consumers, glaciers tend to accumulate precipitation and grow; during the hot, dry years they tend to release more water. In 1960, Meier (4-420-429) estimated that the average annual runoff amounts to 13 CF of water from each square foot of glacier area. On that basis, glaciers contribute about 1.4 million acre-feet of water annually. An important fact is that nearly two-thirds of this water is released during the months when precipitation is low.(1)

(1) Information Source: Ref. 4, Columbia-North Pacific Region, Comprehensive Framework Study, Appendix II, p. 64.

Similarly, about 561 million acre-feet of ground water are contained in the top 100 feet of the region's water-bearing strata. Estimated gross annual ground-water recharge is about 116 million acre-feet.

Table II-B-7, in presenting subregional annual averages for surface water runoff and ground-water storage, illustrates the wide variance of water supply among subregions.

Large water quantities are obtained from wells and springs, and the base flow of surface streams is maintained by natural discharge from ground-water aquifers. During prolonged dry weather periods, the flow of many streams is mostly or entirely composed of ground-water effluent. About 40% of the region is underlain by aquifers yielding only small amounts of water, which often are of poor quality. That is especially true in the coastal subregion.

There probably are few large aquifers whose existence is unknown, but knowledge about many is incomplete. And particularly in arid parts of Idaho and Oregon, ground-water knowledge is very sketchy, because only reconnaissance-type geologic mapping has been accomplished. Detailed ground-water investigations have been conducted only in about 10% of the region. Therefore, estimated ground-water distribution, summarized by aquifer units in Table II-B-7, is only a rough approximation.

From Table II-B-21, gross annual ground-water recharge is estimated to be about 120 million acre-feet. Because some of that water moves between the surface and underground as it travels, net annual recharge probably is only about 100 million acre-feet. That equals a continuous flow rate of about 138,000 CFS, which is about 36% of the region's average annual surface runoff.(1)

The quality of ground water generally ranges from good to excellent for most uses throughout the region. Water from alluvial deposits and volcanic rocks west of the Cascade Range and in the humid areas east of the Cascade Range usually holds less than 300 mg/ℓ dissolved solids. The water ranges from soft to hard--from less than 60 mg/ℓ to more than 120 mg/ℓ. (Hardness of

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(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.

water is expressed in terms of equivalent concentration of calcium carbonate.) Iron is a problem, especially in water from shallow depths in the alluvial deposits. The marine sedimentary rocks yield saline water and do so in some places at depths ranging from less than 100 feet down to several hundred feet.

These supplies are being tapped increasingly for irrigation, industrial use, and other purposes. Variations in subsurface materials result in marked local differences in water-yielding capabilities and in the depths at which adequate supplies can be reached. East of the Cascades, irrigation water has been provided in the Quincy district for some time from wells. The Spokane Valley of eastern Washington and the Snake River Plain of southcentral Idaho are favored with outstanding ground-water resources. In the former, ground-water underflow on the order of 1000 CFS is the source of municipal supply at Spokane, as well as for several thousand acres of irrigation agriculture. In the vicinity of Minidoka, Idaho underflow on the order of 5000 CFS has been tapped for the first major federal reclamation development in the United States utilizing ground water. This development will irrigate about 64,000 acres. Ground water has a number of advantages over surface water, including availability at point of use, flexibility of withdrawal as needed, generally lower temperatures in summer, less variation in chemical quality, and freedom from suspended matter.(1)

Water Management

Obviously, full utilization of Northwest streams requires effective management to overcome disparities between patterns of water availability and water-use areas, and the problems of unequal seasonal and yearly runoff. Water will need to be routed over considerable distances to areas of use. Some of the flood-season runoff will have to be retained in mountain reservoirs to permit maximum benefits and to protect millions of dollars of property investments on flood plains. Today there is relatively little effective flood control storage available, although there are over 250 reservoirs of all kinds in the Columbia Basin. For example, the combined capacity of the Snake

(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.

River irrigation reservoirs is 8.7 million acre-feet, but only 2.8 million acre-feet are usable for flood control. Because of its multiple purpose functions, Grand Coulee, with its 5.12 million acre-feet of storage, can contribute only 1 million acre-feet of effective flood control until outlet valves are modified.

The Columbia River system is one of the most promising in the world from the standpoint of management and use. Favorable qualities include:

- large volumes of water
- relatively small amounts of silt
- relatively steep gradient
- mountain and mainstream dam and storage sites
- relatively deep channel extending far inland
- passage of the system through a large portion of the arid section of the region
- maximum runoff during the growing season.(1)

Considering only the regional average annual runoff (especially the large runoff quantity returning to the Pacific Ocean), it would appear that the Pacific Northwest has an abundant water supply. But average annual runoff variations among subregions demonstrate that some subregions would have limited water even if their total supply could be controlled. When seasonal runoff characteristics are also considered, along with seasonal precipitation patterns, it is evident that all subregions need careful water management.(2)

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(1) Information Source: Ref. 5, Water Today and Tomorrow, pp. 3-24.
(2) Information Source: Ref. 5, Ibid, pp. 3-24, 27.

TABLE II-B-1

AREA OF INLAND WATER

State/Rank	Total Area		Land Area[a]		Water Area[b]	
	mi^2	km^2	mi^2	km^2	mi^2	km^2
Alaska/1	586,412	1,518,807	566,432	1,467,059	19,980	51,748
Idaho/13	83,557	216,413	82,677	214,133	880	2,279
Oregon/10	96,981	251,181	96,184	249,117	797	2,064
Washington	2,068,192	196,617	66,570	172,416	1,622	4,201
Region	2,835,142	2,163,018	811,863	2,102,725	23,275	60,292
U.S.	3,615,122	9,363,166	3,536,855	9,160,454	78,267	202,712

(a) Dry land and land temporarily or partially covered by water, as marshland, swamps etc.; streams and canals under one-eighth statute mile wide; and lakes, reservoirs, and ponds under 40 acres of area.

(b) Permanent inland water surface such as lakes, reservoirs, and ponds having 40 acres or more of area; streams, slough, estuaries, and canals one-eighth statute mile or more in width; deeply indented embayments and sounds, and other coastal waters behind or sheltered by headlands or islands separated by less than 1 nautical mile of water, and islands having less than 40 acres of area. Excludes oceans, bays, sounds, etc. lying within U.S. jurisdiction but not defined as inland water.

Data Source: Ref. 6, Statistical Abstract of the U.S., 1977, p. 197.

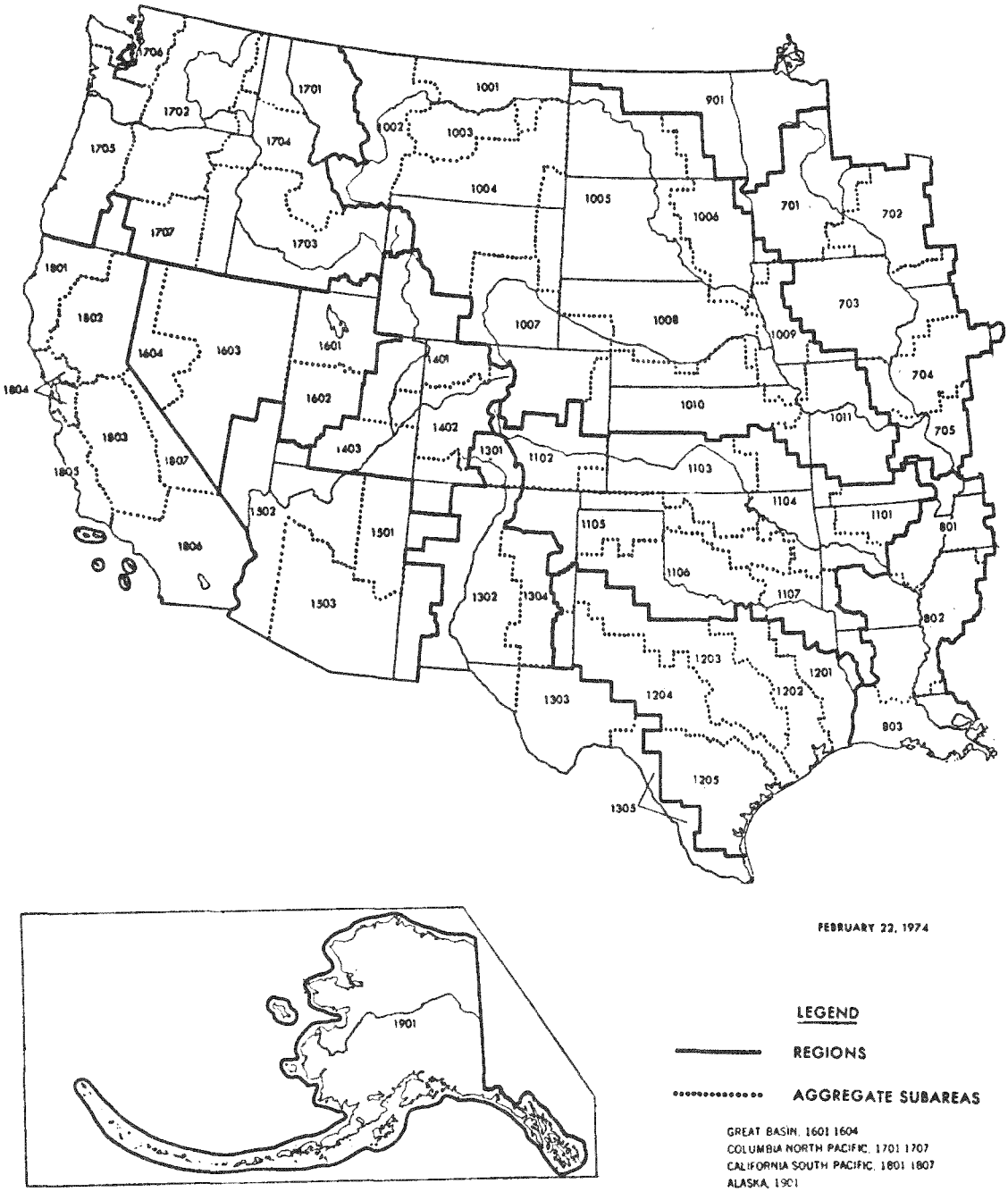


FIGURE II-B-1. ASR Areas

Data Source: Ref. 7, The Nation's Renewable Resources - An Assessment, p. 188.

TABLE II-B-2

ASR'S FOR ALASKA, IDAHO, OREGON AND WASHINGTON

ASA No.	Name	Area (mi^2)
1701	Clark Fork-Kootenai-Spokane	37,500
1702	Upper Columbia-Yakima-Mid-Columbia	59,456
1703	Upper and Central Snake	66,155
1704	Lower Snake	31,661
1705	Lower Columbia-Willamette-Coastal	38,359
1706	Puget Sound	15,781
1707	Oregon Closed Basin	18,397
1901	Alaska	586,412
		853,721

Data Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21, p.D.1

TABLE II-B-3

RIVER BASINS

Region/River Basin	Basin Number	1975 Estimated Population (in thousands)	Total Area in Acres (in thousands)
Columbia-North Pacific Pend Oreille, Kootenai, Spokane	1701	610	22,848
Yakima, Upper Columbia, Deschutes, Middle Columbia	1702	665	38,016
Upper Snake, Middle Snake	1703	549	41,600
Salmon, Lower Snake	1704	171	20,288
Willamette, Lower Columbia, Washington-Oregon Coastal	1705	2,306	24,576
Puget Sound	1706	2,389	10,048
Oregon Closed Basin	1707	14	11,776
Total		6,704	169,152

Data Source: Reference 8, Water Pollution Control, 1977.

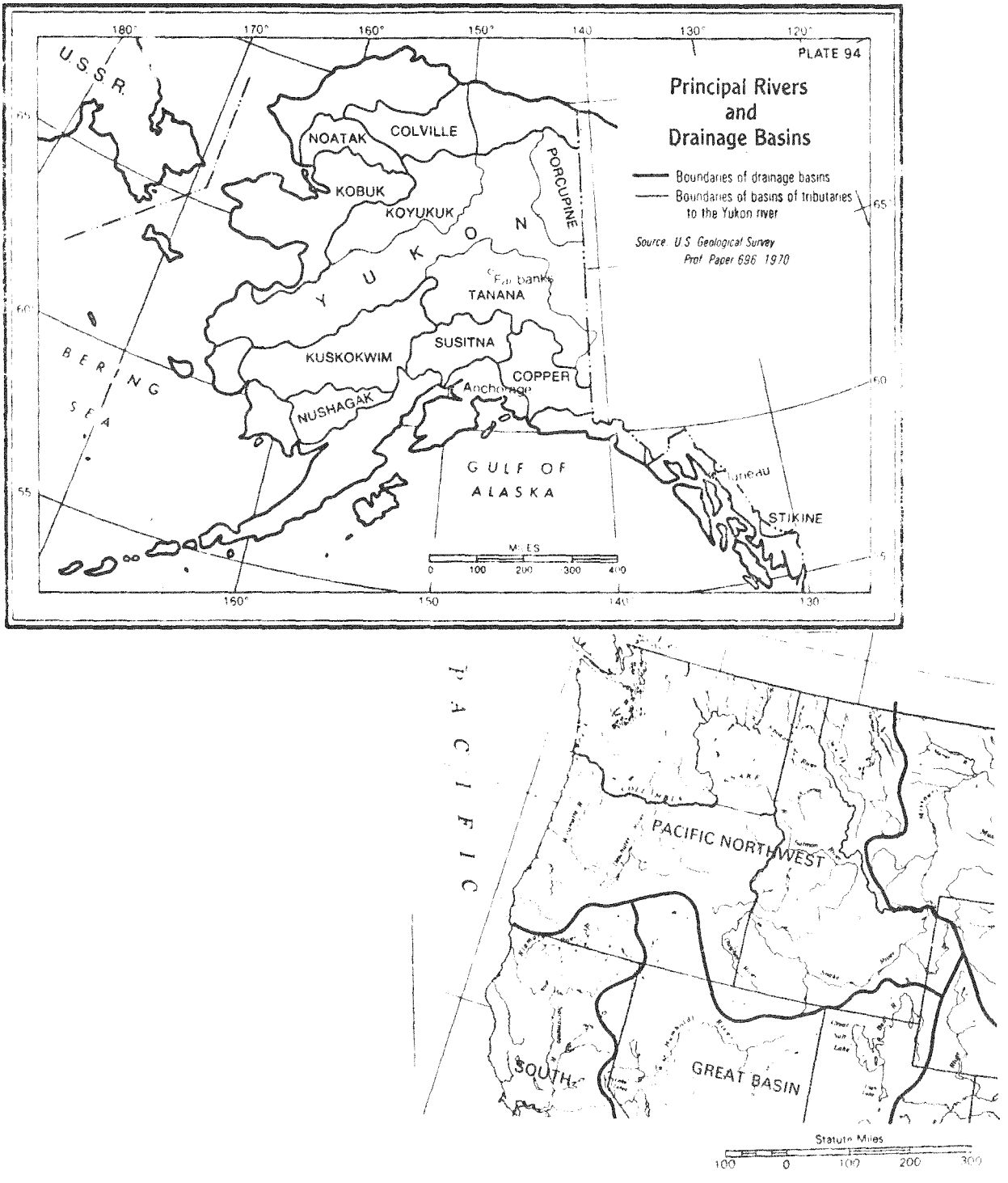


FIGURE II-B-2. Principal Rivers and Drainage Basins

Data Source: Ref. 9, Water Atlas, Plates 94 and 17.

FIGURE II-B-3. Subregion River Basins for Idaho, Oregon and Washington

Data Source: Ref. 4, Columbia - North Pacific Comprehensive Framework Study, p. 1.

TABLE II-B-4

LENGTH OF PRINCIPAL RIVERS

Rank	River	Drainage Area (mi^2)	Average Discharge (1931-60) (cfs)	Average Discharge (1941-70) (cfs)	Length (miles)	Most Distant Source	Mouth
2	Columbia	258,000	253,000	262,000	1,243	Columbia Lake, B.C.	Pacific Ocean
5	Yukon	327,600	-	240,000[a]	1,770	Coast Mountains, B.C.	Bering Sea
12	Snake	109,000	49,500	50,000	1,038	Ocean Plateau, Teton Co., Wyo.	Columbia River
15	Willamette	11,200	34,170	35,660	270	Tumblebug Creek, Douglas Co., Ore.	Columbia River
19	Pend Oreille	25,820	27,600	29,900	490	Near Butte, Mont.	Columbia River

(a) Average is for 1957-70 period; station operated only since 1956.

Data Source: Reference 10, USGS Circular 686.

TABLE II-B-5

Alaska Regional and Area Breakdown in Square Miles

Regional Profile	Area or Subregion	Drainage Area Alaska sq. mi.	Canada sq. mi.	Total sq. mi.
Arctic	1.1 West Arctic	31,000	–	31,000
	1.2 Colville	24,000	–	24,000
	1.3 East Arctic	26,000	–	26,000
	TOTAL FOR THE REGION	81,000		81,000
Northwest	2.1 Kotzebue Sound	41,000	–	41,000
	2.2 Norton Sound	26,000	–	26,000
	TOTAL FOR THE REGION	67,000		67,000
Yukon	3.1 Lower Yukon	38,000	–	38,000
	3.2 Central Yukon	19,000	–	19,000
	3.3 Koyukuk	33,000	–	33,000
	3.4 Upper Yukon-North	60,000	25,000	85,000
	3.5 Tanana	45,000	500	45,500
	3.6 Upper Yukon-Canada	9,000	105,000	114,000
	TOTAL FOR THE REGION	204,000	130,500	334,500
Southwest	4.1 Kuskokwim Bay	58,000	–	58,000
	4.2 Bristol Bay	40,000	–	40,000
	4.3 Aleutian	11,000	–	11,000
	TOTAL FOR THE REGION	109,000		109,000
Southcentral	5.1 Kodiak Shelikof	11,000	–	11,000
	5.2 Cook Inlet	38,000	–	38,000
	5.3 Copper River-Gulf of Alaska	34,000	1,000	35,000
	TOTAL FOR THE REGION	83,000	1,000	84,000
Southeast		42,000	35,000	77,000
	TOTAL FOR THE REGION	42,000	35,000	77,000
	TOTALS	586,000	166,500	752,500

Subregional numbers 1.1 through 5.3 designate areas of study used by the Joint Federal-State Land Use Planning Commission.

Data Source: Reference 11, Alaska Regional Profiles

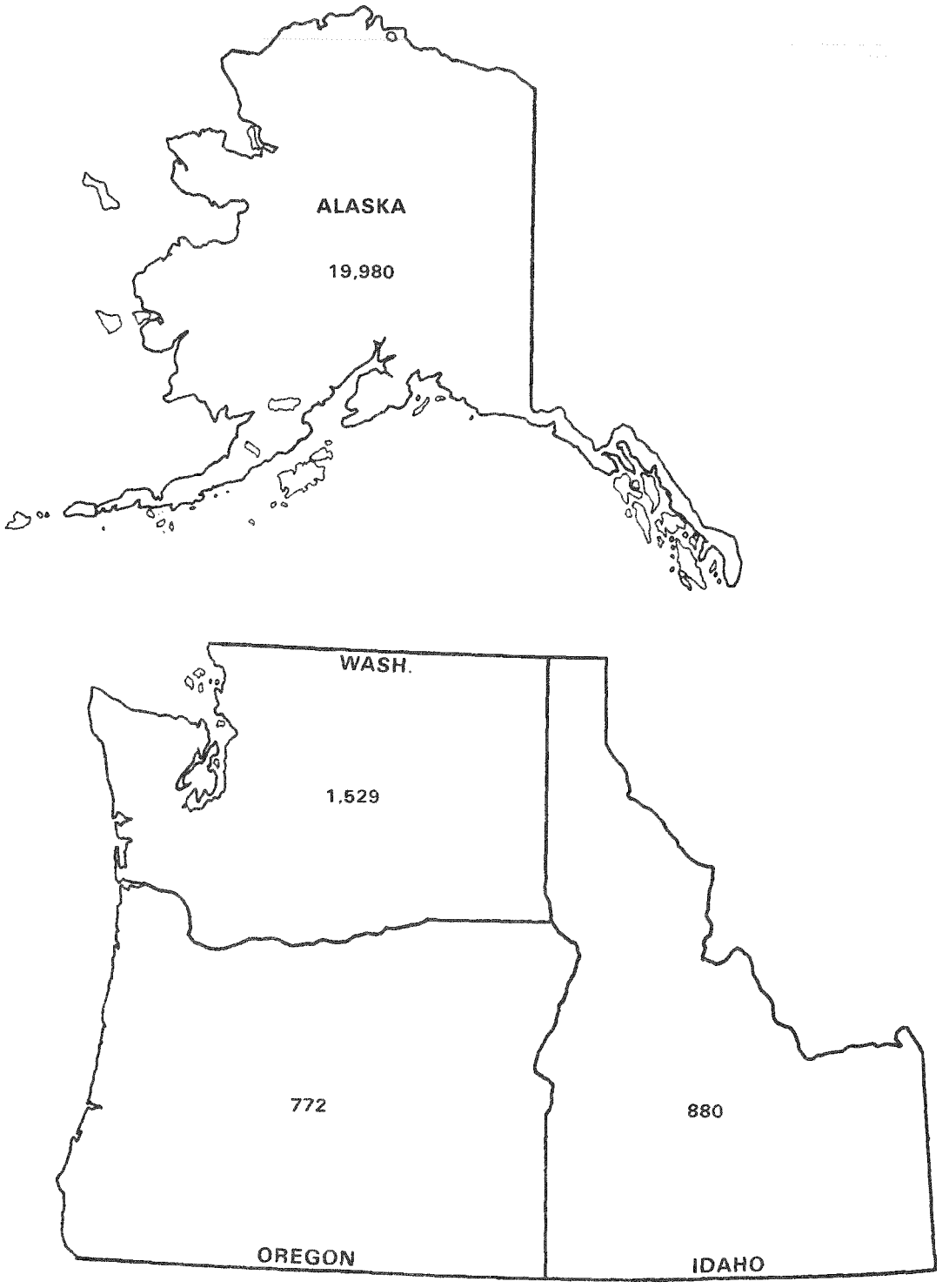


FIGURE II-B-4. Area Covered by Inland Water

Data Source: Ref. 9, Water Atlas, Plate 20.

STREAM FLOW FOR 6 MONTHS ENDING MARCH 31, 1977

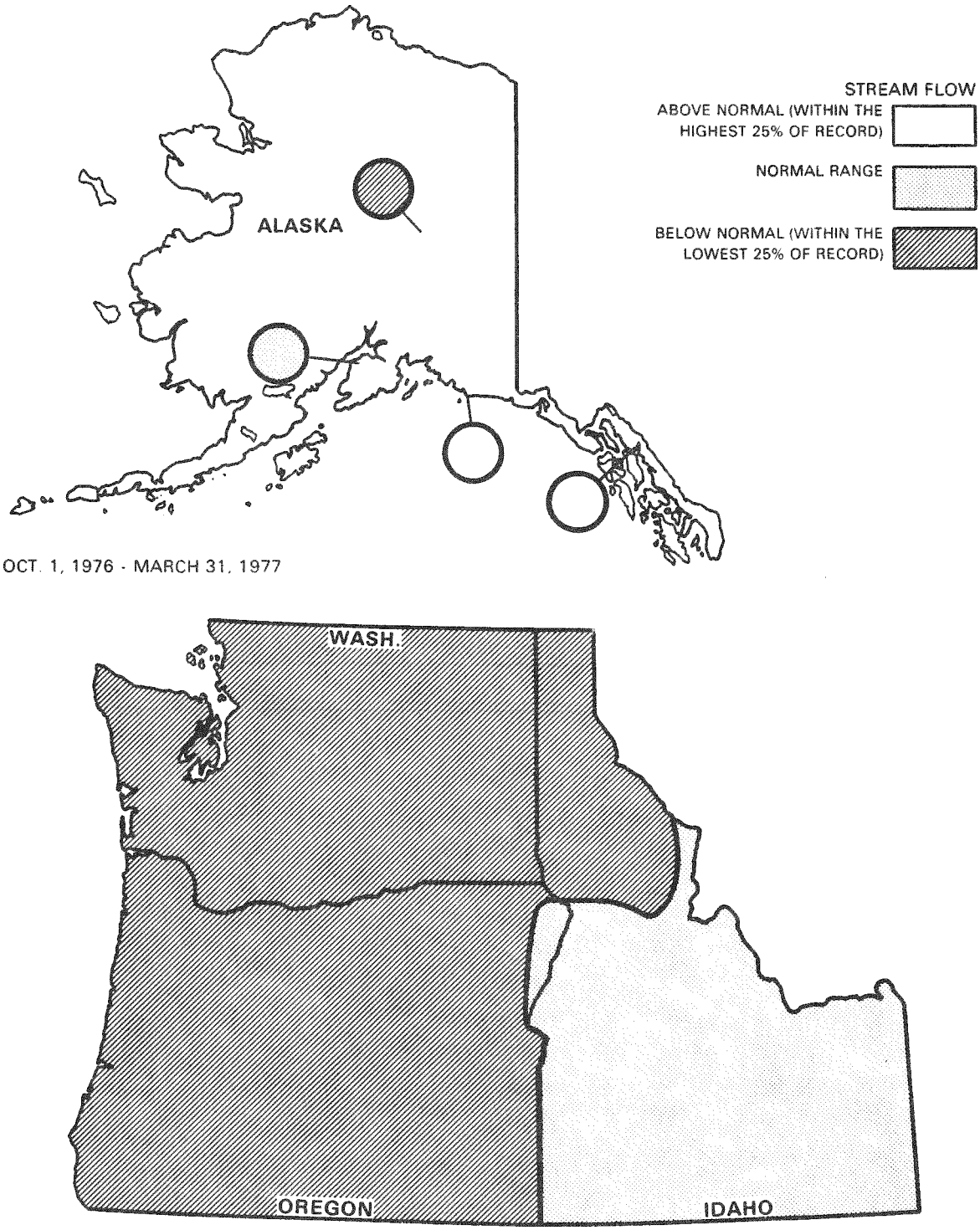


FIGURE II-B-5. Stream Flow, 1977

Data Source: Ref. 12, Environmental Quality Annual.

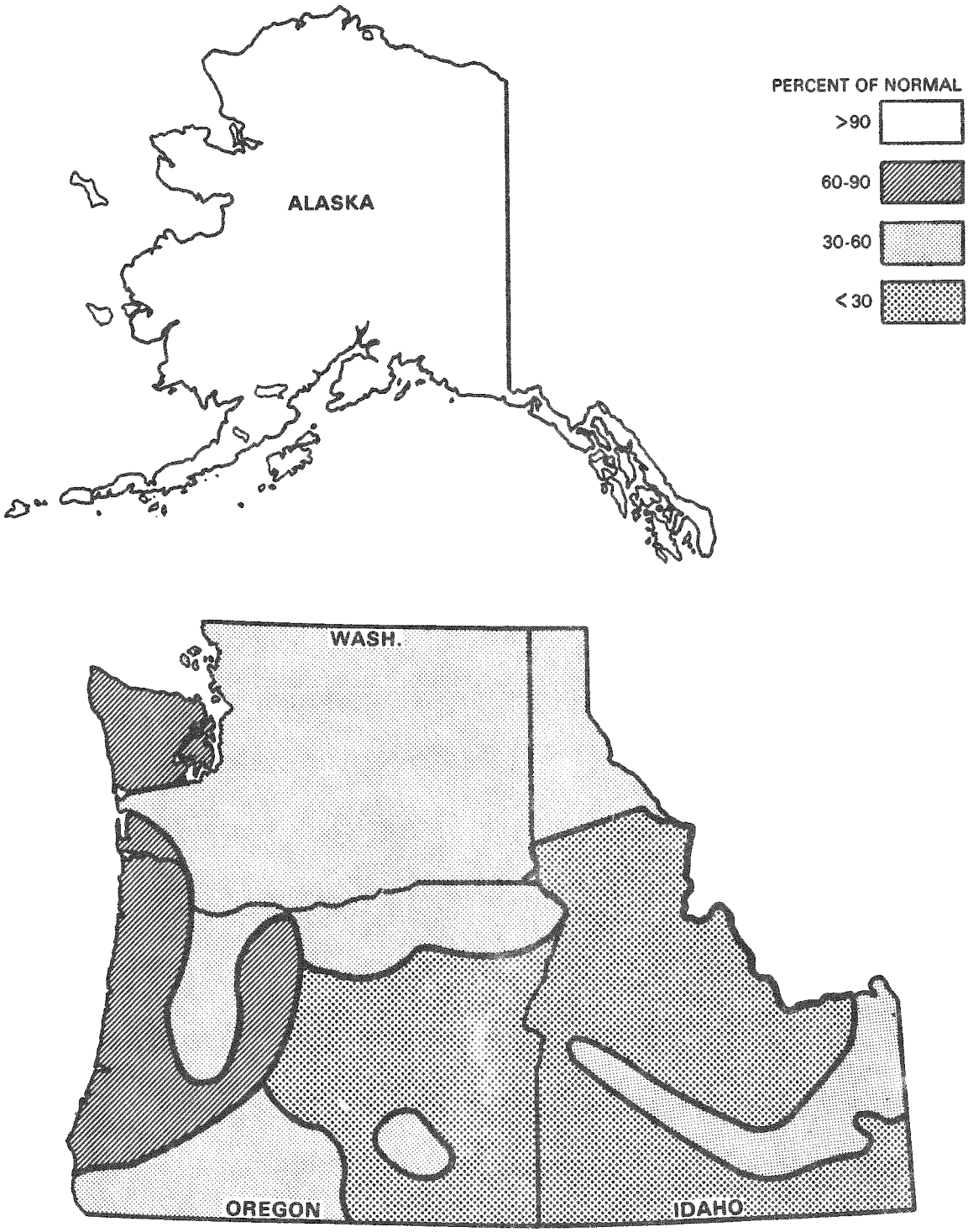


FIGURE II-B-6. Stream Flow Forecast, 1977

Data Source: Ref. 12, Environmental Quality Annual.

STREAM FLOW DURING WATER YEARS 1974 AND 1975 (ANNUAL RUNOFF)

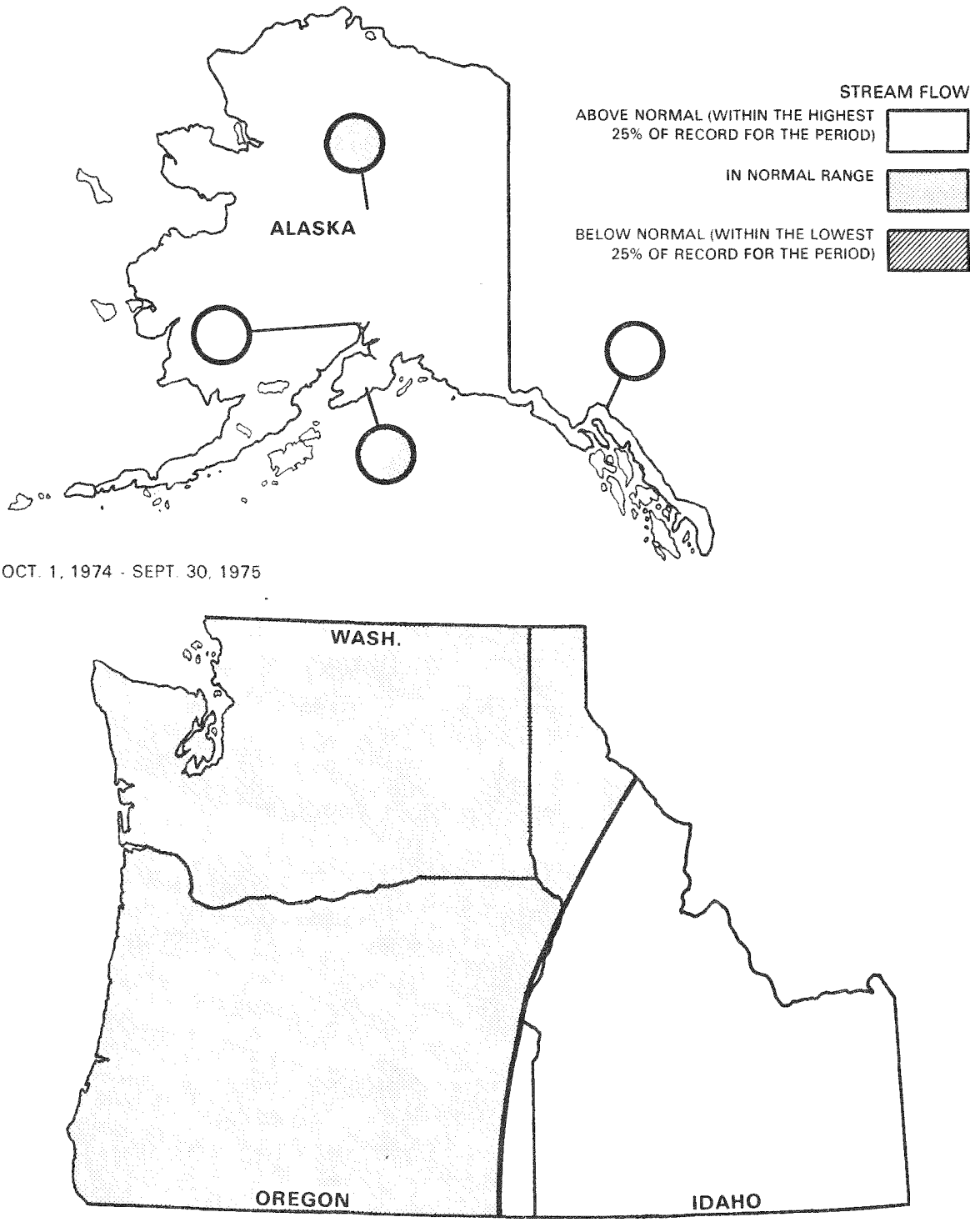
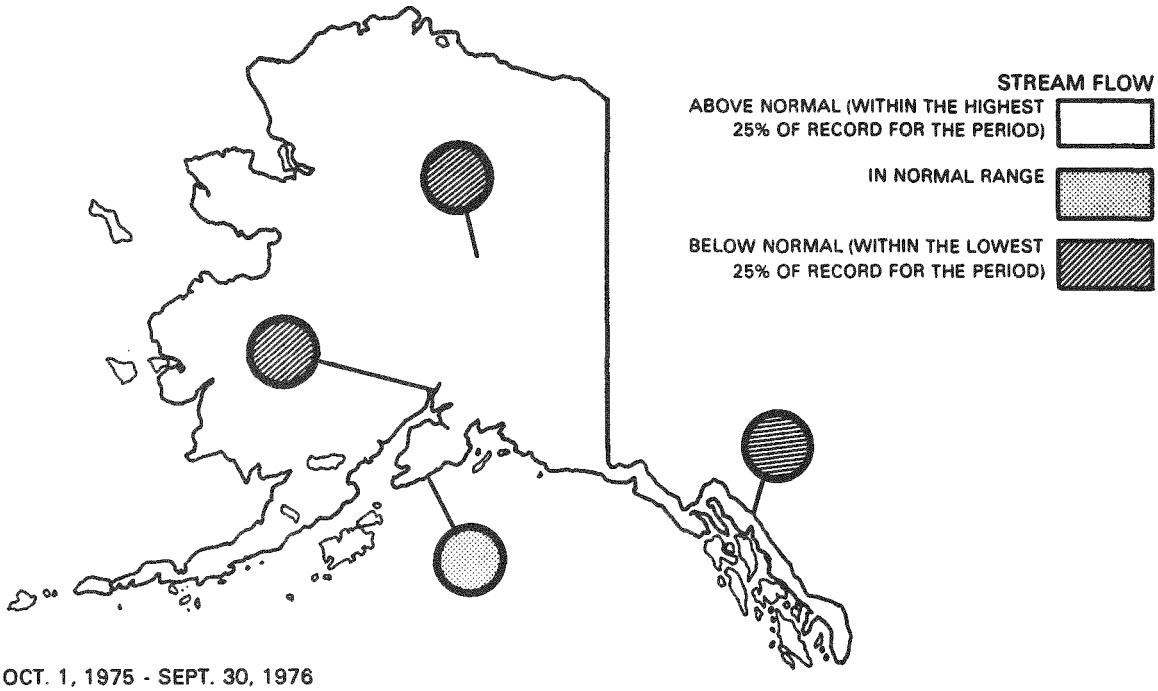


FIGURE II-B-7. Stream Flow 1974-1975

Data Source: Ref. 12, Environmental Quality Annual.

STREAM FLOW DURING WATER YEARS 1975 AND 1976 (ANNUAL RUNOFF)



OCT. 1, 1975 - SEPT. 30, 1976

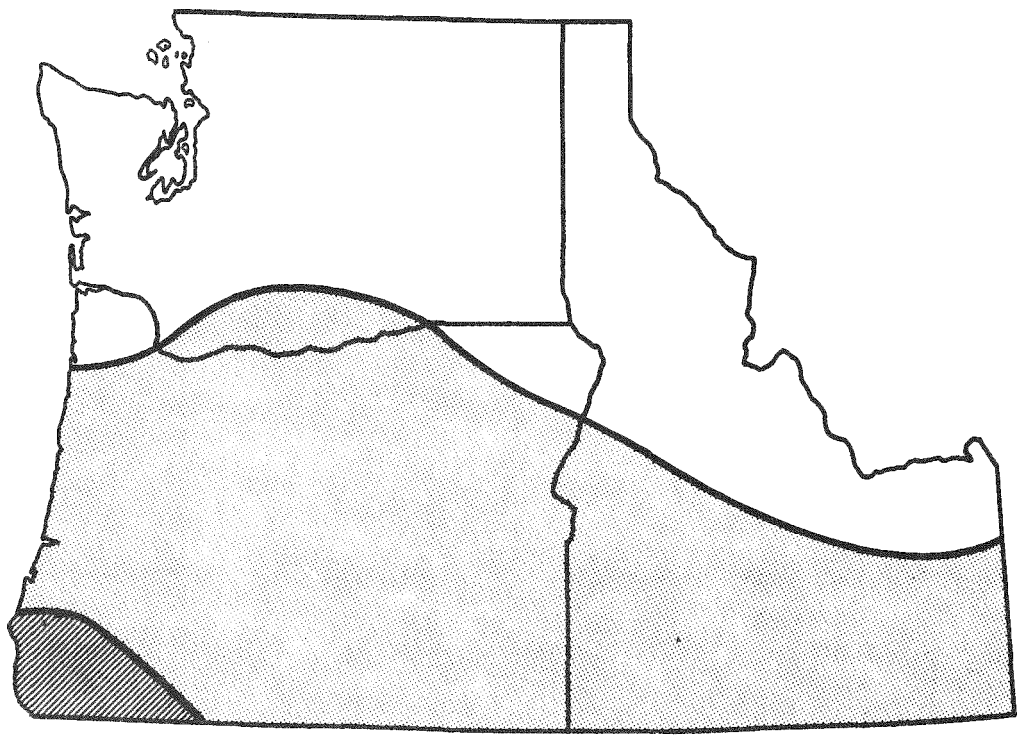


FIGURE II-B-8. Stream Flow 1975-1976

Data Source: Ref. 12, Environmental Quality Annual.

TABLE II-B-6

ANNUAL WATER SUPPLY BY SUBREGION
NORTHWEST REGION

	Surface Water			Groundwater[a]	
Subregion	Mean Annual Inflow (1,000 CFS)	Mean Annual Outflow (1,000 CFS)	Outflow Minus Inflow[b] (1,000 CFS)	Aquifer Storage Volume (million acre-feet)	Mean Annual Recharge (million acre-feet)
1	12	49	37	69	19
2	110	115	5	35	6
3	0	3	3	13	2
4	0	9	9	100	18
5	9	16	7	100	5
6	16	46	30	31	9
7	164	177	13	47	12
8	216	235	19	8	6
9	0	39	39	27	11
10	0	88	88	27	16
11	1	53	52	40	11
12	0	0	2	56	1

(a) Gross values of storage and recharge for the top 100 ft of the water-bearing strata

(b) Mean annual quantity of surface runoff originating in the designated area

Data Source: Ref. 5 , Water Today and Tommorrow, Vol. II, p. 3-23

TABLE II-B-7

STREAMFLOW SUMMARY FOR SELECTED SITES
PACIFIC NORTHWEST REGION

Subregion	Stream	Station	Drainage Area (Sq. Mi.)	Annual Flow[a] Mean	Max.	80% Flow	Min.	Momentary Flow[b] Max.	Min.
					(cfs)			(cfs)	
1	Kootenai	Porthill	13,700	15,328	22,143	10,722	9,926	125,000	1,380
1	Pend Oreille	Z-Canyon	25,200	25,839	37,624	17,902	14,861	171,300	2,500
1	Spokane	Spokane	4,290	6,485	10,353	3,923	2,970	49,000	95
1	Clark Fork	Plains	19,958	18,328	26,253	12,697	9,954	134,010	3,200
2	Columbia	Priest Rapids	96,000	114,100	159,000	89,900	86,600	692,600	4,120
2	Okanogan	Tonasket	7,280	2,894	4,588	1,785	1,241	40,900	126
2	Wenatchee	Peshastin	1,000	3,010	5,386	1,888	1,729	32,300	183
3	Yakima	Kiona	5,615	3,240	6,843	1,766	1,540	67,000	105
4	Snake	King Hill	35,800	8,590	11,999	7,044	6,909	47,200	1,250
4	Henrys Fork	Rexburg	2,920	1,512	2,387	1,034	798	11,000	183
5	Snake	Oxbow	73,150	16,338	26,037	12,349	11,124	76,800	441
5	Boise	Notus	3,820	960	2,325	410	289	20,500	10
5	Payette	Payette	3,240	2,707	4,521	3,722	1,430	30,900	180
6	Snake	Ice Harbor Dam	108,500	45,984	66,398	35,220	31,029	298,000	11,800
6	Salmon	Whitebird	13,550	10,690	15,891	7,563	5,792	106,000	1,580
6	Clearwater	Spalding	9,570	14,573	22,447	10,599	9,826	177,000	500
7	John Day	McDonald Ferry	7,580	1,925	3,669	982	630	42,800	4
7	Deschutes	Moody	10,500	5,186	7,340	4,097	3,940	75,500	2,400
7	Columbia	Bonneville	240,000	177,400	247,346	142,517	131,353	1,240,000	35,000
8	Lewis	Ariel	731	4,752	7,069	2,298	3,090	129,000	1
8	Cowlitz	Castle Rock	2,238	8,932	12,484	5,893	5,776	139,000	998
8	Columbia	Mouth	259,000	239,671	388,362	185,228	165,611		
9	McKenzie	Coburg	1,337	5,508	8,242	3,361	3,170	88,200	1,250
9	Santiam	Jefferson	1,790	7,596	11,722	4,441	4,656	197,000	260
9	Willamette	Oregon City	10,008	29,900	43,694	16,480	17,660		
10	Rogue	Gold Beach	5,060	11,290	21,150	5,252	4,621		
10	Umpqua	Elkton	3,683	7,353	13,350	3,925	3,150	256,000	640
10	Chehalis	Grand Mound	995	2,761	4,444	1,540	1,569	48,400	90
10	Quinalt	Quinalt Lake	264	2,766	3,571	1,842	1,780	50,200	276
11	Puyallup	Puyallup	948	3,292	4,927	2,356	2,087	57,000	400
11	Snoqualmie	Carnation	603	3,714	5,190	2,410	2,314	59,500	230
11	Sauk	Sauk	714	4,241	5,923	2,950	2,887	82,400	572
11	Skagit	Concrete	2,737	14,224	20,003	10,421	9,507	500,000	2,160
12	Chewaucan	Paisley	275	139	341	32	32	6,490	0
12	Silvies	Burns	934	164	375	44	15	4,960	0

(a) Regulated values for base period (1929-1958) adjusted to 1970 conditions
(b) Observed values for period of record

Data Source: Ref. 5, Water Today and Tomorrow, Vol. II, p. 25.

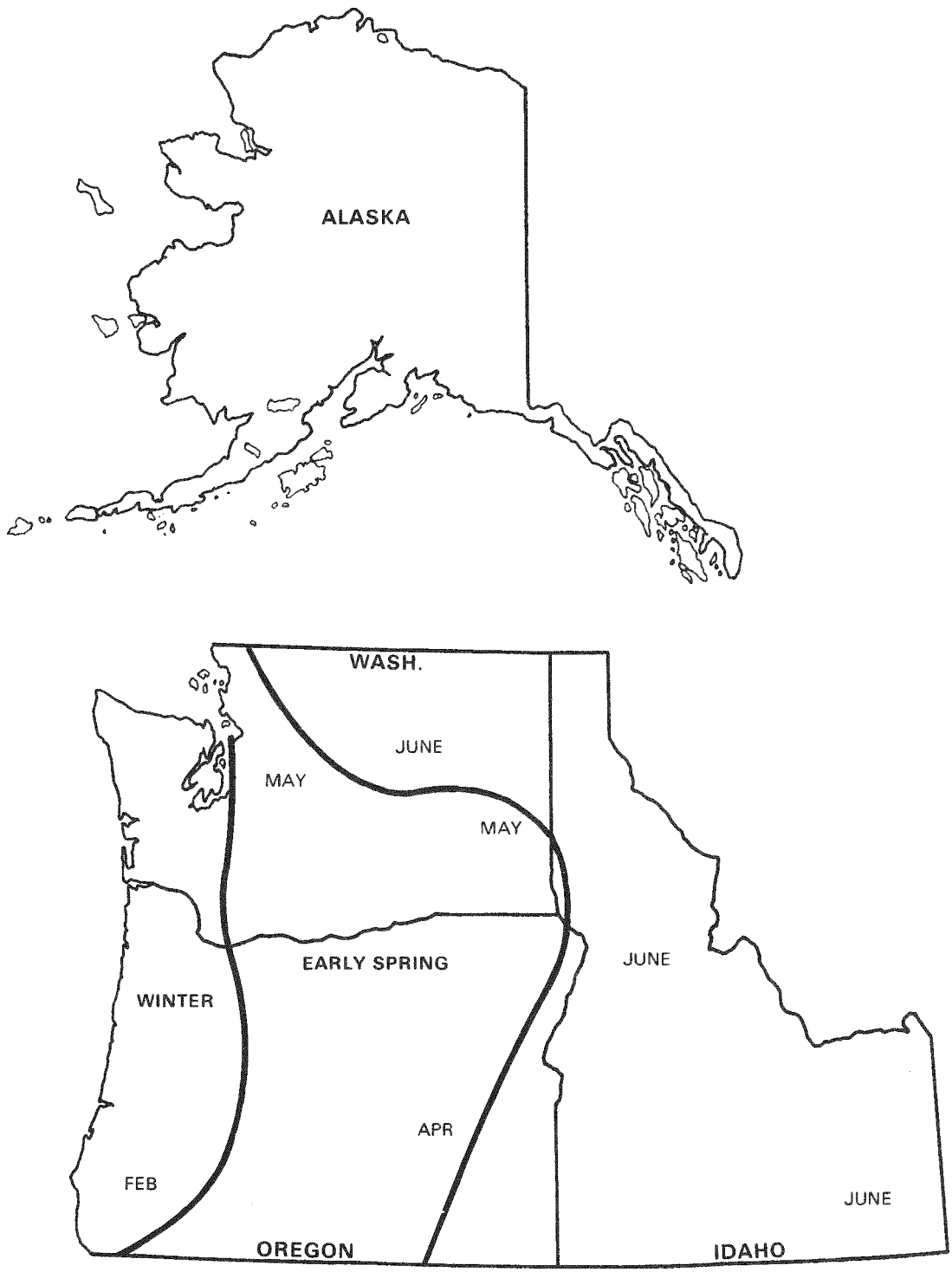


FIGURE II-B-9. Season of Highest Stream Flow

Data Source: Ref. 9, Water Atlas, p. 39.

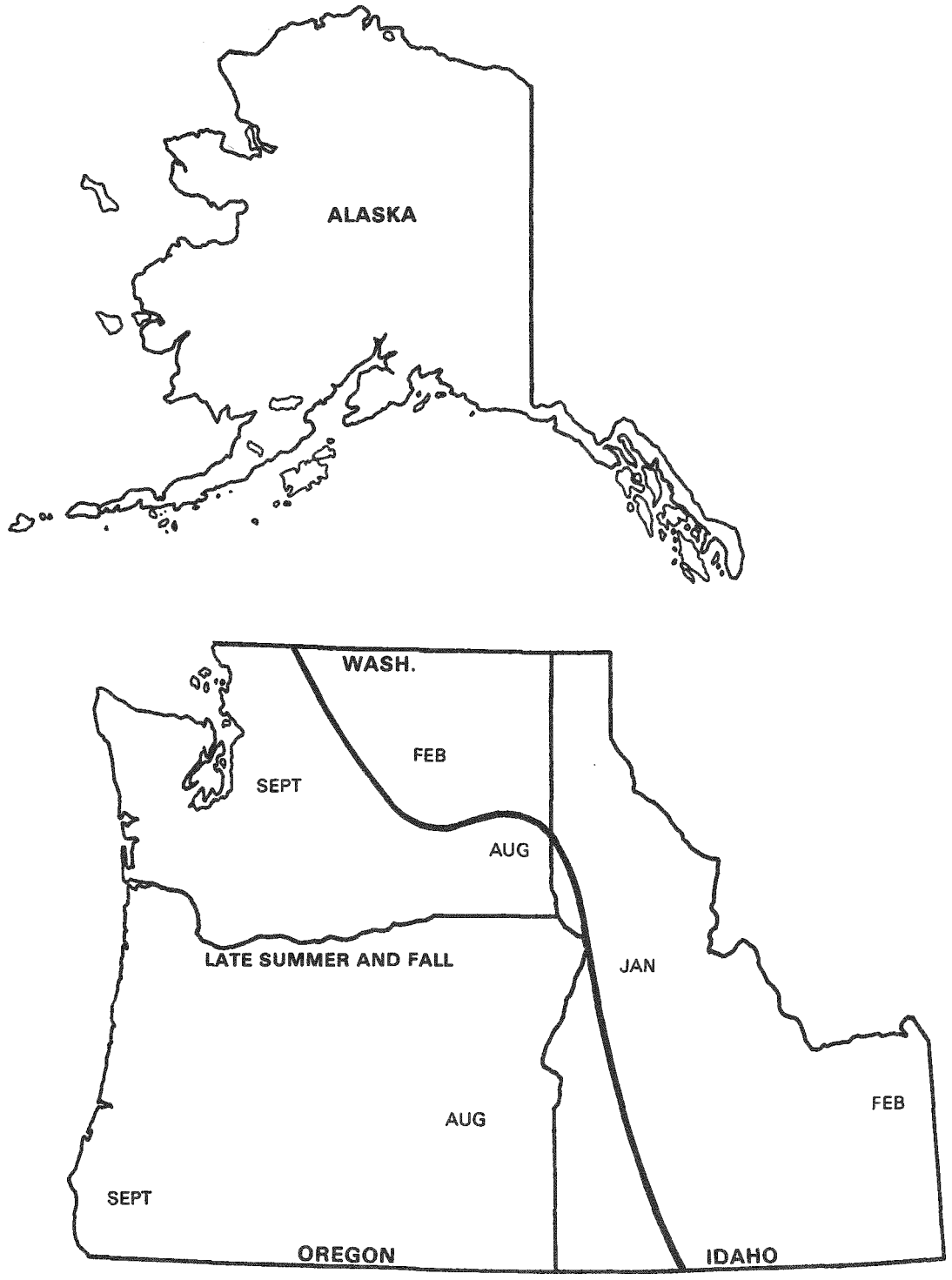
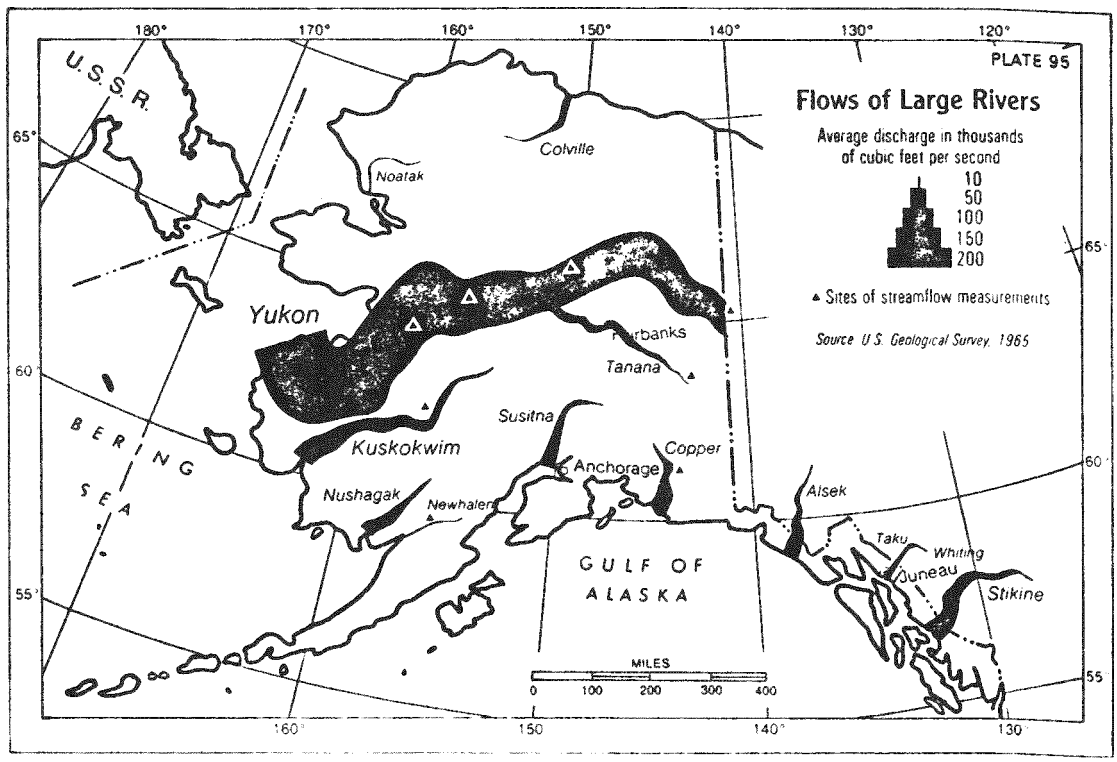


FIGURE II-B-10. Season of Lowest Stream Flow

Data Source: Ref. 9, Water Atlas, p. 39.



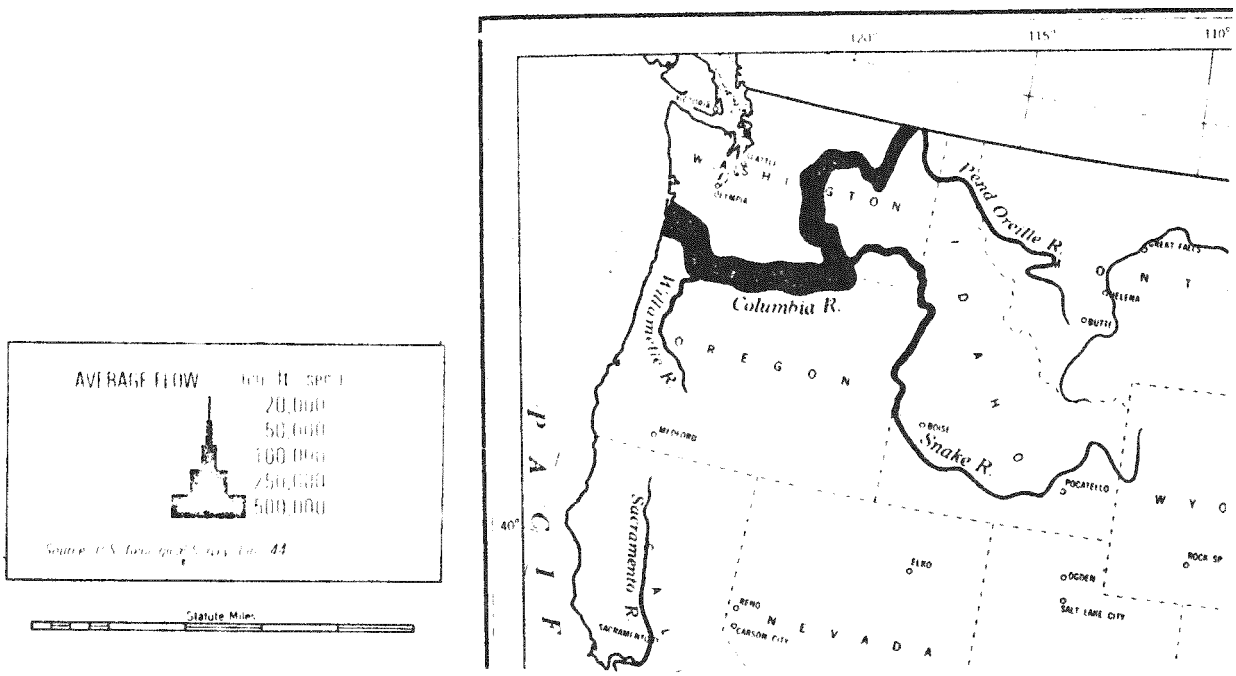


FIGURE II-B-11. Flows of Large Rivers

Data Source: Ref. 9, Water Atlas, Plates 23 and 95.

TABLE II-B-8

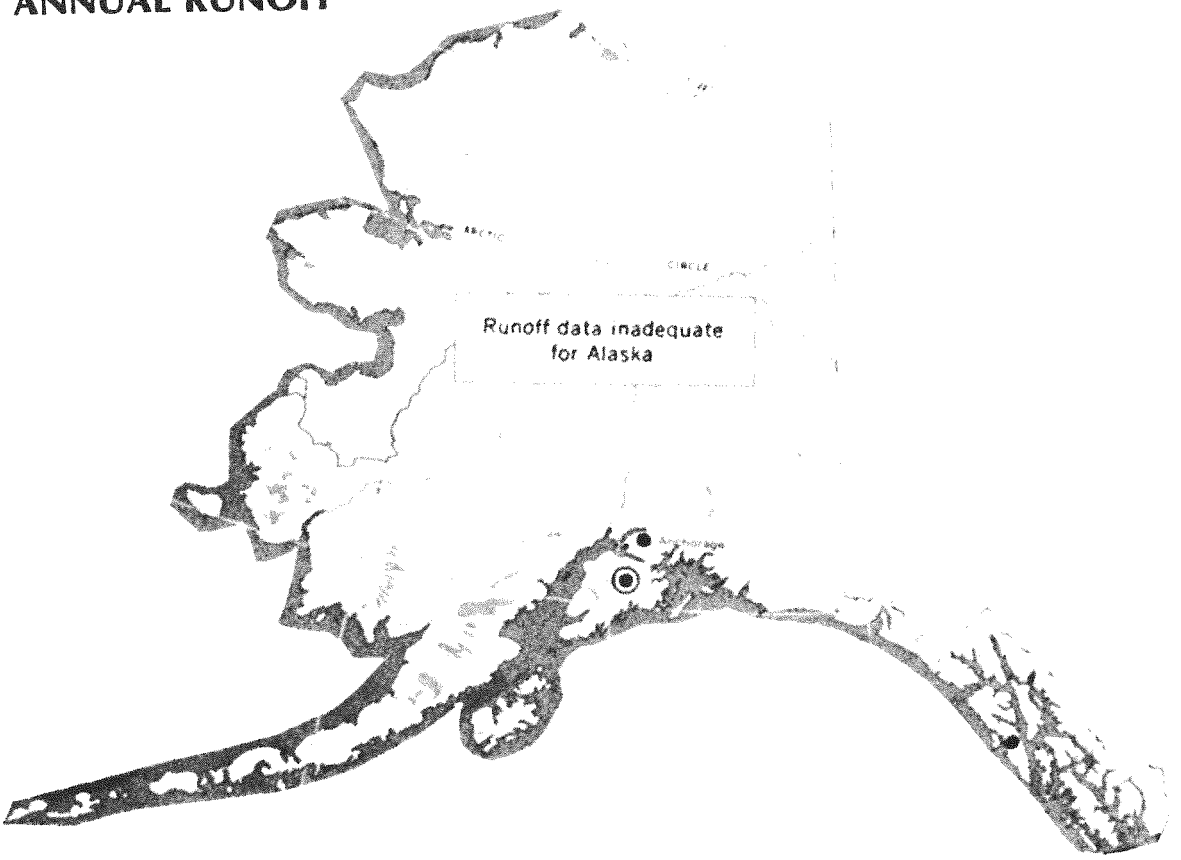
Mean and Lowest Monthly Flows Simulated for Key Points on the Columbia and Snake Rivers, 1970 Irrigation Depletion Level[a][b]

	June		July		August		September	
	Mean[c] (MGD)	Lowest[c] (MGD)	Mean (MGD)	Lowest (MGD)	Mean (MGD)	Lowest (MGD)	Mean (MGD)	Lowest (MGD)
Columbia River								
Chief Joseph Dam	66,340	28,150	45,564	29,162	54,084	40,296	43,953	35,640
Priest Rapids Dam	83,132	35,180	55,875	36,909	58,568	45,633	48,029	40,479
McNary Dam	141,218	72,701	81,586	57,854	73,295	60,632	64,689	57,952
John Day Dam	140,588	69,945	82,419	59,465	74,149	61,159	65,248	58,710
The Dalles, OR	144,086	72,459	85,344	61,506	76,651	64,020	68,079	62,021
Bonneville Dam	147,982	74,794	87,700	63,185	78,000	65,406	69,599	63,462
Snake River								
Brownlee Dam	9,753	4,616	6,779	3,230[d]	6,571	5,066	7,459	5,056
Lower Granite Dam	54,965	18,941	22,725	8,252	12,425	8,200	14,509	8,908
Little Goose Dam	55,025	19,025	22,990	8,265	12,607	8,129	14,634	8,862
Lower Monumental Dam	55,017	19,133	23,638	8,640	13,151	8,167	14,990	8,785
Ice Harbor Dam	55,017	19,133	23,638	8,640	13,188	8,180	14,990	8,785

(a) U.S. Army Corps of Engineers, Portland, OR, unpublished data, July 22, 1977.
(b) Flow data have been adjusted to reflect current storage operation with year 2020 load levels and have been reduced for irrigation depletions under 1970 development levels. Based on 1928-1958 flow data.
(c) Flows based on the average flow experienced during a month for each of 30 years of simulation. Mean is the mean monthly average for the 30 years; lowest is the lowest monthly average experienced in any one of the 30 years.
(d) Required minimum flow is 5000 cfs (3230 MGD).

Data Source: Ref. 1, The Impact of Increased Coal Consumption, p. D.2.

ANNUAL RUNOFF



RUNOFF
IN INCHES

- 40 and over (1 meter and over)
- 5-30 (125-750 millimeters)
- 2 and under (50 mm. and under)

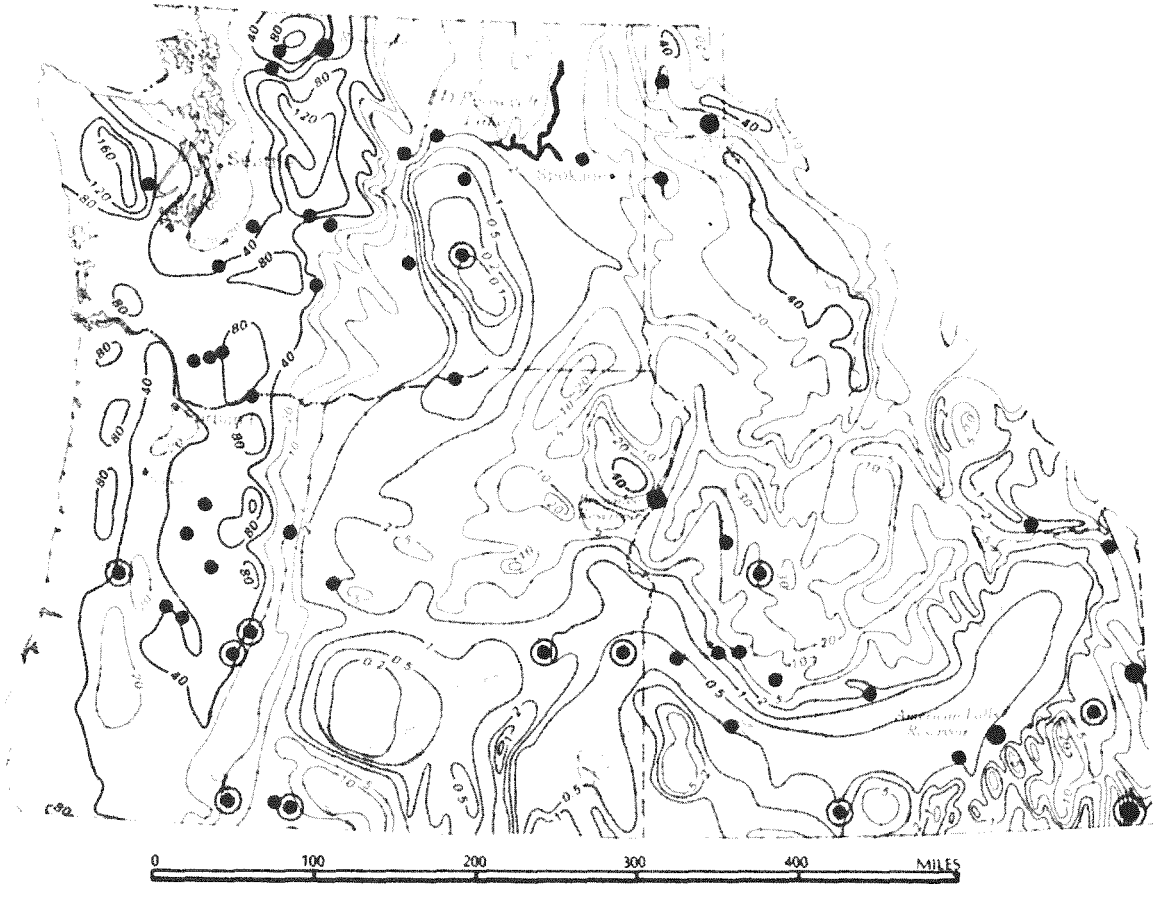
Runoff data based chiefly on records for the period 1931-1960, as in HA-212, by U.S. Geological Survey 1966

USABLE CAPACITY OF RESERVOIRS
IN ACRE-FEET

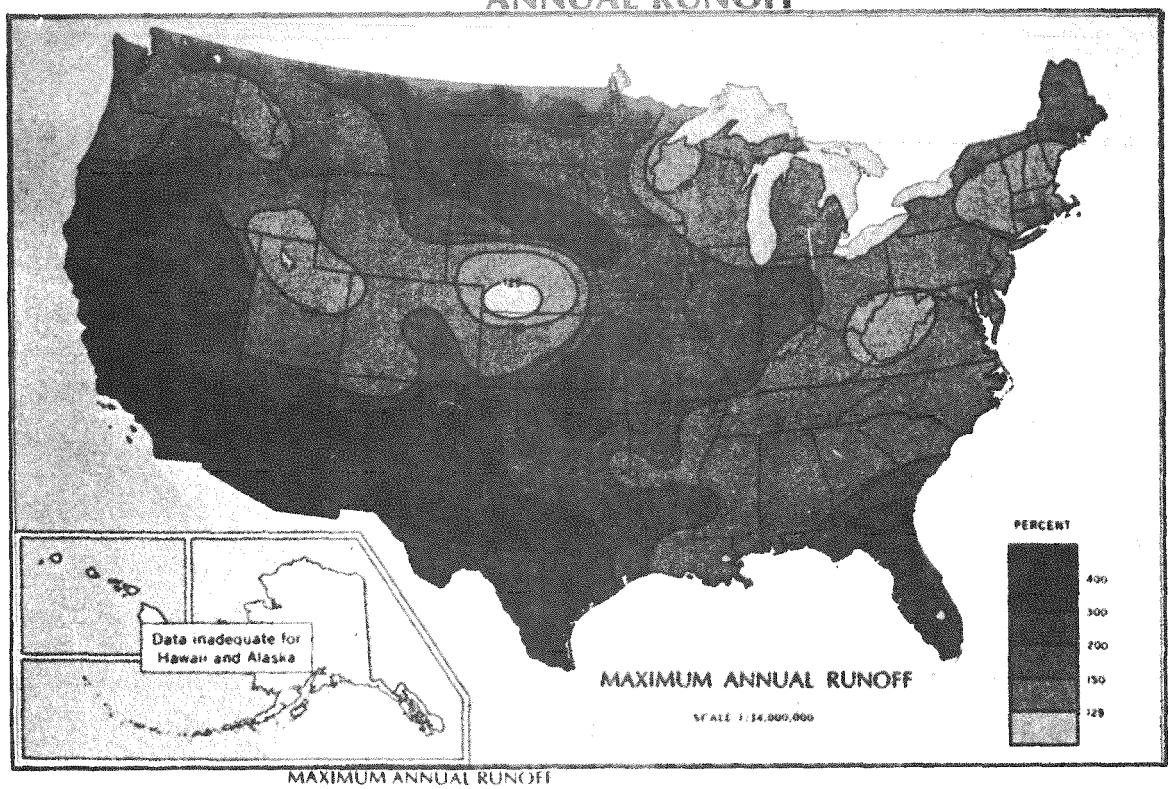
- Over 4,000,000 (5.0 cubic kilometers)
- 810,000-4,000,000 (1.0-5.0 cubic kilometers)
- 81,000-810,000 (0.1-1.0 cubic kilometer)
- Usable reservoir capacity exceeds average annual inflow (storage ratio greater than 1)

Reservoir data as of 1966

FIGURE II-B-12. Average Annual Runoff and Large Surface Reservoirs

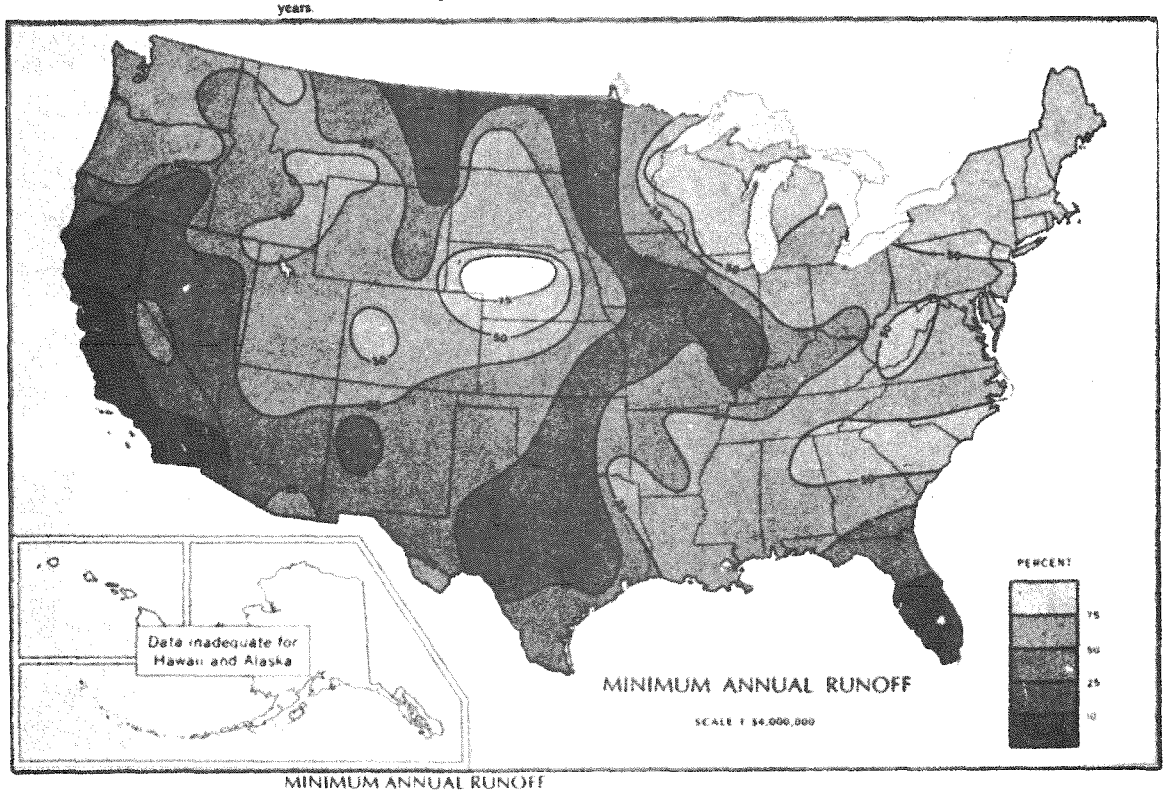


Data Source: Ref. 13, National Atlas, p. 119.



MAXIMUM ANNUAL RUNOFF

Numbers show maximum annual runoff, in percent of the 1931–60 average, from representative drainage basins less than 4,000 km². The maximum runoff is necessarily greater than 100 percent of the average. The maximums for the individual streams occurred in various years.

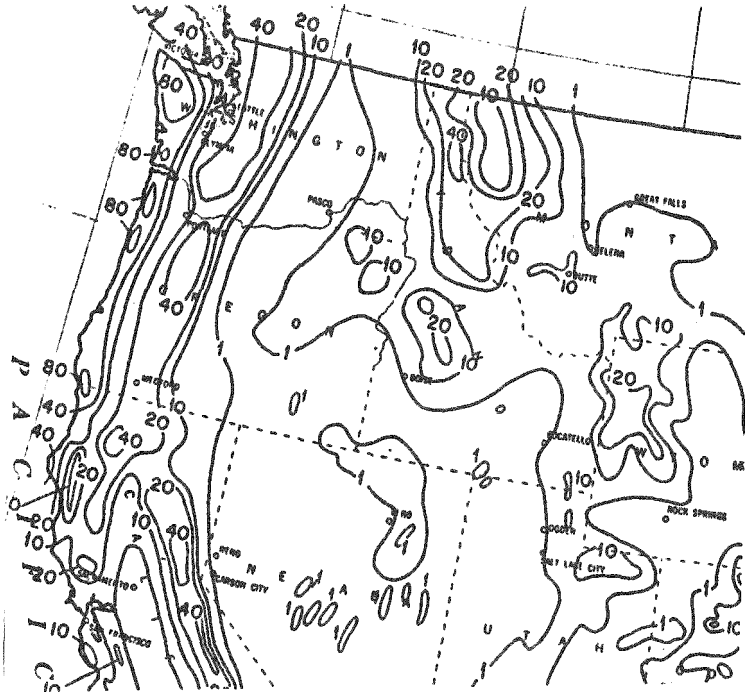


MINIMUM ANNUAL RUNOFF

Numbers show minimum annual runoff from representative drainage basins, in percent of the 1931–60 average. The minimum runoff is necessarily less than 100 percent of the average. The minimums for the individual streams occurred in various years.

FIGURE II-B-13. Variations in Runoff

Data Source: Ref. 13, National Atlas, p. 120.



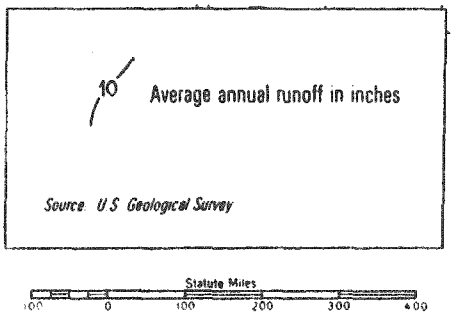


FIGURE II-B-14. Surface Water

Data Source: Ref. 9, Water Atlas, Plate 21.

TABLE II-B-9
Critical Surface Water Supply Estimates for ASRs
in the Pacific Northwest Region

ASR#	Water Resources Council Aggregated Subregion (ASR) Pacific Northwest Region	Critical Surface Supply (CSS) in Mgd[a]	Critical Supply Month[a]	95% Flow in Mgd[b]	1975 Total Consumption in Mgd[b]
1701	Clark Fork-Kootena	10167.2	Sept.	9000.0	1191.0
1702	Upper & Middle Columbia	79705.9	Sept.	65600.0	5987.0
1703	Upper & Middle Snake	11662.1	Sept.	5200.0	6594.0
1704	Salmon-Lower Snake	17511.6	Sept.	10500.0	555.0
1705	Lower Columbia-Coast	92162.5	Sept.	77300.0	780.0
1706	Puget Sound	10795.9	Aug.	10400.0	404.0
1707	Oregon Closed Basin	2633.0	July	65.0	2568.0

(a) Calculated by Oak Ridge National Laboratory

(b) Water Resources Council, The Nation's Water Resources, April 1978, (Draft Data)

Data Source: Ref. 14, Oak Ridge National Laboratory

FIGURE II-B-15. Offstream and Instream Competition for Water

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

INADEQUATE WATER SUPPLY FOR OFFSTREAM USES

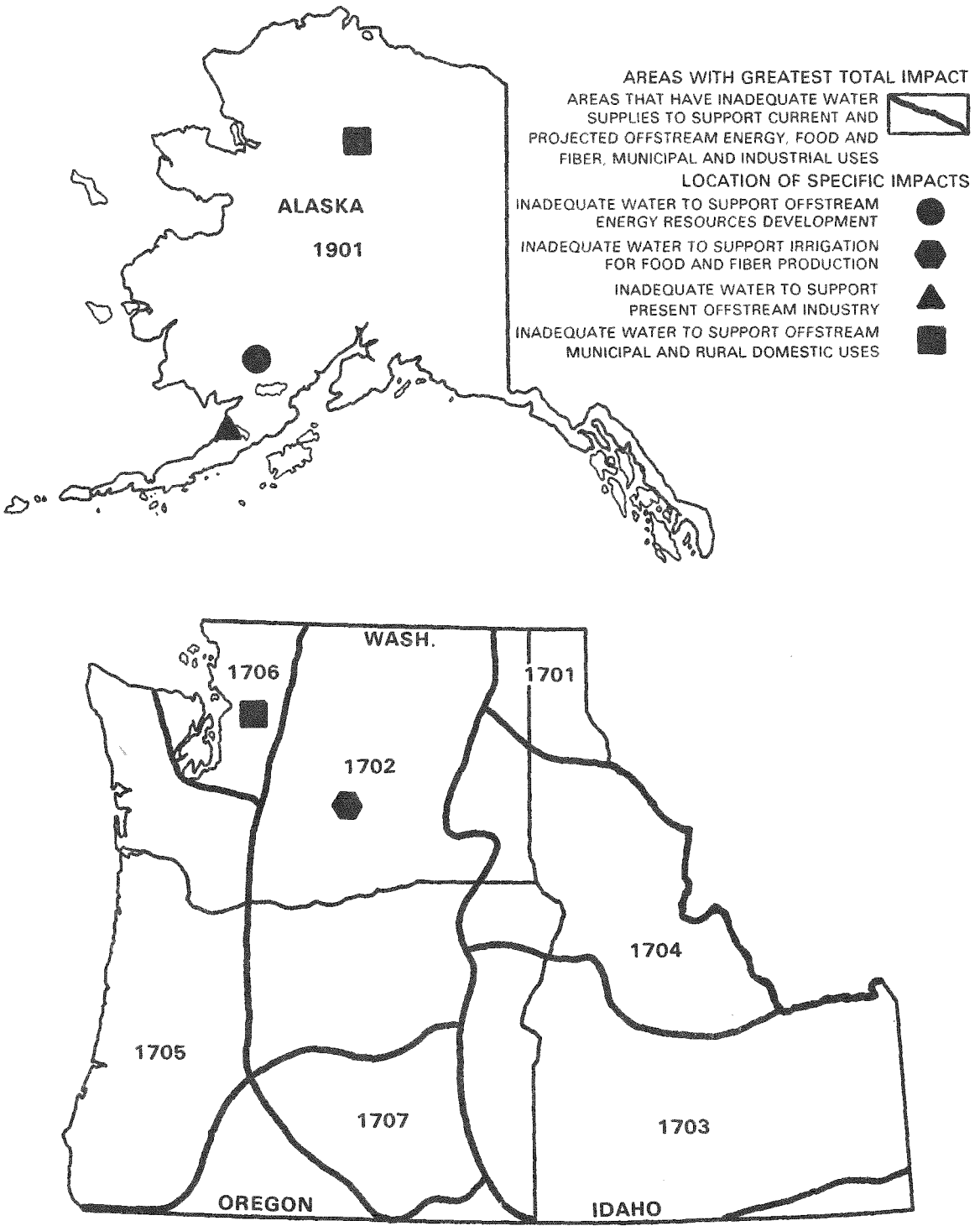


FIGURE II-B-16. Inadequate Water Supply for Offstream Uses

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

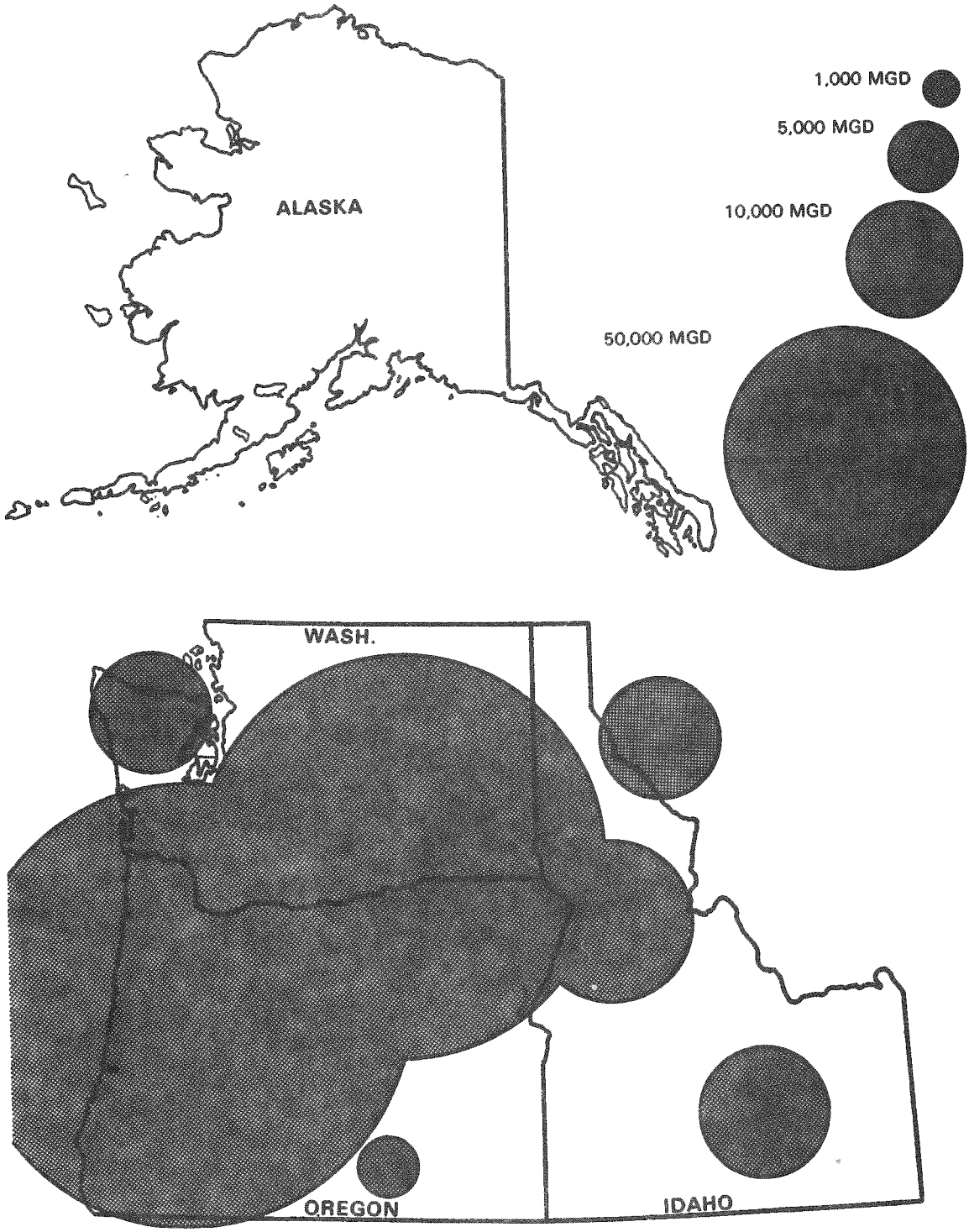


FIGURE II-B-17. Critical Surface Water Supply Values for Aggregated Subareas Derived by ORNL

Data Source: Ref. 14, Oak Ridge National Laboratory.

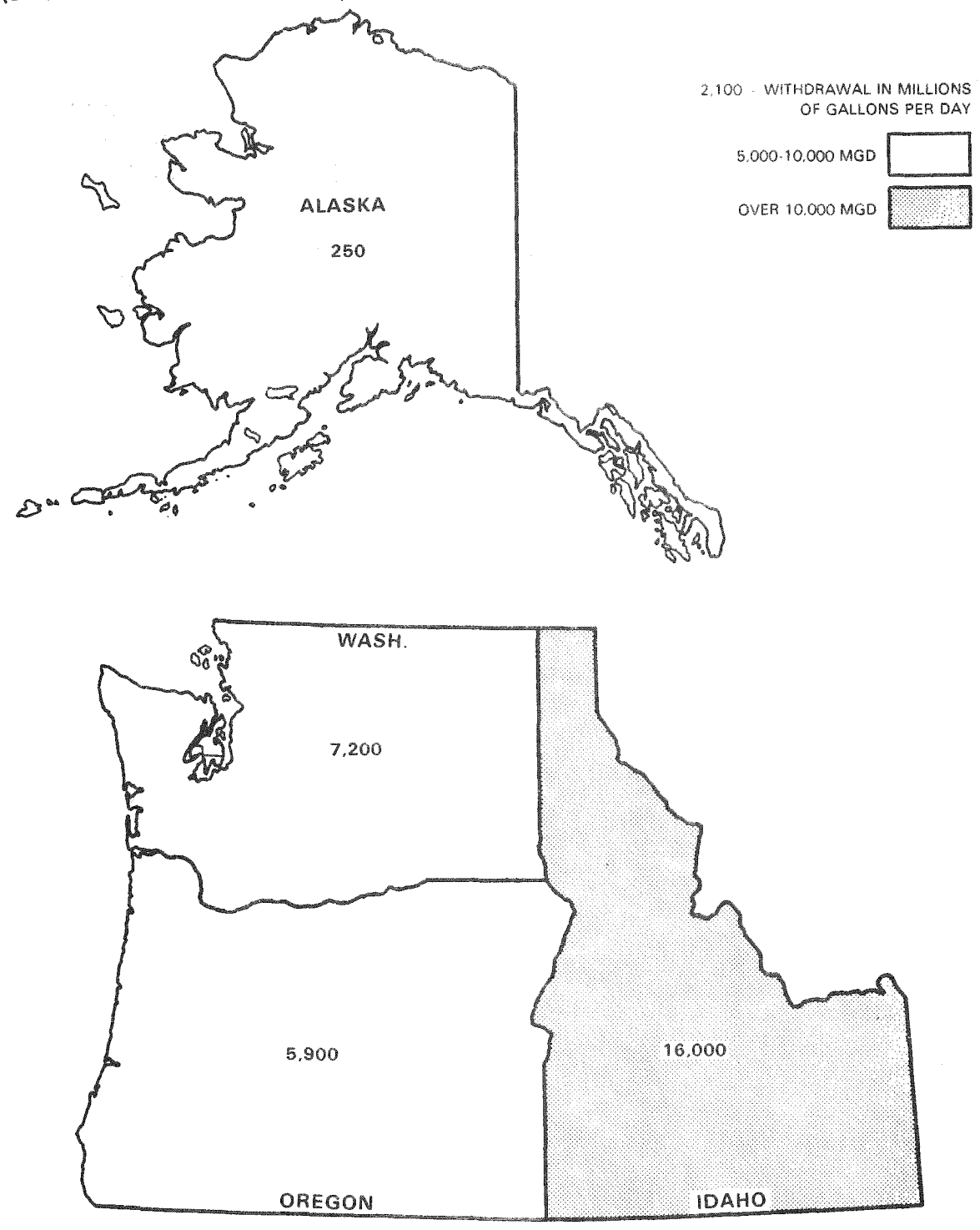


FIGURE II-B-18. Total Withdrawal of Water, Excluding Hydroelectric Power, 1970

Data Source: Ref. 9, Water Atlas, Plate 75.

TABLE II-B-10

WATER WITHDRAWN PER DAY - 1970

State	Per Capita Gal	Total MM Gal	Surface MM Gal	Fresh Water Consumed MM Gal
Alaska	830	250	210	16
Idaho	22,000	16,000	13,000	4,700
Oregon	2,800	5,900	5,000	2,500
Washington	2,100	7,200	6,300	2,500

Data Source: Ref. 16, 1977 U.S. Fact Book.

TABLE II-B-11

WATER CONSUMPTION BY COAL ELECTRIC POWER GENERATING PLANTS

Cooling System	Water Consumption (gal/kWh)
Once-through	0.1-0.3
Cooling Pond (1 acre/MWe)	0.6-1.0
Spray Pond or Canal	0.4-0.6
Mechanical Draft Wet Tower	0.5-0.7
Natural Draft Wet Tower	0.5-0.7
Mechanical Draft Dry Tower	0-0.01

Data Source: Ref. 1, The Impact of Increased Coal Consumption.

TABLE II-B-12

MISCELLANEOUS WATER USE IN COAL ELECTRIC GENERATING PLANTS

Water Stream or Loss	Water Used (gal/day/MWe)
Cooling Tower Blowdown	2000-7500
Ash Handling Discharge	100-400
Metal Cleaning Wastes	15-20
Boiler Blowdown	50-60
Losses in Ash	70-100
Low Volume and Miscellaneous Uses	100-125

Data Source: Ref. 1, The Impact of Increased Coal Consumption, p. 3.15.

TABLE II-B-13

WATER DEMAND AND SUPPLY BALANCES

Aggregated Subareas	Million Gallons a Day: Water Supplies Mean	Water Supplies 95%	Consumptive Use Projections (medium level) 1975	1985	2000	2020	Consumptive Use Equals or Exceeds 95% Supply 1975	1985	2000	2020	Percent of Area of Forest and Range Land
1701	32,093.8	18,074.2	1,169.0	1,778.2	1,816.6	2,051.4					86
1702	122,814.2	90,470.3	4,885.6	6,230.4	6,542.1	7,387.8					67
1703	13,820.6	8,850.1	7,346.4	9,093.3	8,159.9	9,371.4		x	x	x	43
1704	33,353.5	23,832.7	624.8	899.0	1,070.7	1,209.1					77
1705	219,876.8	158,071.9	860.1	1,510.5	1,821.0	2,056.4					75
1706	34,327.4	24,030.9	175.2	306.2	470.5	531.3					68
1707	273.4	273.4	632.8	879.1	942.1	1,063.9	x	x	x	x	36

Data Source: Ref. 1, The Impact of Increased Coal Consumption.

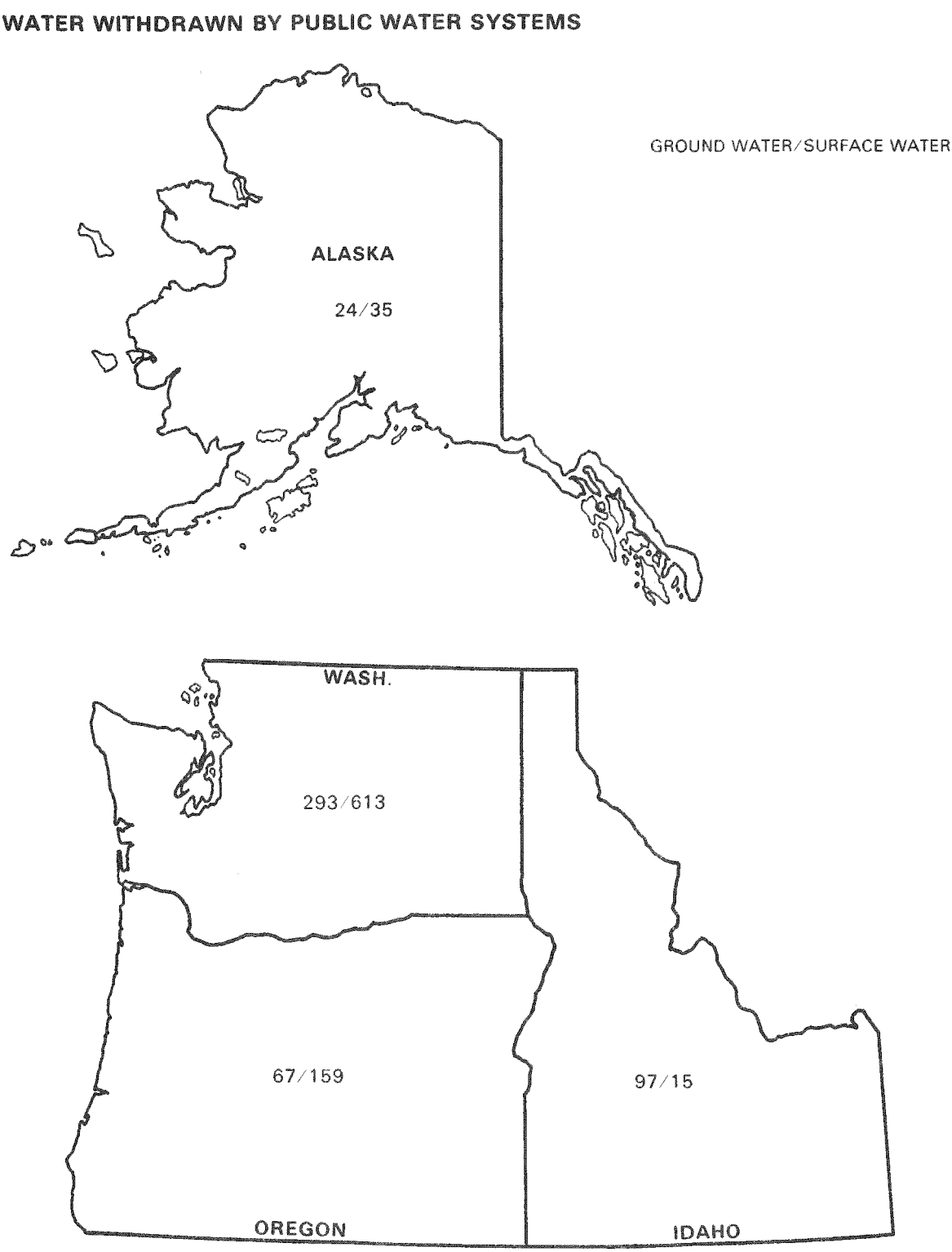
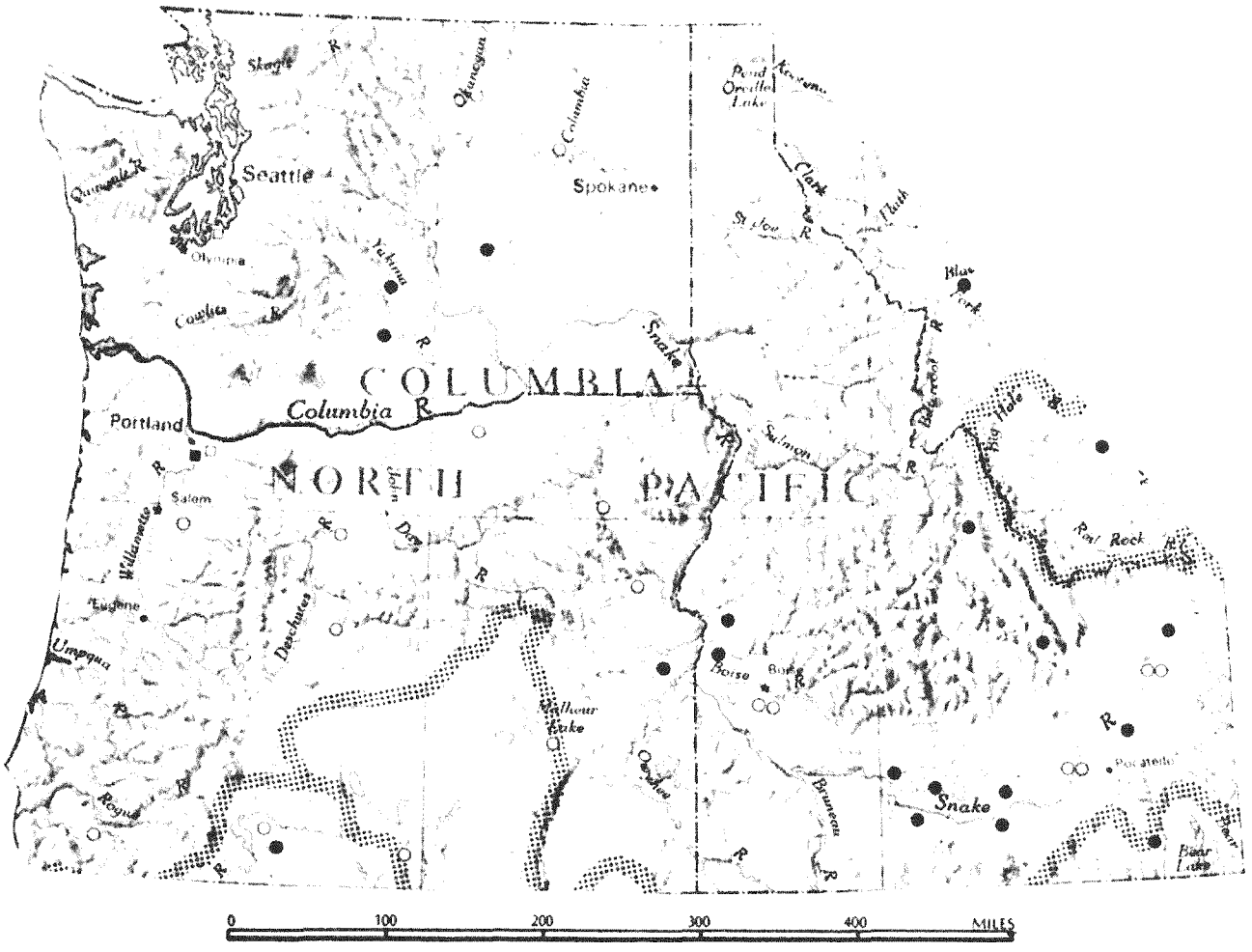


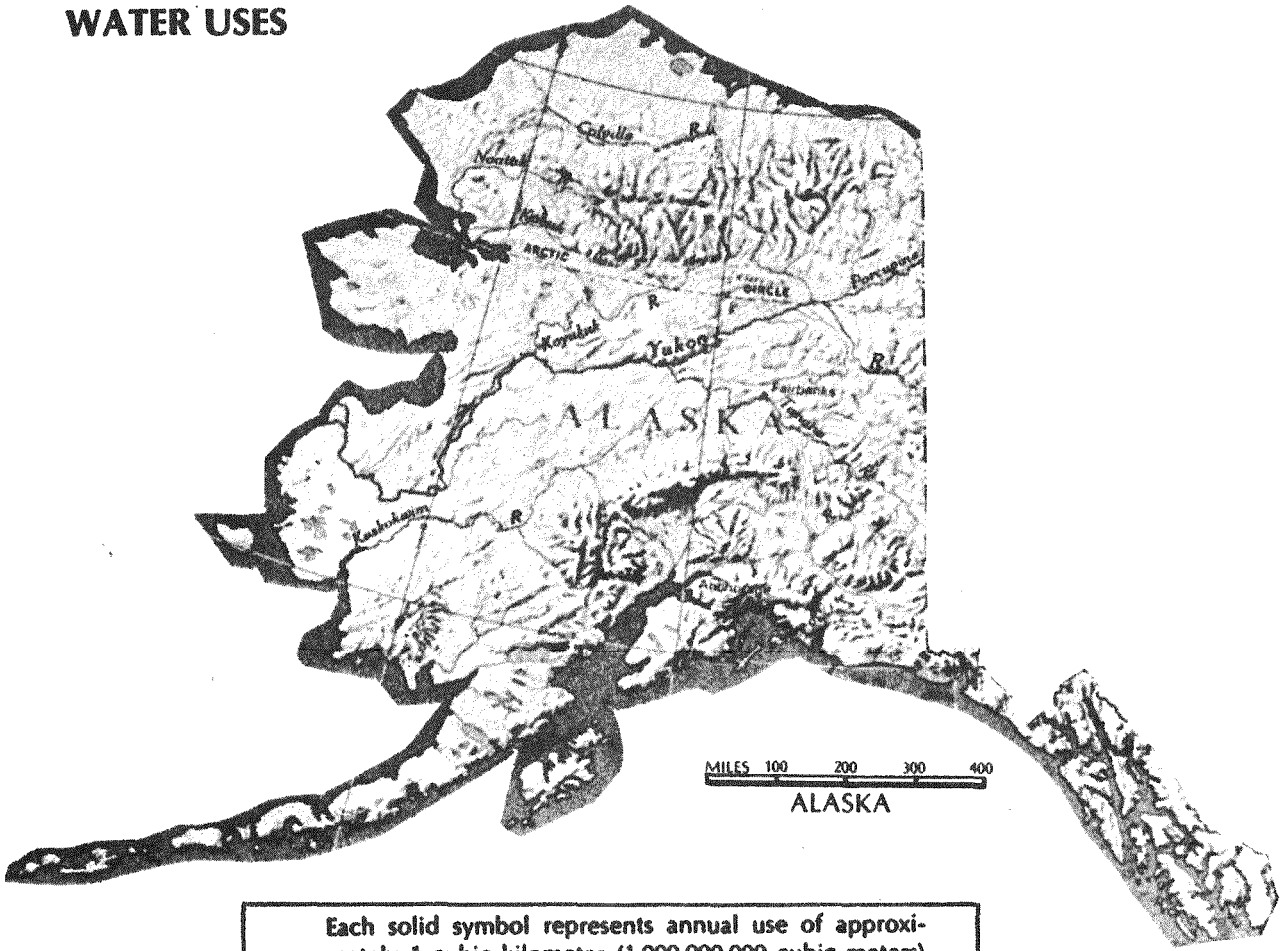
FIGURE II-B-19. Water Withdrawal by Public Water Systems (MGD)

Data Source: Ref. 17, Draft EIS Proposed Regulation: Criteria for Classification of Solid Waste Disposal Facilities.



Data Source: Ref. 13, National Atlas, pp. 126 and 127.

WATER USES



Each solid symbol represents annual use of approximately 1 cubic kilometer (1,000,000,000 cubic meters) of water, equivalent to 810,000 acre-feet, or to an average use of 720 million gallons per day. Open symbols represent half this rate of use

TYPE OF USE*	SOURCE		
	FRESH SURFACE WATER	FRESH GROUND WATER	SALINE WATER
Public supply	♦ ◊	♦ ◊	
Irrigation	● ○	●	
Fuel-electric power generation	★ ☆	★	★ ☆
Other industrial	■ □	■	■ □

*Nonwithdrawal uses for hydropower, navigation, recreation, and dilution are not shown

FIGURE II-B-20. Principal Uses of Water, 1960

Data Source: Ref. 13, National Atlas, p. 126 and 127.

PER CAPITA WATER CONSUMPTION 1970

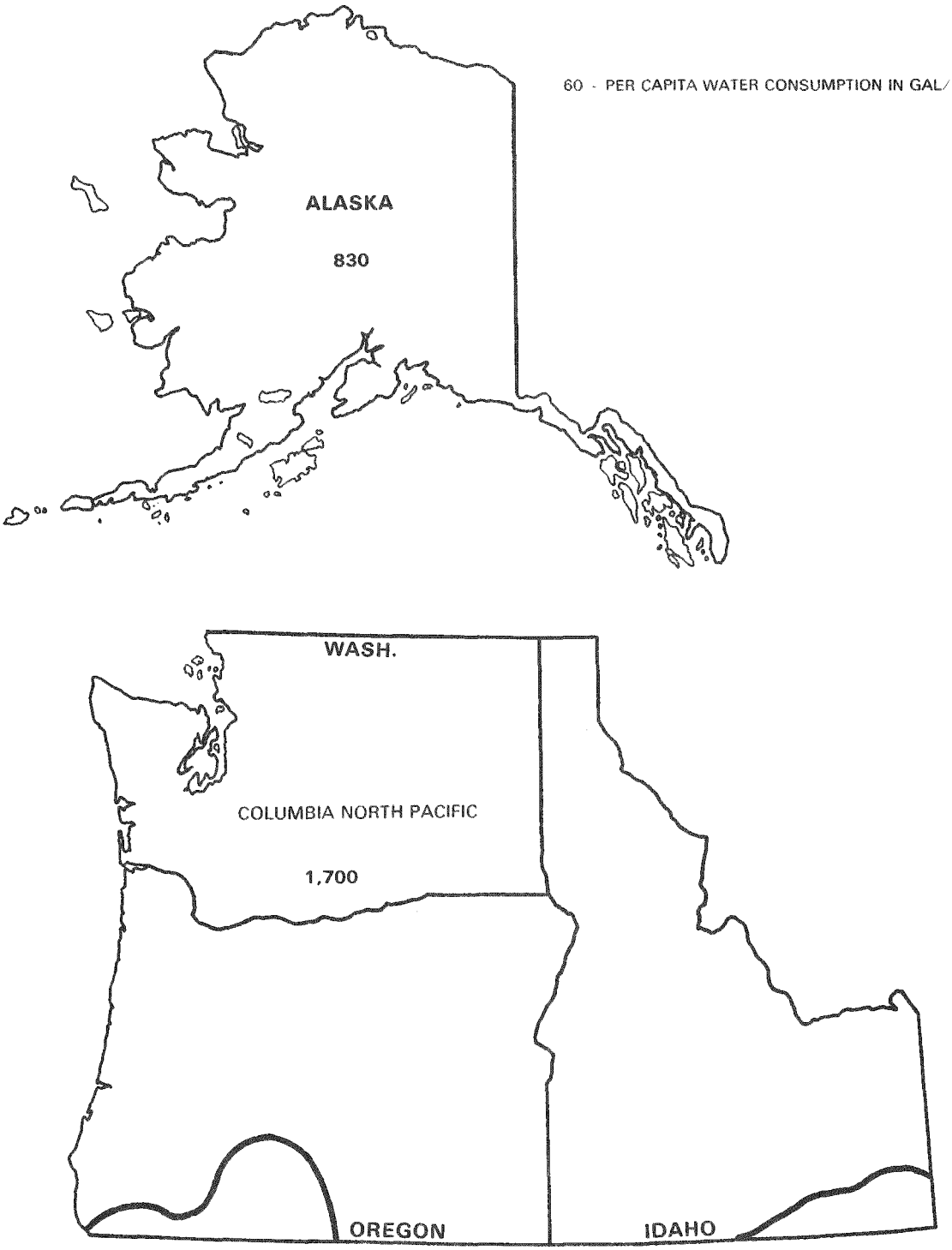


FIGURE II-B-21. Per Capita Water Consumption, 1970

Data Source: Ref. 9, Water Atlas, Plate 35.

PER CAPITA WATER USE 1970

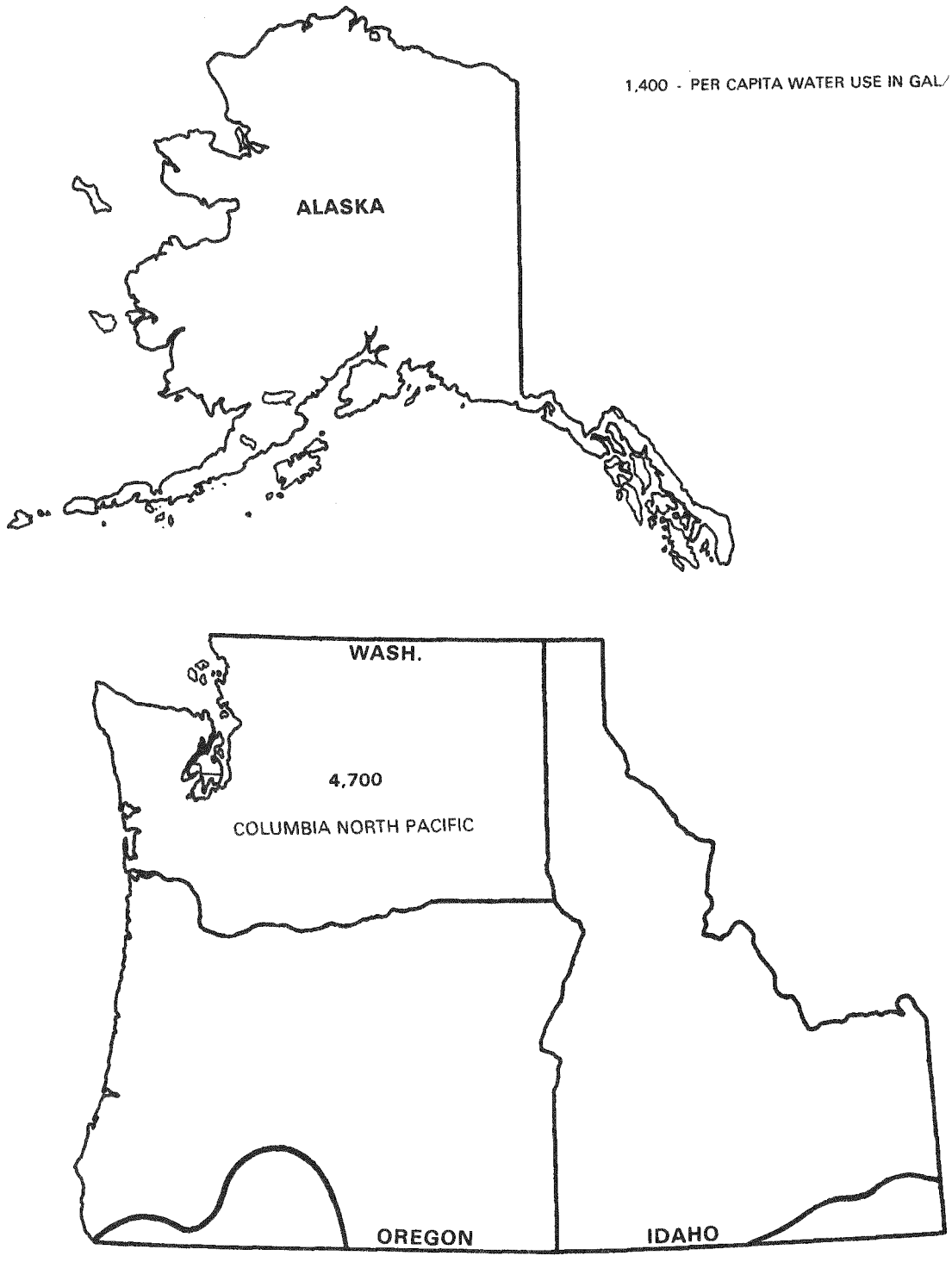


FIGURE II-B-22. Per Capita Water Use, 1970

Data Source: Ref. 9, Water Atlas, Plate 84.

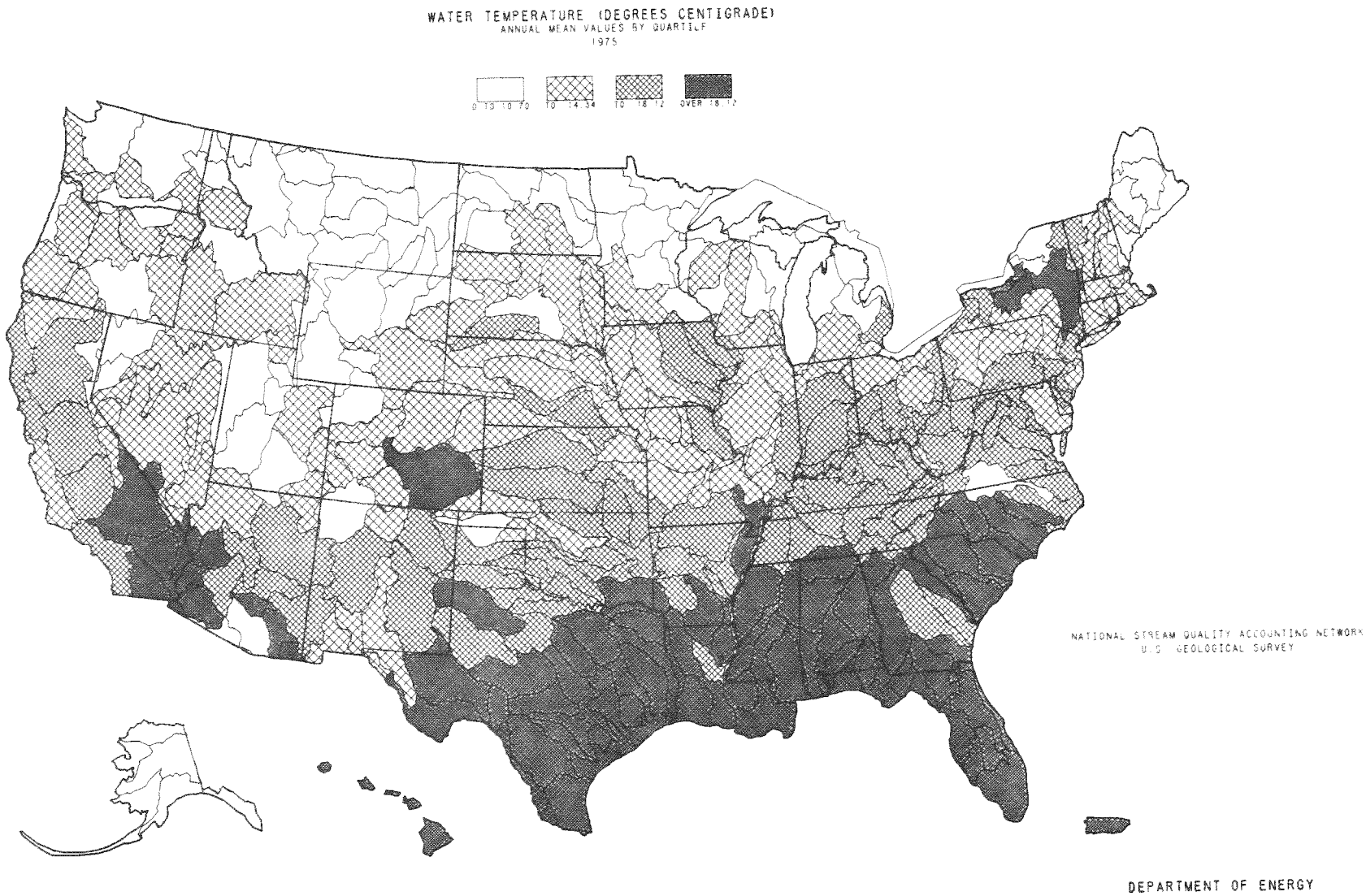


FIGURE II-B-23. Water Temperature (Degrees Centigrade)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

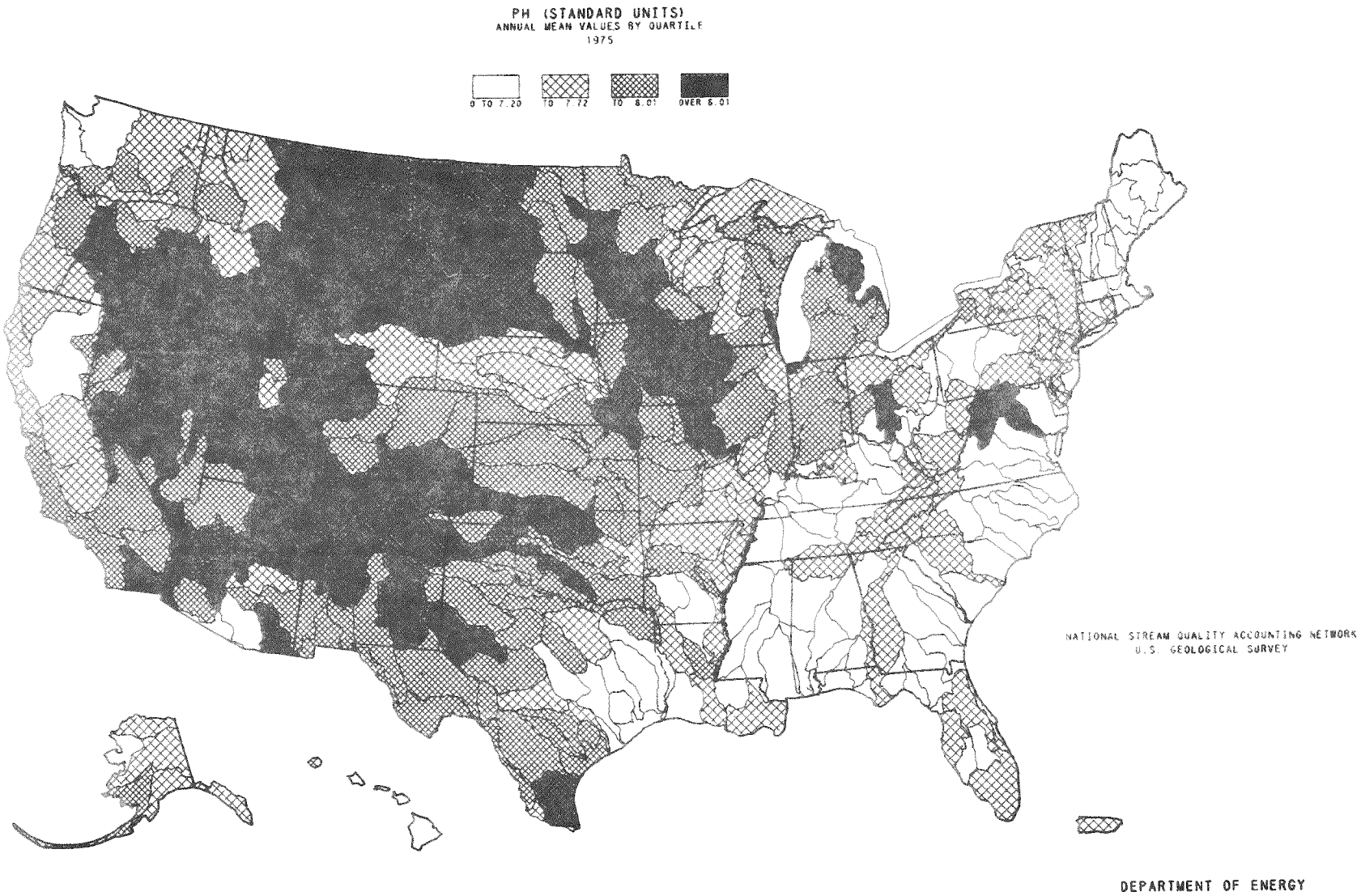


FIGURE II-B-24. pH (Standard Units)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

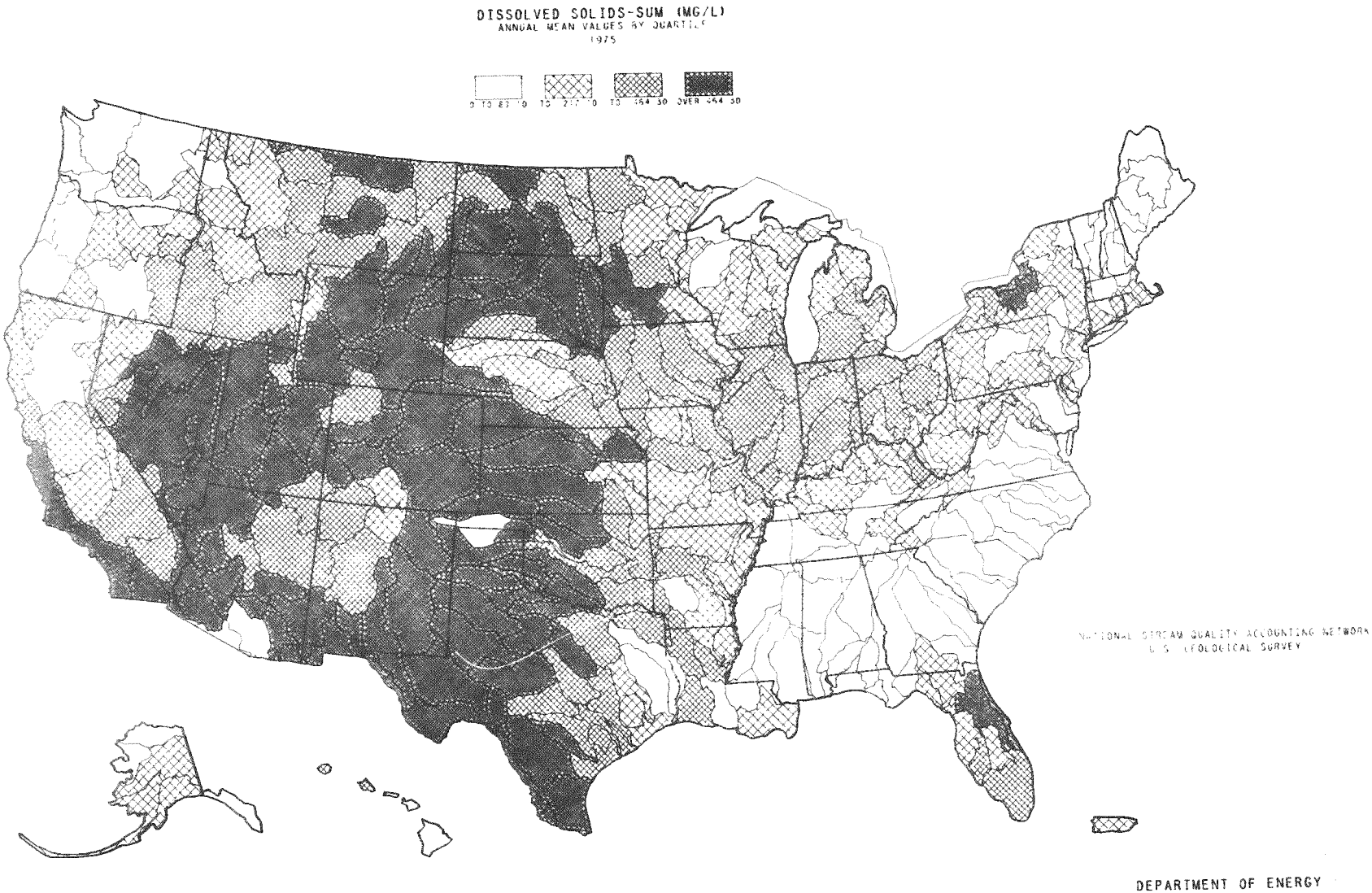


FIGURE II-B-25. Dissolved Solids - Sum (mg/L)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

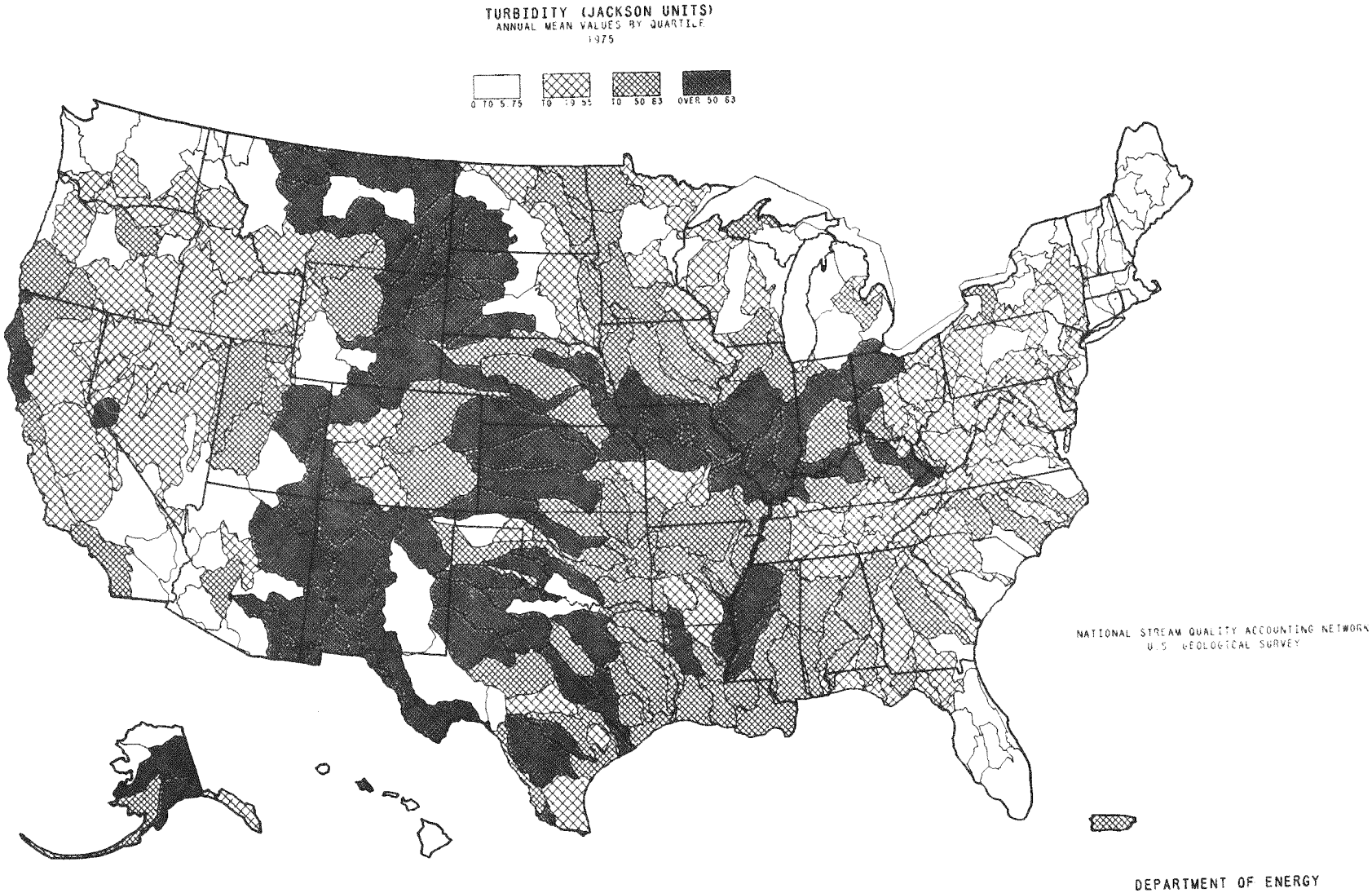


FIGURE II-B-26. Turbidity (Jackson Units)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

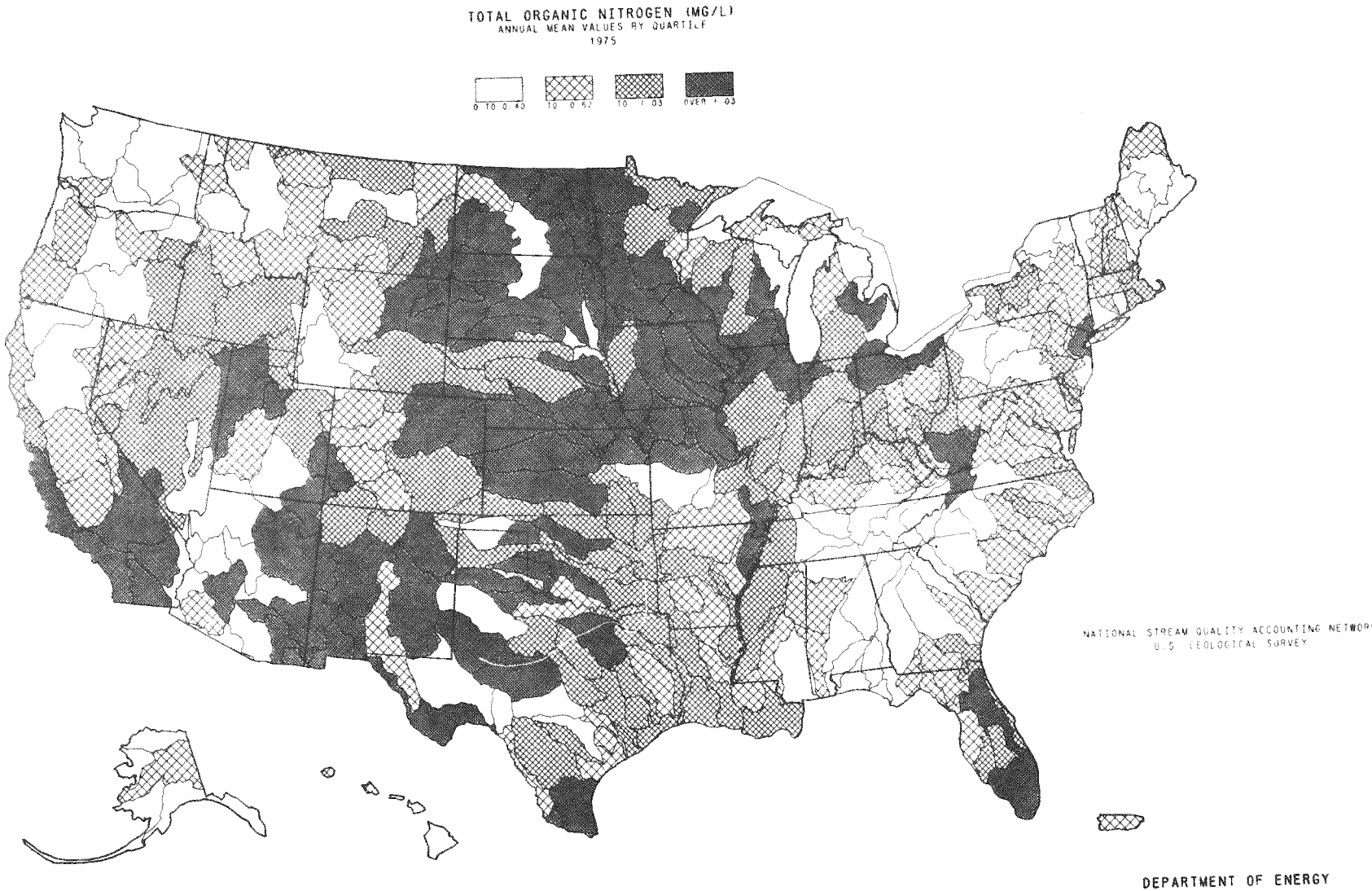


FIGURE II-B-27. Total Organic Nitrogen (mg/L)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

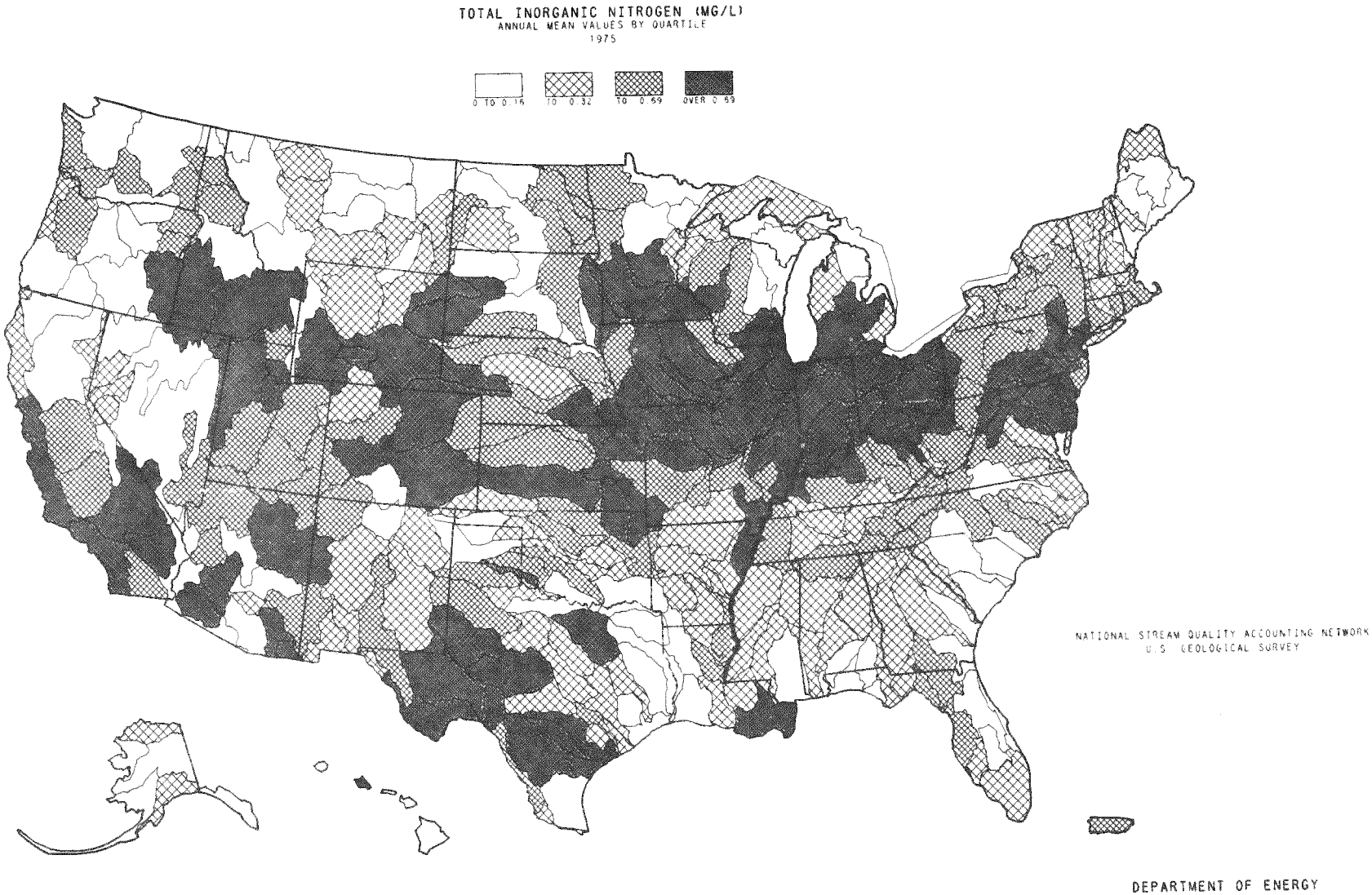


FIGURE II-B-28. Total Inorganic Nitrogen (mg/L)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

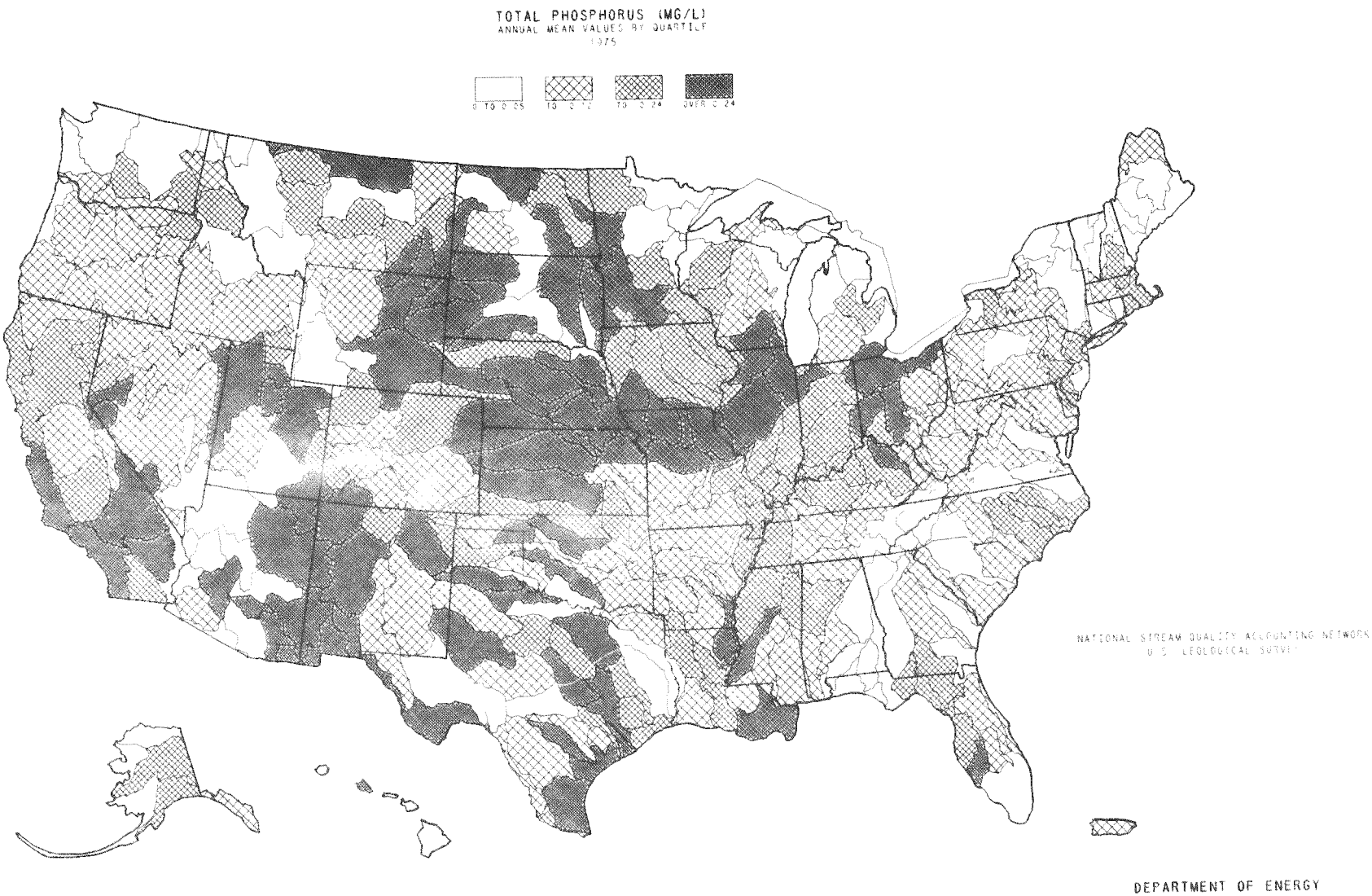


FIGURE II-B-29. Total Phosphorus (mg/L)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

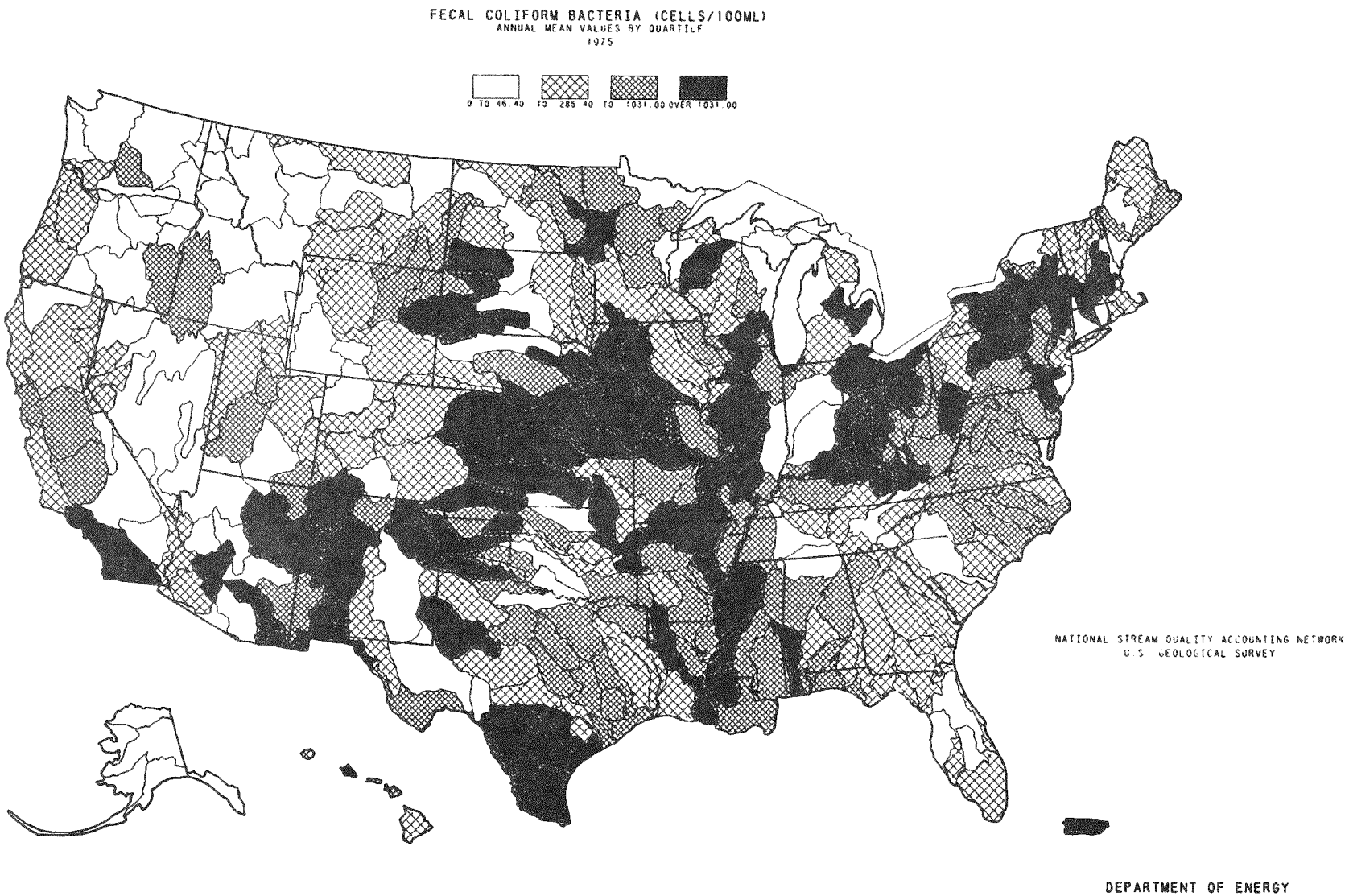


FIGURE II-B-30. Fecal Coliform Bacteria (cells/100 ML)

Data Source: Ref. 18, The National Stream Quality Accounting Network.

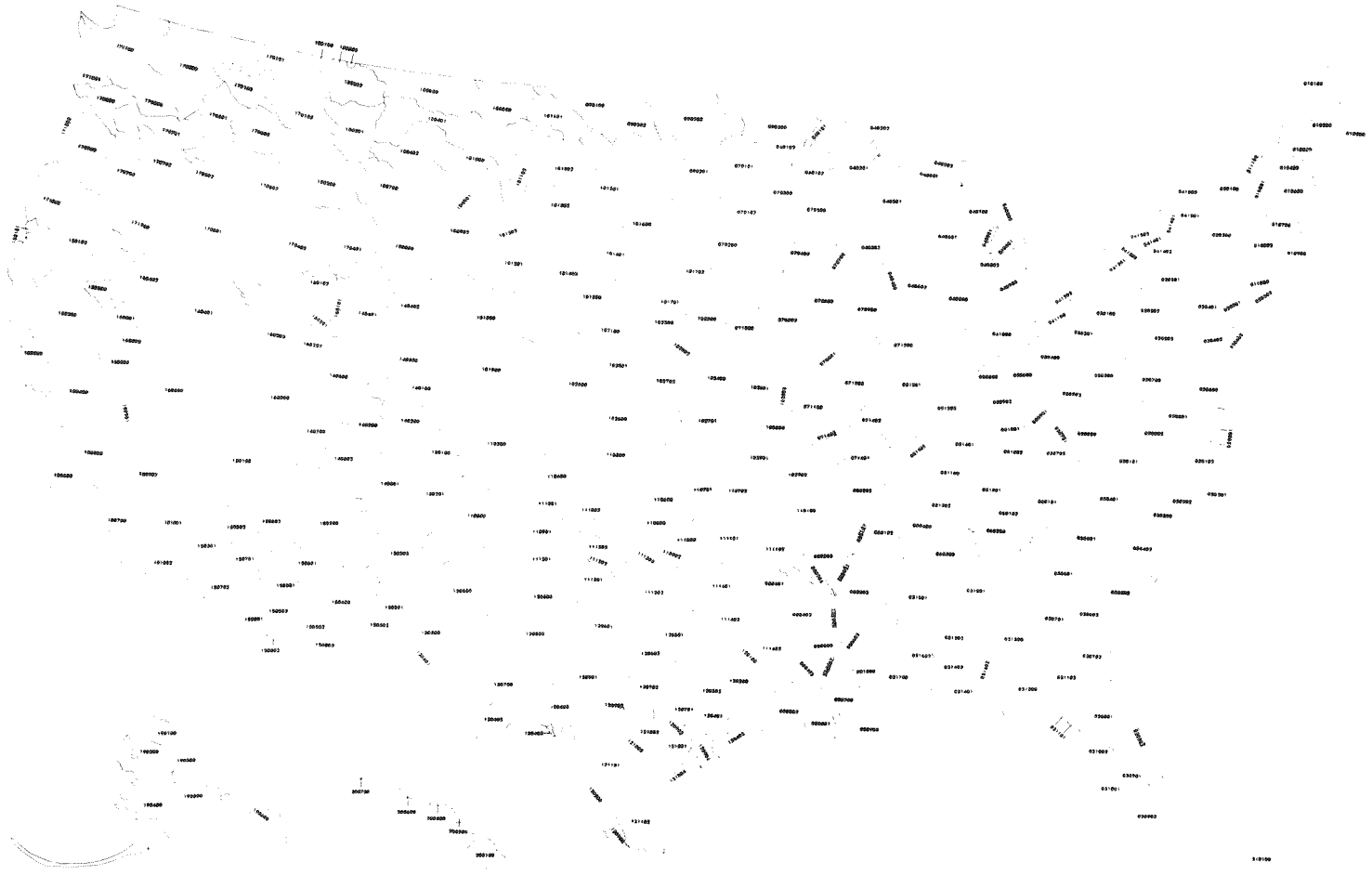


FIGURE II-B-31. Regional Sub-Basins Defined by the Water Resources Council

Data Source: Ref. 18, The National Stream Quality Accounting Network.

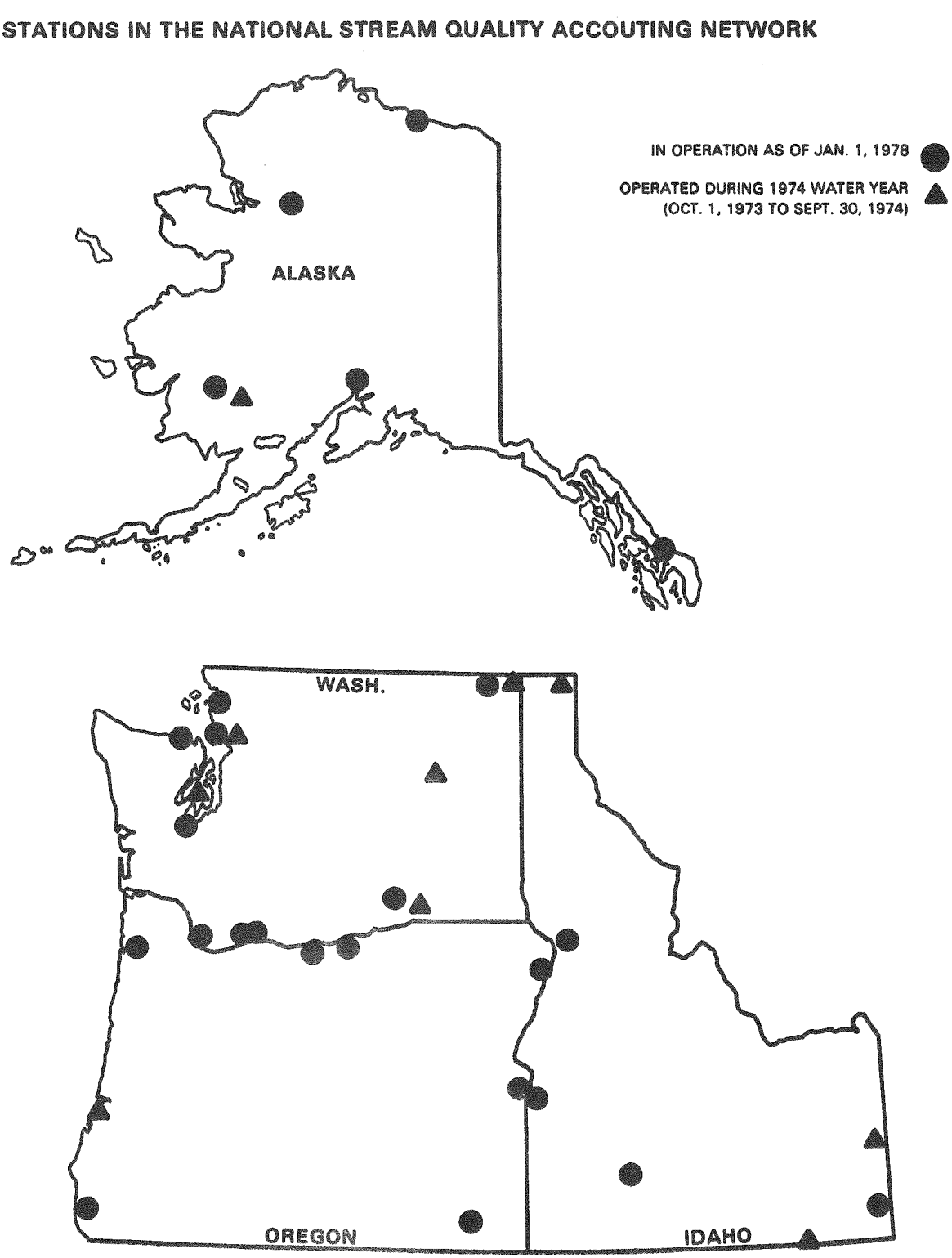


FIGURE II-B-32. Locations of Stations in NSQAN

Data Source: Ref. 18, The National Stream Quality Accounting Network.

TABLE II-B-14
Stream Quality Accounting Network
(1975 Annual Average Values)

NASQAN Accounting Unit	Total Residue MG/L	Total Cobalt UG/L	Total Iron UG/L	Total Lead UG/L	Total Carbon UG/L
170101	108.50	50.00	432.50	100.00	2.75
170102	93.84	38.18	167.04	100.00	2.48
170103	80.67	50.00	165.00	100.00	6.45
190100	111.50	50.00	1017.50	100.00	10.87
190200	0.0	0.0	0.0	0.0	0.0
190300	132.60	50.00	7833.33	100.00	16.27
190400	104.40	50.00	3160.00	100.00	4.57
190500	96.13	50.00	7015.00	100.00	6.10
190600	81.00	50.00	3009.99	100.00	1.35

Data Source: Ref. 18, U.S. Geological Survey, National Stream Quality Accounting Network - NSQAN Database, 1975.

TABLE II-B-15.

PRODUCTION RESIDUALS DISCHARGED TO WATER, 1973

Aggregated Subarea	Biochemical Oxygen Demand (million lb/yr)	Percent	Total Suspended Solids (million lb/yr)	Percent
1701	189	20	44,883	39
1702	96.6	10	34,701	30
1703	39.5	5	2,697	2
1704	81.1	9	15,456	13
1705	319	34	15,325	13
1706	220	23	904	1
1707	3.77	4	1,597	1
	948.97	100(a)	115,563	100(a)

(a) Does not add due to rounding

Data Source: Ref: 1 , The Impact of Increased Coal Consumption, RAP-21, p. D.4.

TABLE II-B-16.

TOTAL DISSOLVED SOLIDS AND BICARBONATE IN SELECTED COLUMBIA AND SNAKE RIVER WATER SAMPLES, OCTOBER 1974—SEPTEMBER 1975

Monitoring Points	Total Dissolved Solids(a) (mg/l)	Bicarbonate (HCO_3) (mg/l)
Columbia River		
Grand Coulee Dam, WA	71 - 110(b)	60 - 81
Vernita Bridge, WA	78 - 123(b)	62 - 87
Umatilla, OR	80 - 100(c)	(d)
The Dalles, OR	50 - 71(c)	66 - 96
Warrendale, OR	40 - 76(c)	48 - 103
Snake River		
Blackfoot, ID	127(c)	178
Neeley, ID	203 - 285(c)	117 - 190
King Hill, ID	200 - 204(c)	120 - 254
Murphy, ID	188 - 193(c)	189 - 198
Brownlee Dam, ID	160 - 341	61 - 217

(a) TDS expressed as residue at 180°C.
(b) Calculated: TDS = 0.65 x specific conductance
(c) Calculated: TDS = Sum of constituents - 0.5 x bicarbonate
(d) No data
Data Source: Ref. 1 , The Impact of Increased Coal Consumption, RAP-21, p. D.4.

TABLE II-B-17

MAJOR WATER POLLUTION SOURCE IN THE UNITED STATES, BY STATE, 1972

	Point Sources								Nonpoint Sources				
		Industrial Waste				Other							
State	Municipal Wastes	Pulp, Paper, and Lumbering	Food Processing	Thermal	Unclassified[a]	Recreation	Livestock Feedlots	Vessels	Agriculture Runoff	Irrigation Return Flow	Mining	Silviculture	Construction
Alaska	x	x	x										
Idaho					x					x	x	x	
Oregon	x	x		x		x				x		x	
Wash.	x								x	x		x	

(a) Specific cause not identified other than "industrial pollution," or causes do not fit into other three categories.

Data Source: Ref. 19, National Water Quality Inventory, Volume 1.

TABLE II-B-18

NONPOINT SOURCE PROBLEMS DISCUSSED IN STATE 305(b) REPORTS

Area	Agri-cultural	Silvi-cultural	Mining	Con-struction	Hydrologic Modification	Urban	Residual Waste Disposal	Salt Water Intrusion	Proposed Energy Development
Alaska[a]									
Idaho	x	x	x	x		x			
Oregon[b]									
Washington	x	x	x		x	x			
U.S. Total	44	21	27	25	9	40	9	4	3

(a) State report was not received in time for inclusion.
(b) Not discussed by category.

Data Source: Ref. 19, National Water Quality Inventory, Volume 1.

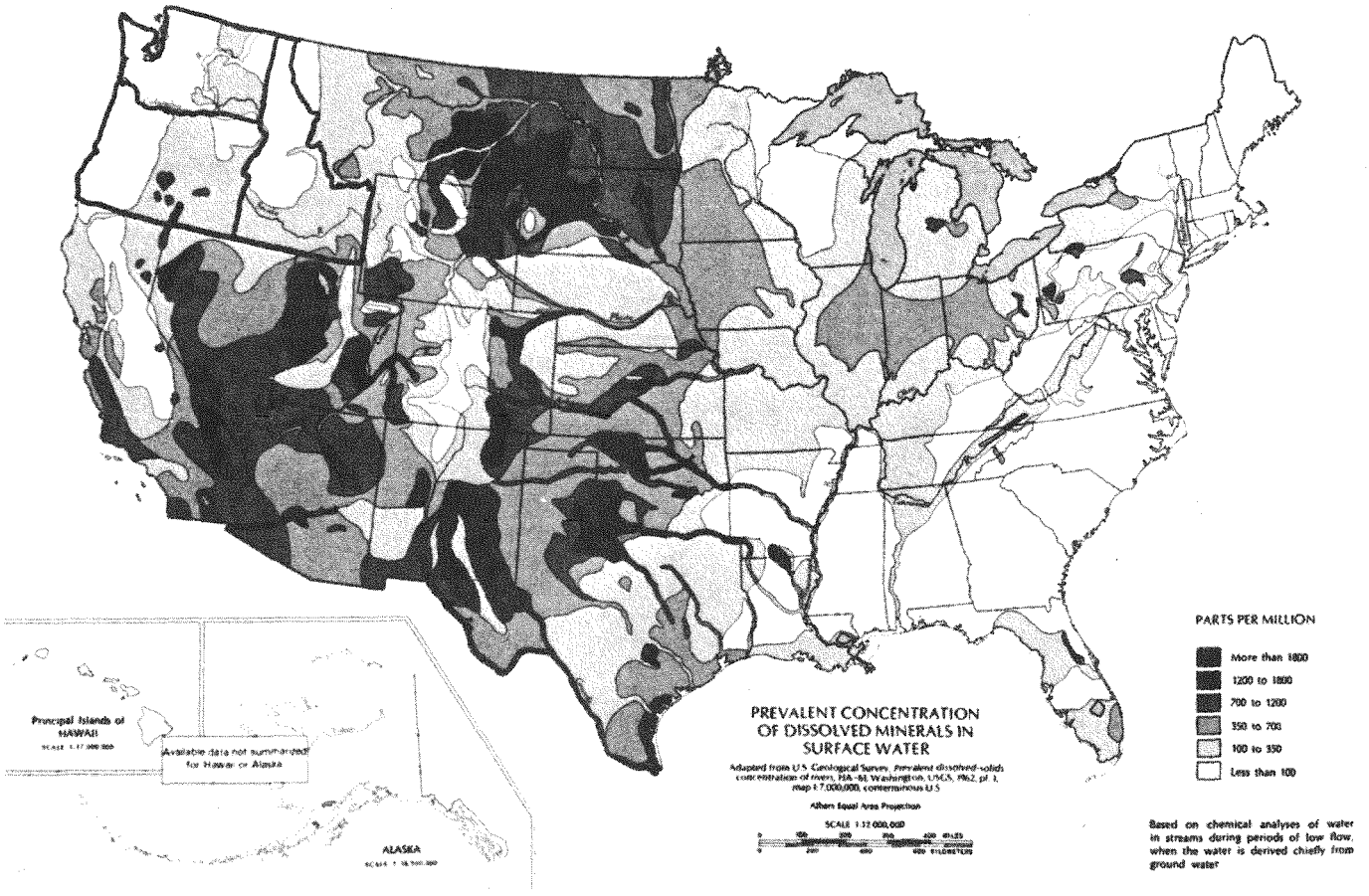


FIGURE II-B-33. Prevalent Concentration of Dissolved Minerals in Surface Water

Data Source: Ref. 13, National Atlas.

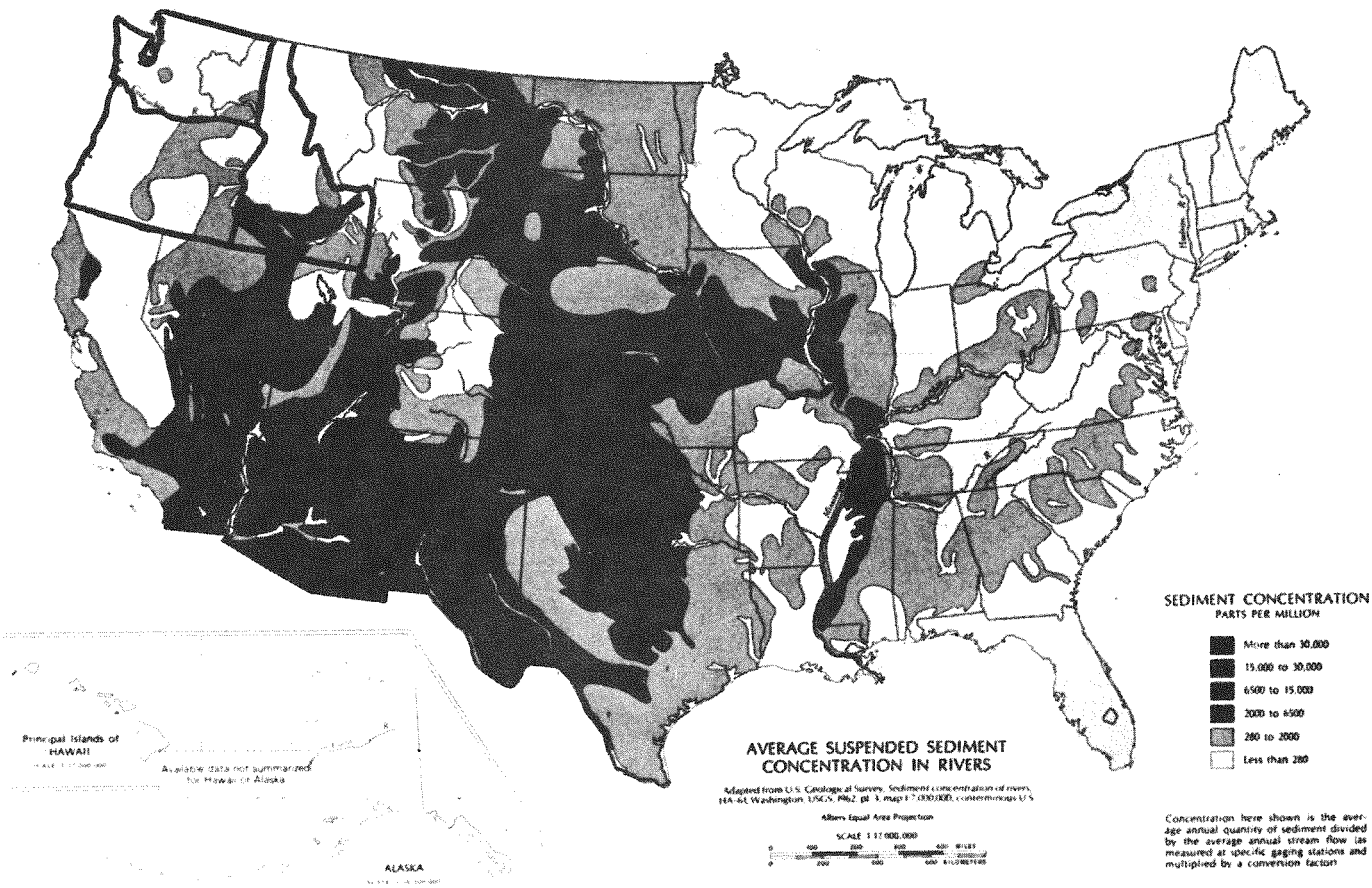


FIGURE II-B-34. Average Suspended Sediment Concentration in Rivers

Data Source: Ref. 13, National Atlas.

SURFACE WATER QUALITY DEGRADATION FROM DISPERSED SOURCES

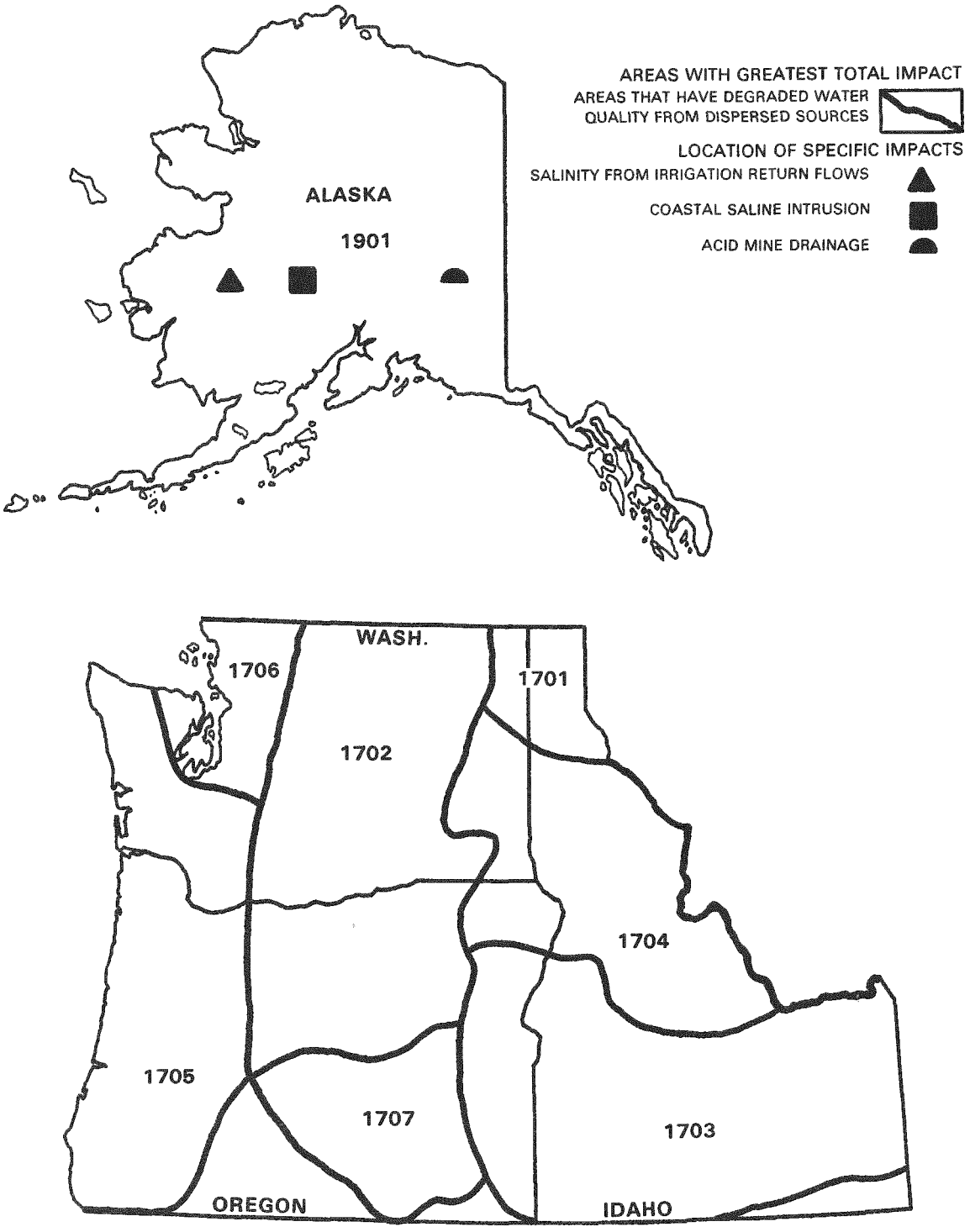


FIGURE II-B-35. Surface Water Quality Degradation from Dispersed Sources

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

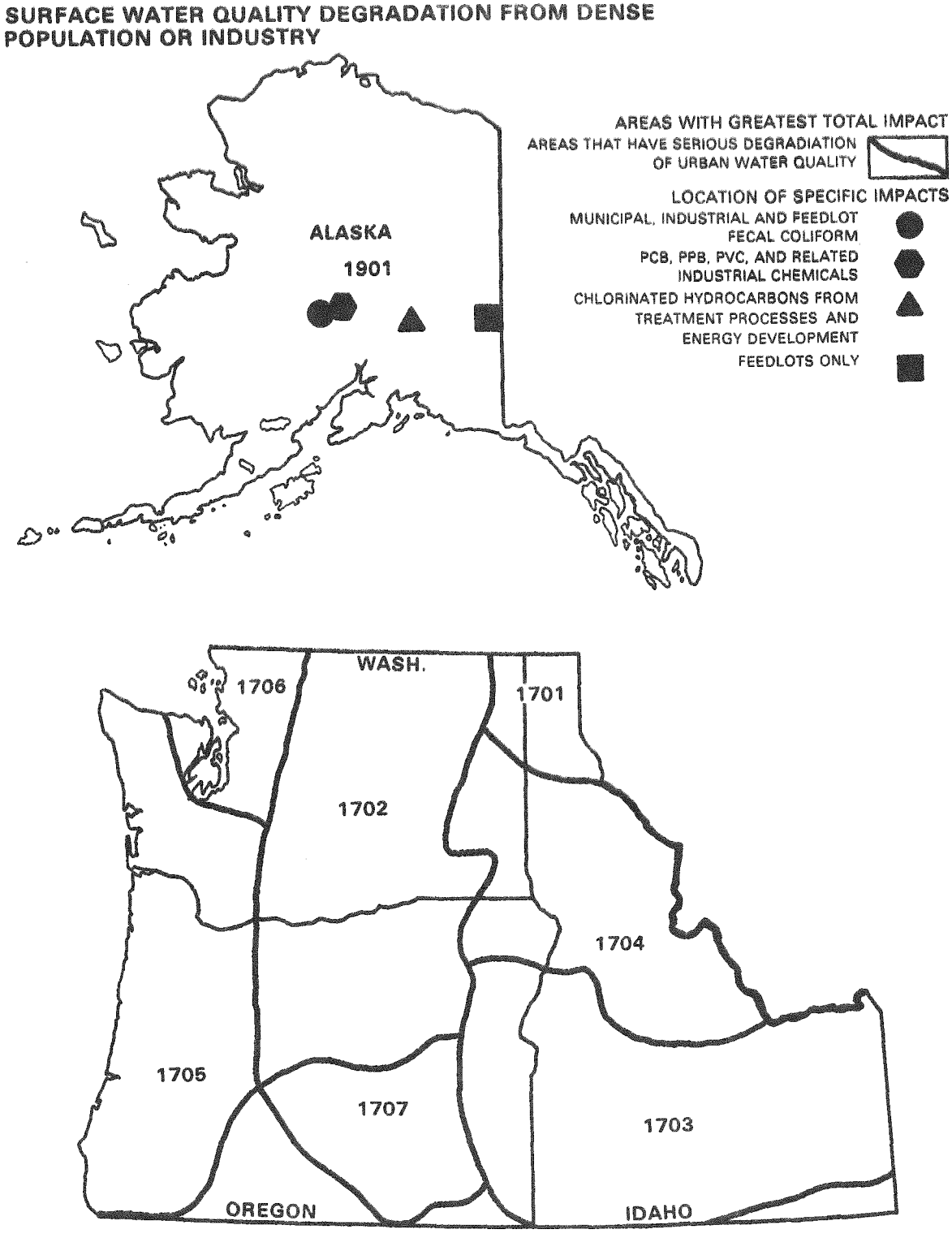


FIGURE II-B-36. Surface Water Quality Degradation from Dense Population or Industry

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

EUTROPHICATION OF MAN-MADE AND NATURAL WATER BODIES

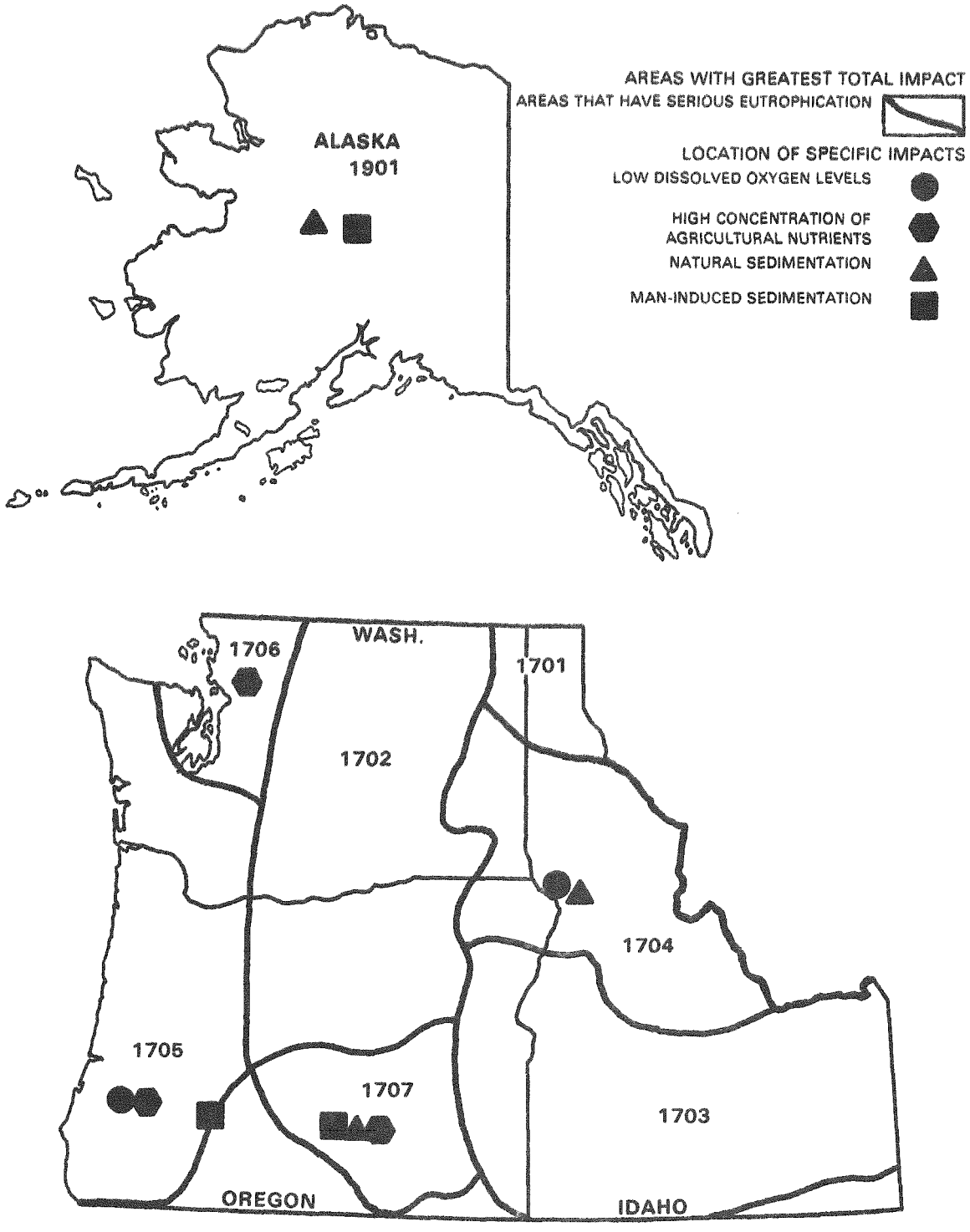


FIGURE II-B-37. Eutrophication of Man-Made and Natural Water Bodies

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

INADEQUATE QUALITY AND QUANTITY OF POTABLE WATER SUPPLIES

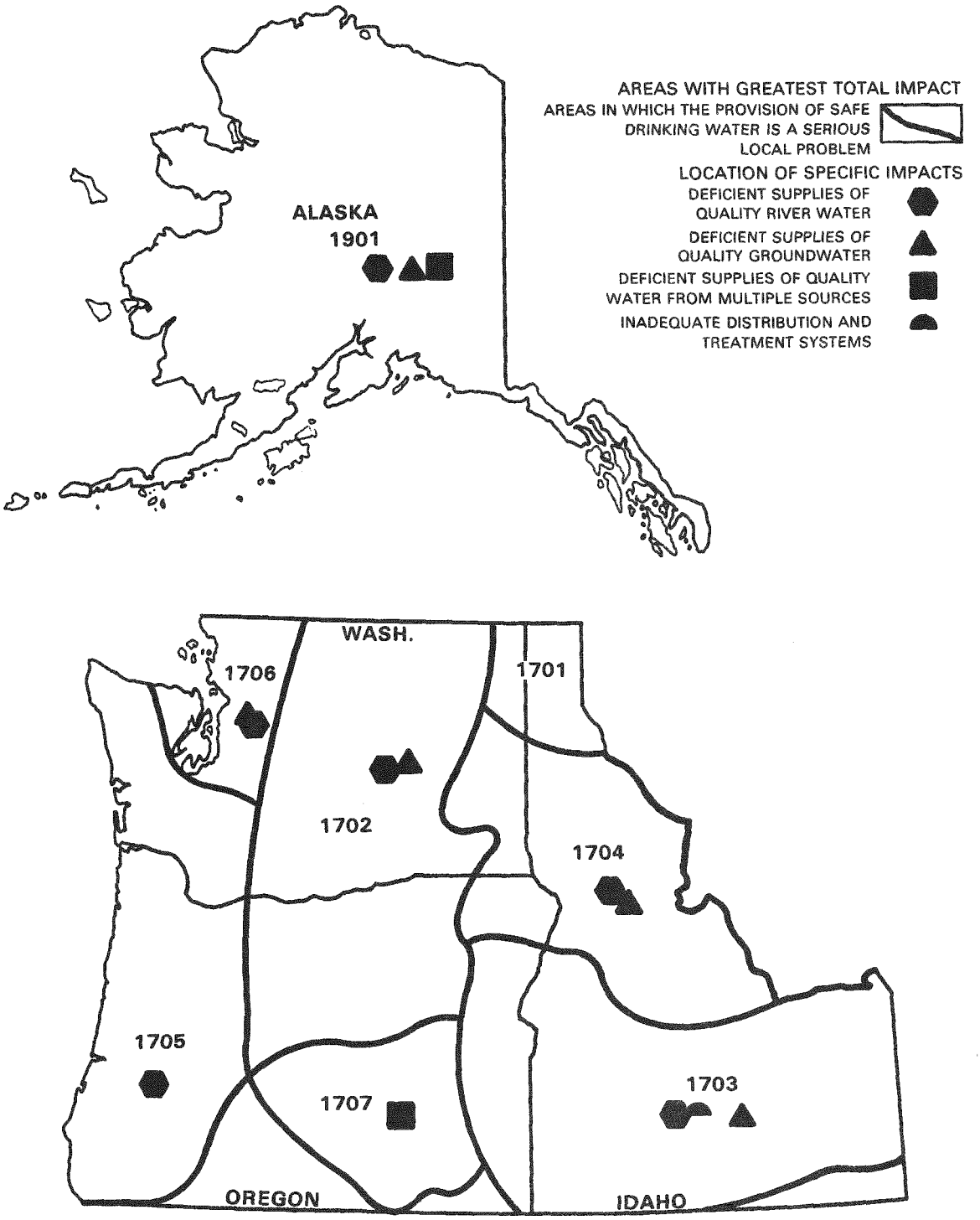


FIGURE II-B-38. Inadequate Quality and Quantity of Potable Water Supplies

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

TOXIC AND HAZARDOUS MATERIALS IN WATER SUPPLY

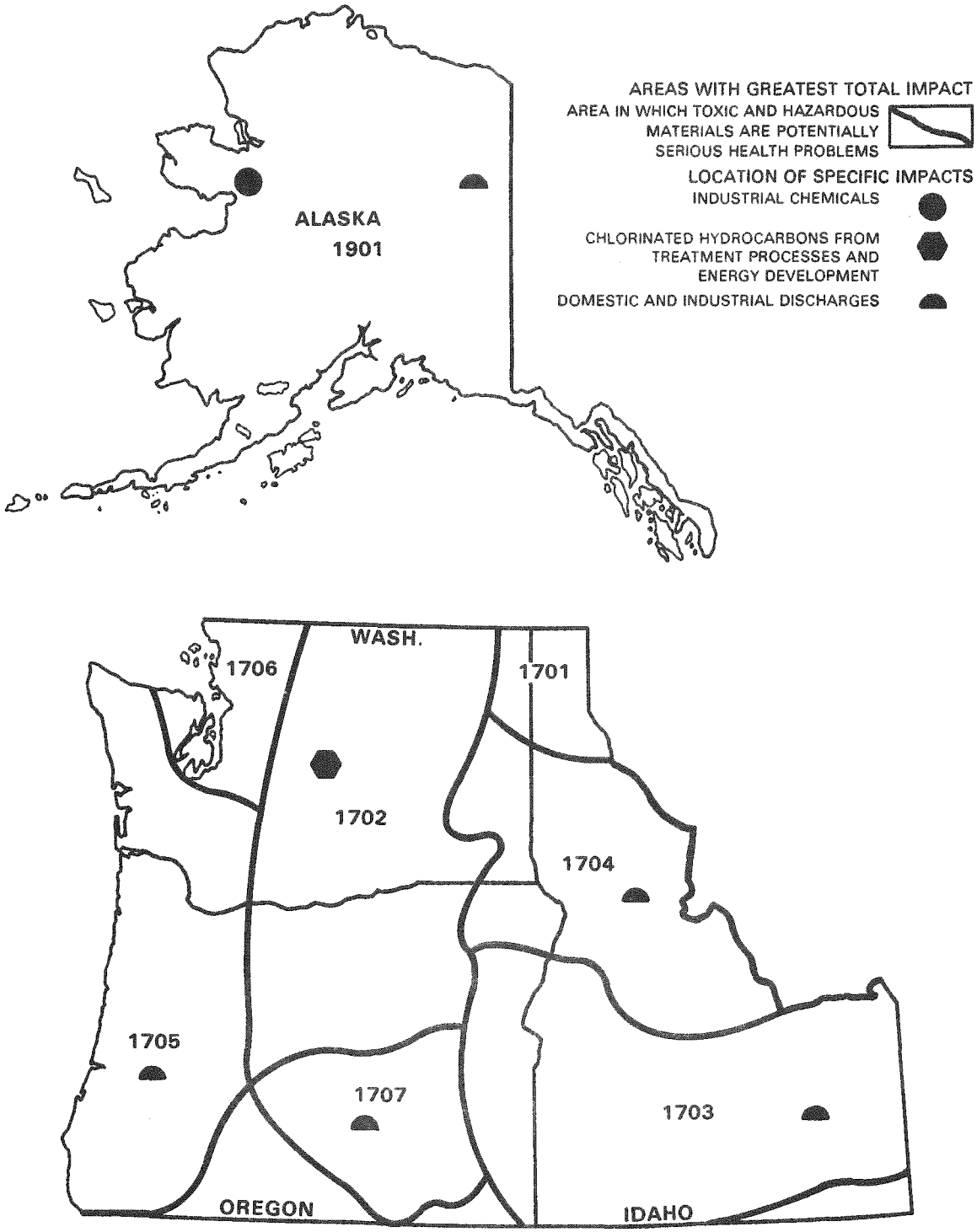


FIGURE II-B-39. Toxic and Hazardous Materials in Water Supplies

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

TABLE II-B-19

ANALYSIS OF WATER FROM THREE MAJOR ARCTIC RIVERS

Chemical constituents	Colville River water near Umiat Milligrams per liter	Sagavanirktok River near Sagwon Milligrams per liter	Kuparuk River near Deadhorse Milligrams per liter
Silica (SiO_2)	1.9	2.1	
Calcium (Ca)	13.0	40.0	17.0
Magnesium (Mg)	4.8	4.8	1.8
Sodium (Na)	1.5	0.7	1.8
Potassium (K)	0.5	0.3	0.4
Bicarbonate (HCO_3)	53.0	128.0	65.0
Sulfate (SO_4)	10.0	9.8	0.6
Chloride (CL)	0.5	0.5	0.5
Nitrate (NO_3)	0.3	0.0	
Dissolved solids (residue on evaporation at 180°C)	59.0	121.0	–
Hardness as $CaCO_3$:			
Calcium, magnesium	52.0	119.0	–
Noncarbonate	8.0	14.0	–
Specific conductance (micromhos at 25°C)	109.0	217.0	–
pH	6.8	8.3	–

Data Source: Ref. 11, Alaska Regional Profiles.

TABLE II-B-20

SEASONAL VARIATION IN TOTAL DISSOLVED SOLIDS AND RELATIVE HARDNESS

Month	Concentrations	Colville River near Umiat (mg/l)	Sagavanirktok River near Sagwon (mg/l)
July-Aug.	Dissolved solids	60	121
	Hardness	54	119
April	Dissolved solids	356	171
	Hardness	318	163

Relative Hardness of Water

Hardness range (mg/l)	Hardness description
0 – 60	Soft
61 – 120	Moderately hard
121 – 180	Hard
More than 180	Very hard

Data Source: Ref. 11, Alaska Regional Profiles.

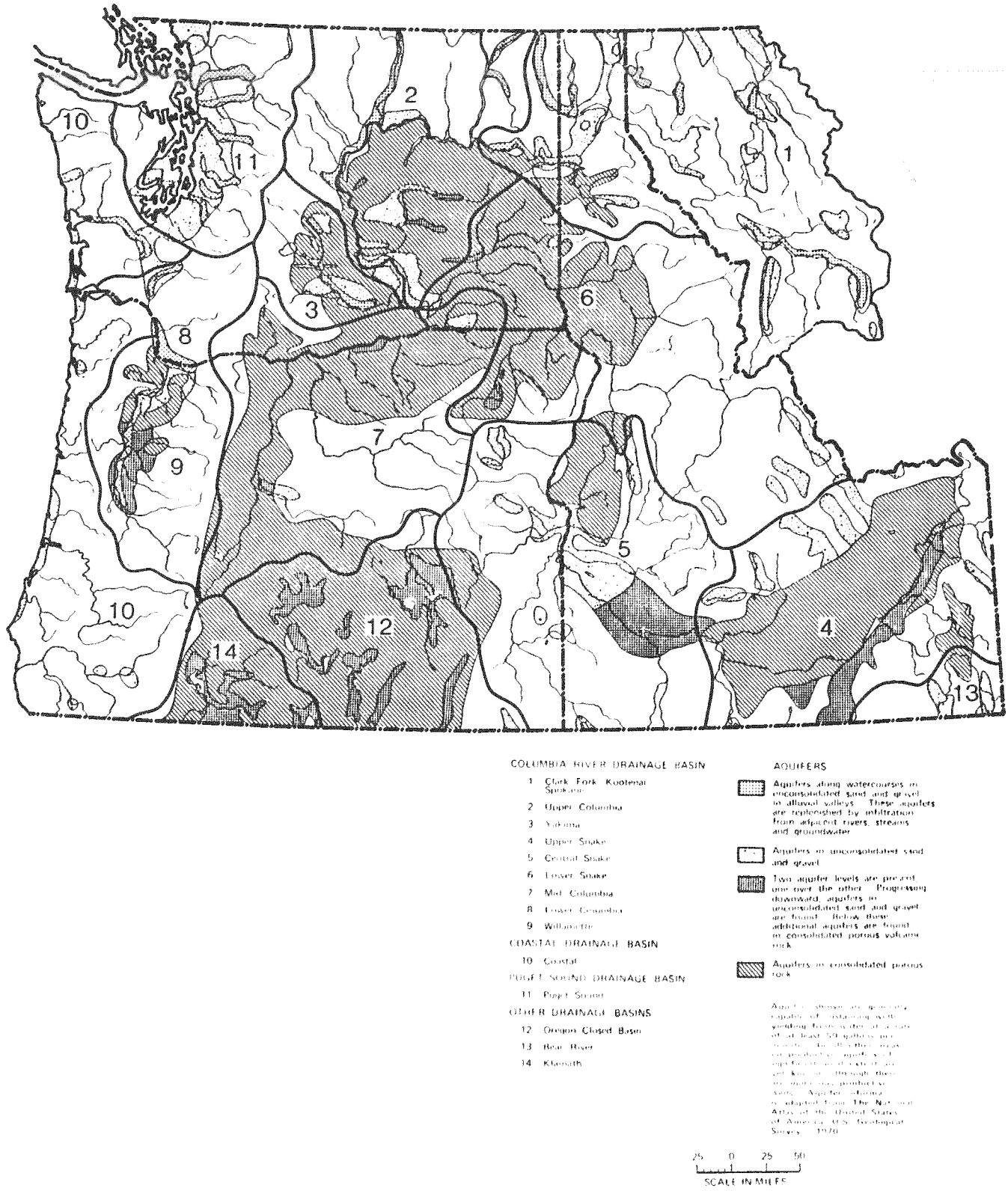


FIGURE II-B-40. Water Resources - Aquifers

Data Source: Ref. 20, BPA Role EIS.

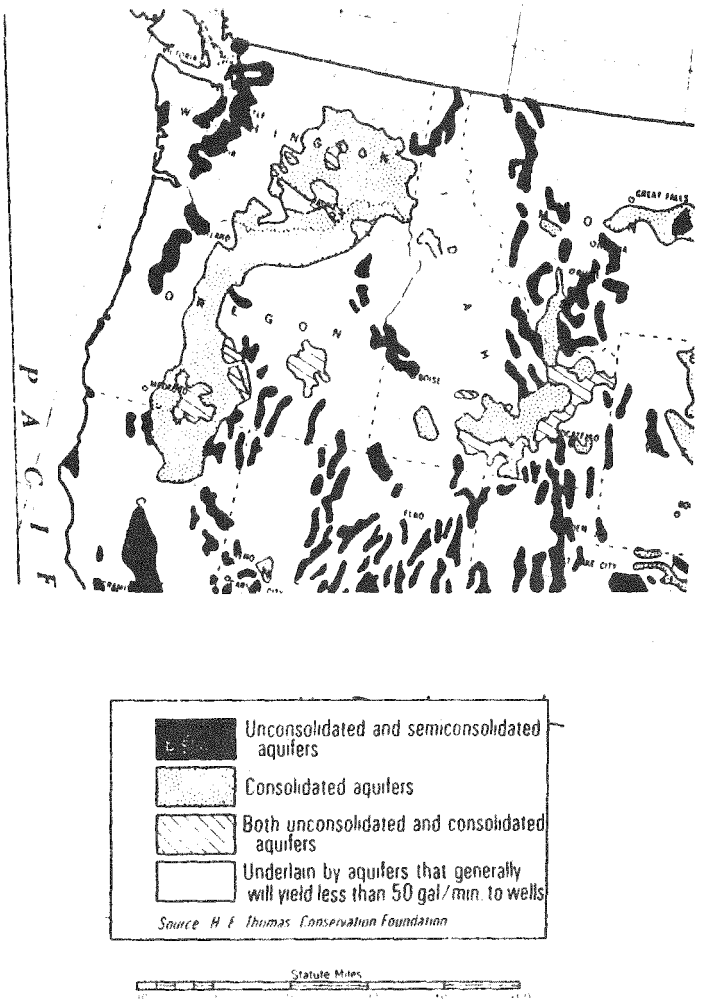


FIGURE II-B-41. Groundwater Areas

Data Source: Ref. 9, Water Atlas, p. 27.

TABLE II-B-21

GROUNDWATER DISTRIBUTION BY AQUIFER UNITS

PACIFIC NORTHWEST REGION

Aquifer Unit	Area		Storage Volume(a)	Recharge(b)
	1,000 square miles	million acres	acre-feet	million acre-feet
Alluvial and Glacial Deposits	41.3	26.5	270	36
Younger Volcanic Rocks	28.9	18.5	80	28
Younger Sedimentary Rocks	16.1	10.3	80	2
Silicic Volcanic Rocks	7.7	4.9	10	1
Middle Tertiary Volcanic Rocks	58.0	37.2	38	10
Undifferentiated Volcanic and Sedimentary Rocks	5.5	3.5	18	1
Older Volcanic Rocks	13.5	8.6	8	7
Older Sedimentary Rocks	11.4	7.3	4	6
Older Volcanic and Sedimentary Rocks	6.5	4.2	3	1
Undifferentiated Pre-Tertiary Rocks	82.3	52.6	47	29
TOTAL (rounded)	271.0	174.0	558	121

(a) Gross volume of water stored in top 50 to 100 ft of water-bearing strata

(b) Gross annual natural recharge and natural and pumped discharge

Data Source: Ref. 5, Water Today and Tomorrow, Volume II, pp. 3-31.

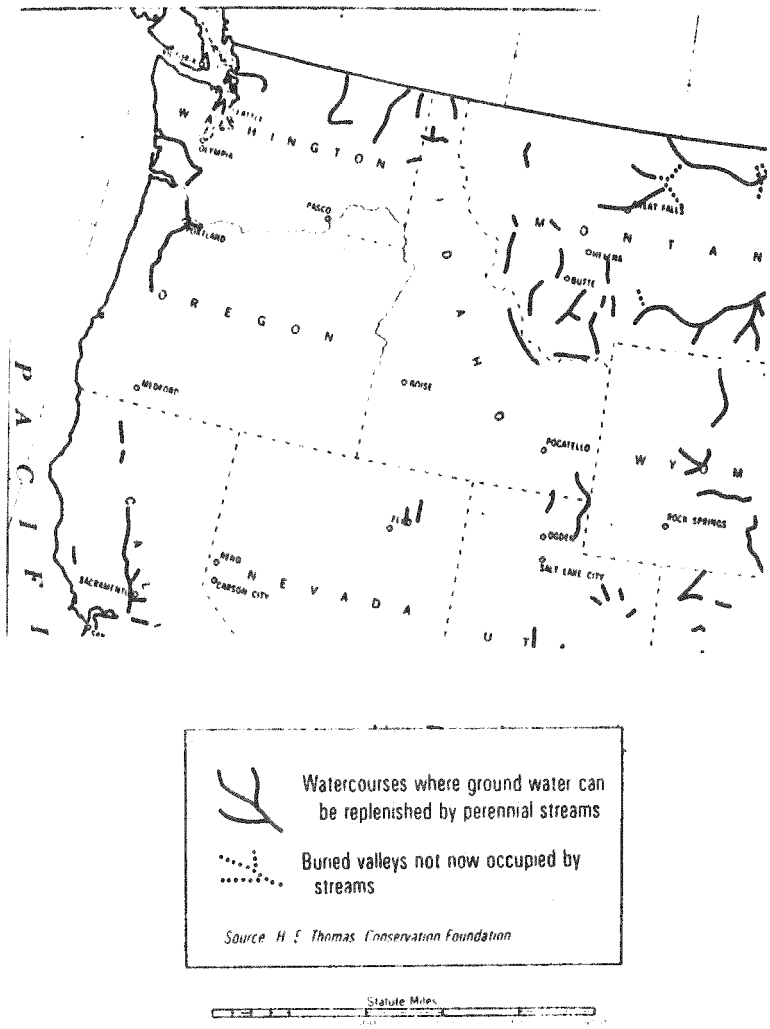


FIGURE II-B-42. Groundwater Areas - Narrow Aquifers Related to River Valleys

Data Source: Ref. 9, Water Atlas, p. 28.

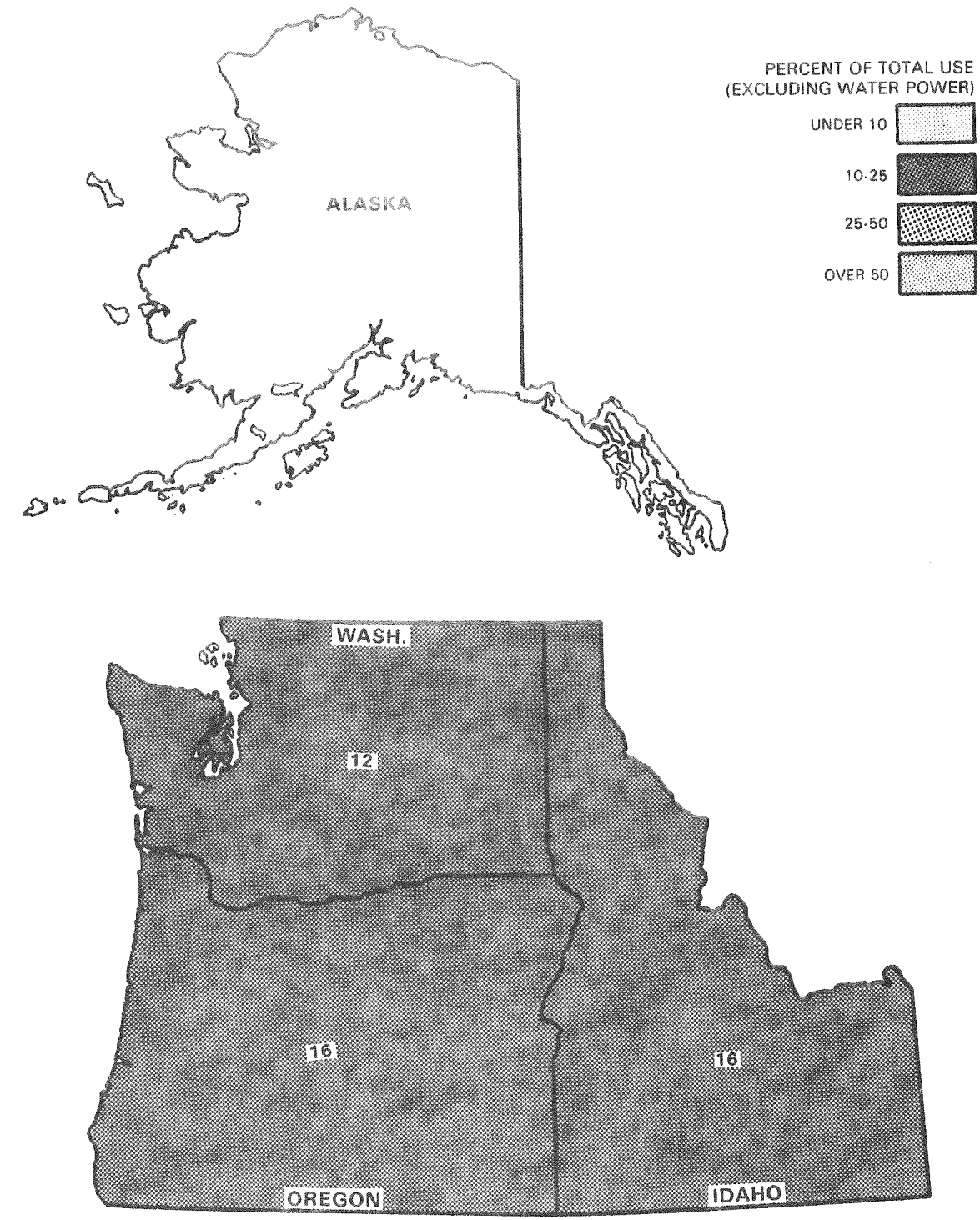


FIGURE II-B-43. Groundwater Use - As Percent of Total Water Use - 1970

Data Source: Ref. 9, Water Atlas, p. 32.

GROUNDWATER DEPLETION

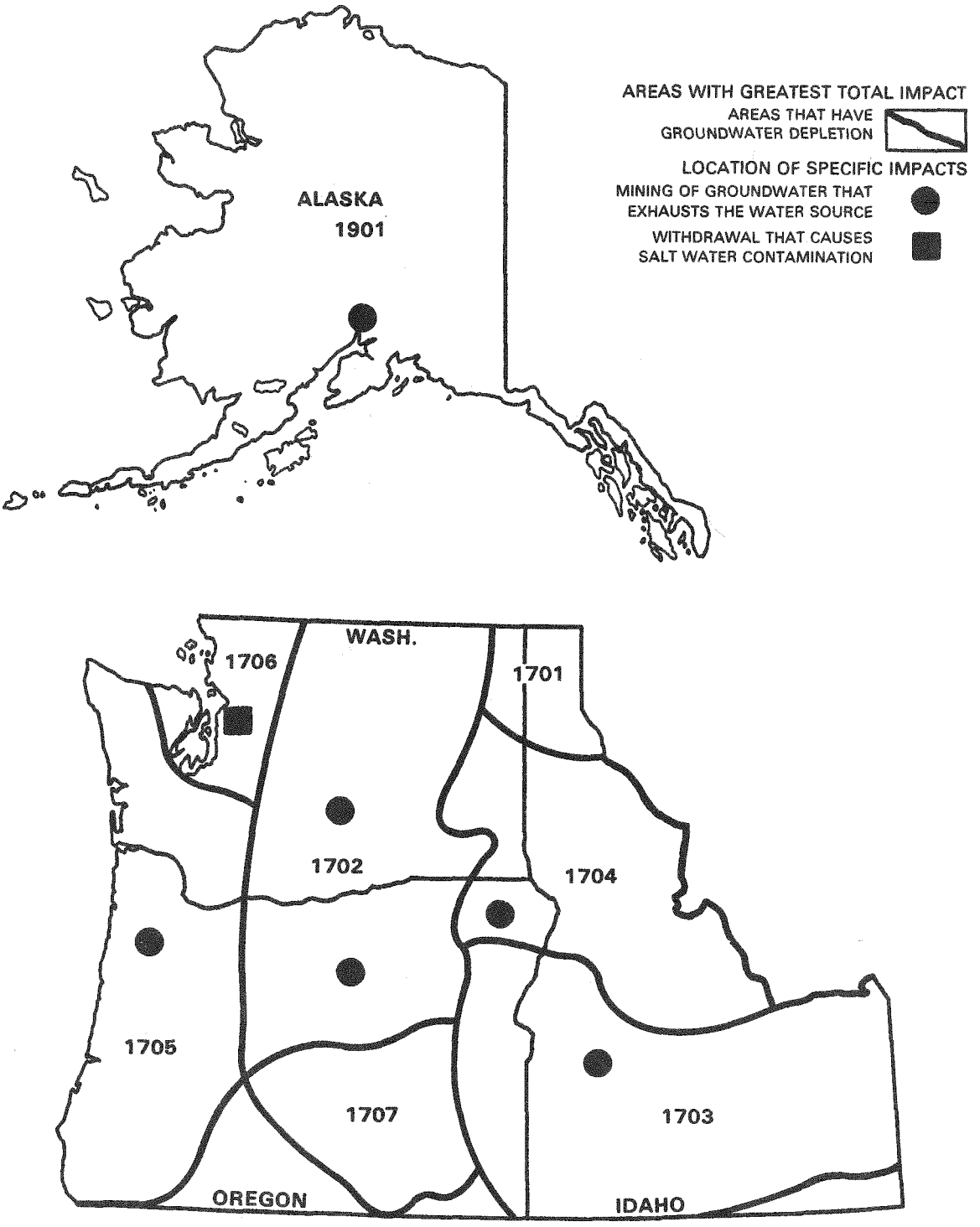


FIGURE II-B-44. Groundwater Depletion

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

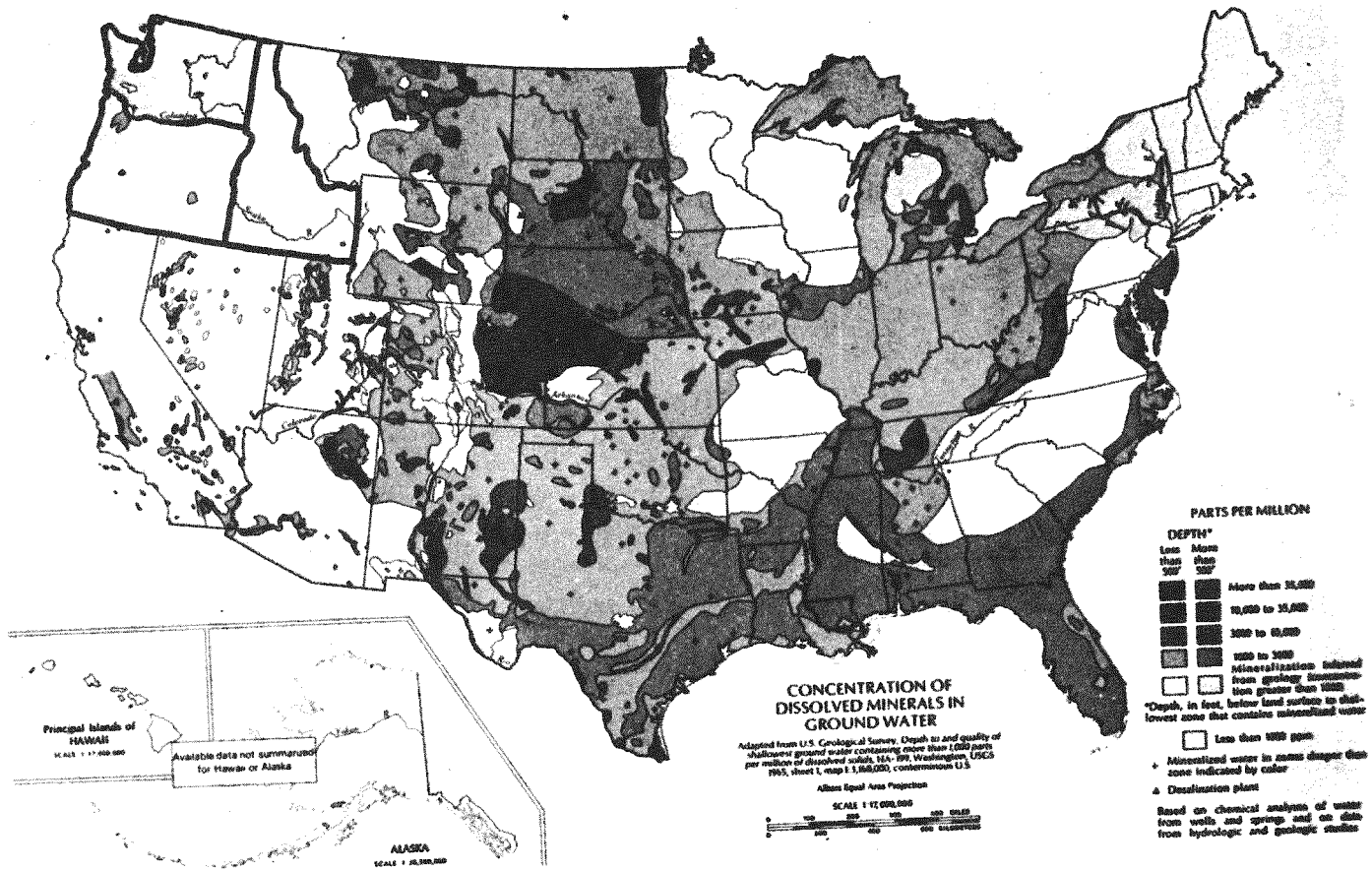


FIGURE II-B-45. Concentration of Dissolved Minerals in Groundwater

Data Source: Ref. 13, National Atlas.

GROUNDWATER CONTAMINATION

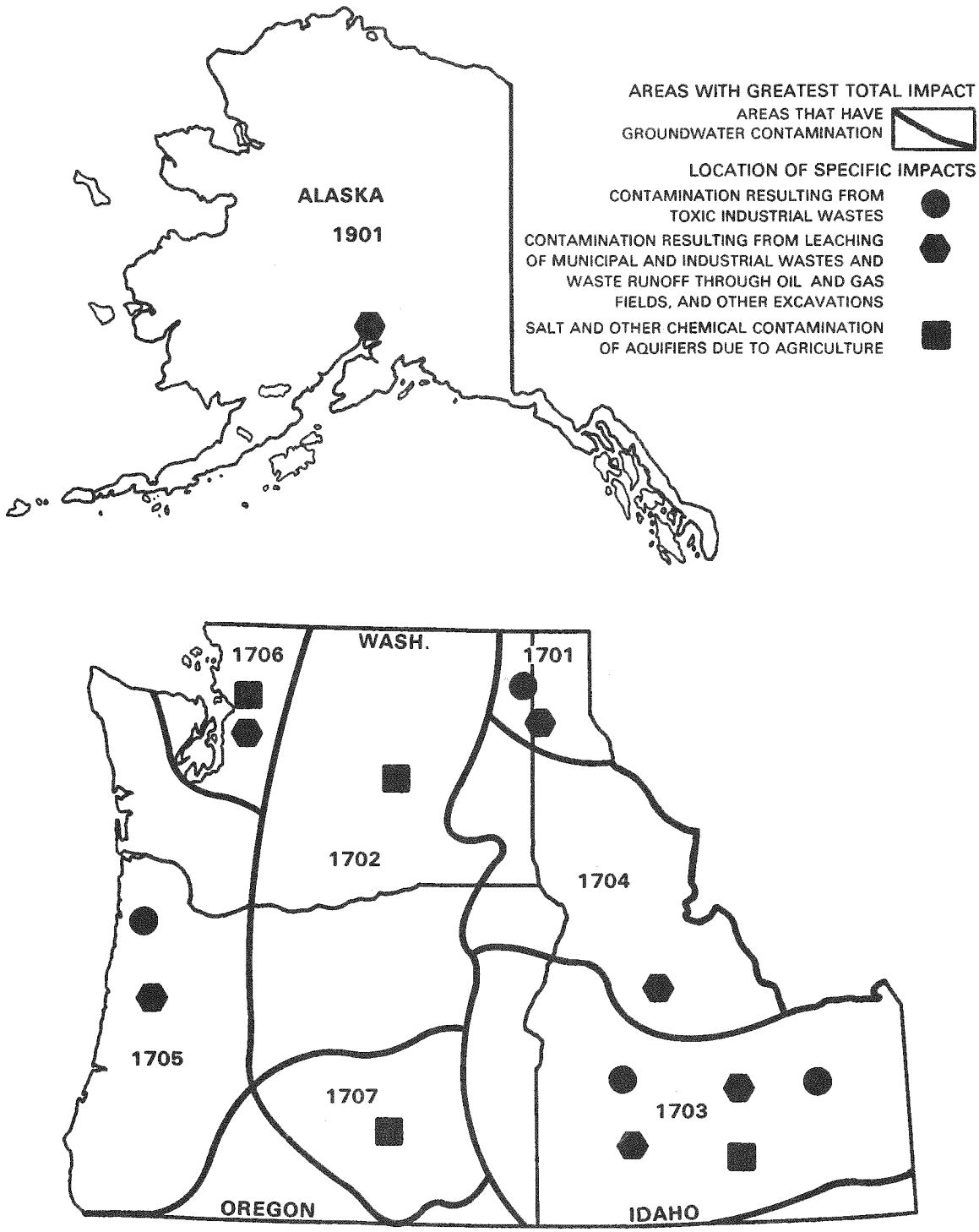


FIGURE II-B-46. Groundwater Contamination

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

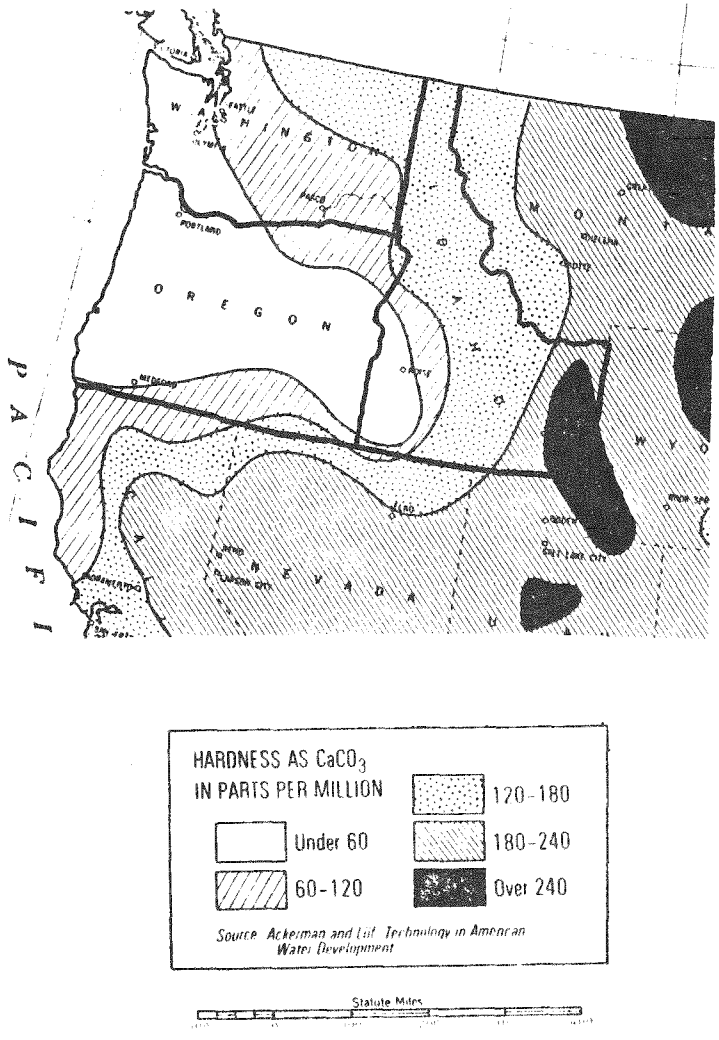
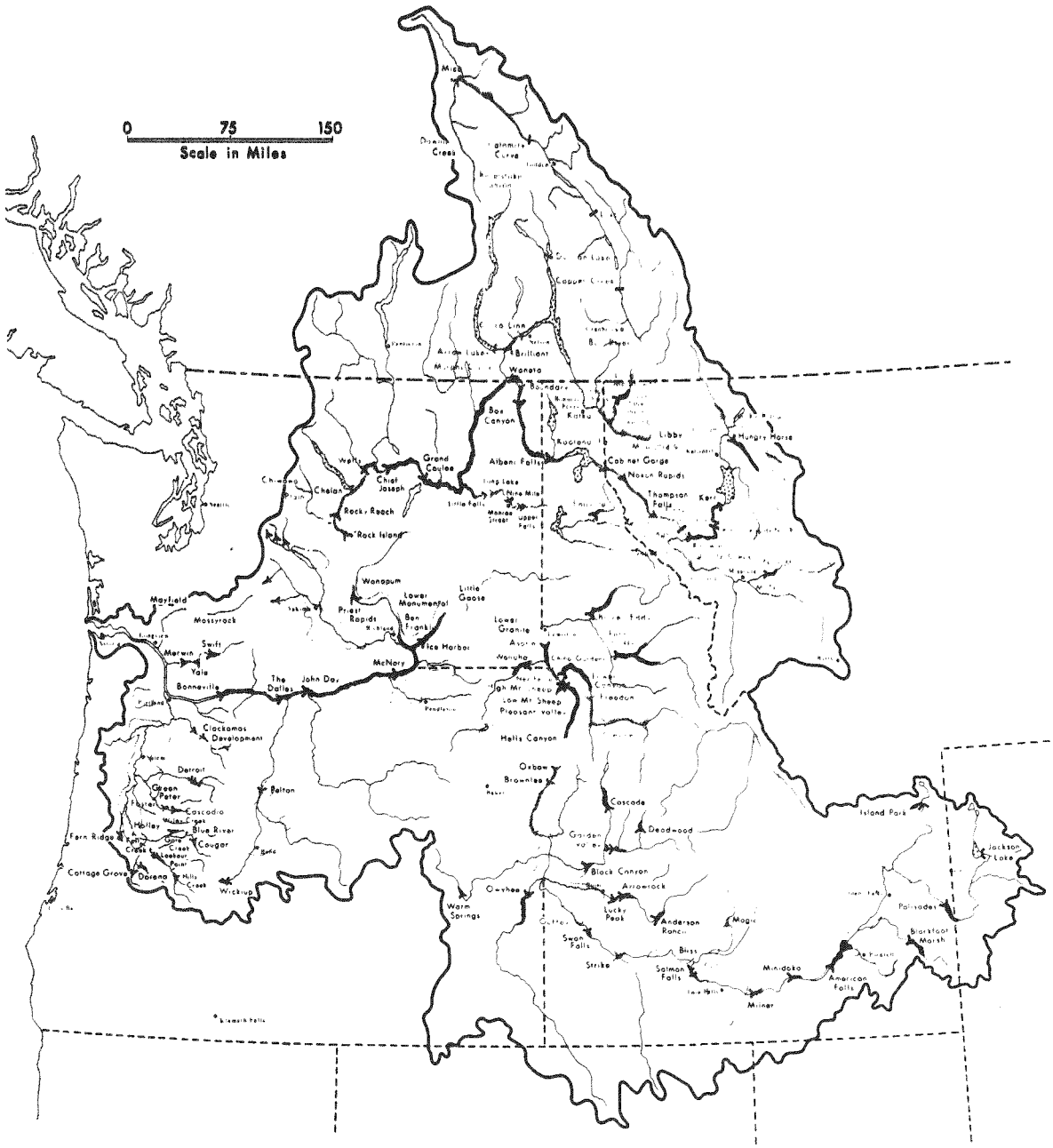


FIGURE II-B-47. Hardness of Groundwater

Data Source: Ref. 9, Water Atlas, Plate 42.



- Projects existing or under construction (Federal)
- Projects existing or under construction (Non-federal)
- Authorized or licensed projects
- Existing or future major irrigation areas
- Natural lake with storage control
- Projects recommended for construction
- Future projects included in detailed system studies
- Other potential projects
- Alternate projects
- Major flood damage areas

FIGURE II-B-48. Columbia Basin, Major Dam and Reservoir Development

Data Source: Ref. 3, Atlas of the Pacific Northwest, Plate 18.

TABLE II-B-22

EXISTING RESERVOIRS

Subregion	Number of Reservoirs	Storage Capacity (1,000 acre feet) Total	Usable
COLUMBIA-NORTH PACIFIC	201	59,630	42,734
Rio Grande	23	3,974	3,958
Arkansas-White-Red	14	1,730	1,321
Missouri	105	32,785	26,005
Upper Colorado River	40	36,186	33,083
Lower Colorado River	27	39,383	35,883
Great Basin	48	4,319	4,237
California-South Pacific	221	38,425	36,931
Texas-Gulf	0	0	0

Data Source: Ref. 21, Critical Water Problems Facing the Eleven Western States.

AIR AND CLIMATE

CLIMATOLOGY

The region has many localized climates which are largely reflections of the diversity in landform and proximity to the marine influence of the North Pacific Ocean and the California Current. The Cascades divide the area into two broad climatic subregions. West of the Cascades the weather is characterized by mild, wet winters and moderate, wet summers. East of the Cascades the climate is typically more arid.

Aloft, the climate of the entire region is associated with the southerly and easterly drift of cyclonic storms that develop over the Northern Pacific. The hydrologic cycle that balances the water economy of the Pacific Northwest begins within the semipermanent high-pressure cyclonic area over the Central Pacific.(1)

Regional climate results from the southerly and easterly movement of North Pacific Ocean storms and from seasonal high pressure migration from the Central Pacific Area. During the winter, storms from the North Pacific pass over the region, bringing generally wet conditions. During the summer, offshore high pressure causes most storms to pass to the region's north, which results in generally dry conditions.

Within the region, climatic conditions reflect the diverse land forms--especially the mountain ranges. Marine air masses moving inland from the North Pacific initially contain a large amount of water. As they rise to pass over each succeeding mountain range, the air masses release moisture in progressively smaller amounts. Thus, the Coast Range west slopes are the region's wettest area, and the Cascades west slopes are the next wettest. By the time the air masses reach the Columbia Plateau east of the Cascades, moisture content is so low that the air tends to become moisture absorbent, resulting in semi-arid conditions. Finally, the air masses again release moisture as they rise to pass over the Rockies.(2)

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(1) Information Source: Ref. 20, BPA Role EIS.
(2) Information Source: Ref. 5, Water Today and Tomorrow

Resulting average annual regional precipitation distribution is shown in Figure II-C-70, Average precipitation ranges from more than 120 in. annually in parts of the Coast and Cascade Ranges to less than 12 in. on parts of the Columbia and Snake River plateaus and in the Oregon Closed Basin. It is about 80 in. in the northern Rockies.

Annual averages are misleading, however, because of highly variable seasonal precipitation patterns. Often overlooked is the fact that very little precipitation falls throughout the Pacific Northwest during July, August, and September, and sometimes during October. One hundred consecutive days without measurable precipitation have been recorded; 70 to 80 such days are normal each summer. About 60% of annual precipitation normally falls between the first of December and the end of April. Consequently, areas west of the Cascades also suffer from an annual summer drought, even though their annual precipitation ranges from 24 in. to more than 120 inches.(1)

Precipitation

Two major factors generally affect precipitation: moisture supply (the Pacific Ocean), and elevation. At the same distance from the ocean, the higher mountains receive more than the valleys and plateaus. Inland, and at higher elvations, a large percent of the total precipitation occurs as snow. Regardless of elevation, however, the western parts receive by far the most precipitation.(2)

The heaviest annual precipitation in the conterminous United States occurs on the western slopes of the Coast and Cascade Ranges, exceeding 200 in. in the Olympic Mountains. From the crest of the Coast Range, annual precipitation decreases to about 35 in. in the Puget Sound-Willamette Trough, then increases again to 100 in. or more along the crest of the Cascade Range. Nearly all precipitation comes with storms moving in from the ocean, and about two-thirds of the year's total falls during the October to March period. At lower elevations it is largely rain, but in the mountains it becomes snow. Heavy snowpacks on many of the higher mountains have formed glaciers which

(1) Information Source: Ref. 5. Water Today and Tomorrow.
(2) Information Source: Ref. 4. Columbia-North Pacific Region Comprehensive Framework Study

are the sources of several rivers. Maximum snowpacks, occasionally to depths of 20 to 30 ft, are generally found in late March and early April. The greatest amount of cumulative snowfall recorded during a winter season in the United States is 1000 in. at Paradise Ranger Station on Mount Rainier. Variations in annual precipitation range from about 60% to 150% of average. Despite high total precipitaiton, hourly intensities are great as 1 in./hr are rare. However, several rainfalls of 6 to 12 in. in 24 hr have been recorded.

East of the Cascade Range, in central Oregon and Washington, precipitation decreases rapidly to 10 in. or less in the valleys and on the plateaus. However, the mountain areas have total precipitation of 40 to 50 in., much of it in the form of snow. General area-wide storms moving in from the west bring the bulk of the precipitation, but late spring and summer convectional storms are common enough to produce significant runoff and occasional floods. Although recorded rainfall intensities rarely reach 1 in./hr, weather stations are scattered and few observations have been made in the known areas of frequent thunderstorm occurrence. Variations in annual precipitation here are somewhat greater than they are west of the Cascade Range, ranging from 50% to 165% of the average.

The Snake River Plain receives from 6 to 15 in. of annual precipitation, with 40 in. or more occurring in the mountains along the southern edge. Both midwinter and late spring runoff peaks characterize the precipitation pattern. On the eastern edges of the Plateau the mountains receive up to 40 in. annual precipitation, forming extensive snow fields that furnish water for lower areas during the summer dry season. Rainfall intensities greater than 1 in./hr have been recorded during summer storms; for short periods, intensities up to 6 in./hr have been recorded.(1)

In the Northern Rocky Mountains, annual precipitation ranges from 10 to 70 inches. Relatively dry belts exist in the rain shadows of the mountain ranges, with greater precipitation on the western windward slopes. In most of the area west of the Bitterroot Divide, the major part of the annual total occurs

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(1) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.

during the late fall and winter season, while in some areas the annual distribution is almost even. In the valleys east of the Bitterroot Divide, half of the annual total occurs during spring and early summer, with May and June being relatively high precipitation months. Intense local storms sometimes occur along the western side of the Continental Divide and the Bitterroot Range, with recorded intensities as great as 2 in./hr. Such storms do not greatly affect the flow of the major streams, but do occasionally produce flash floods in the smaller tributaries. Year-to-year variation in precipitation in this and the Snake River Basin area is similar to that of the rest of the area east of the Cascades. Principal contributions to streamflow come from the accumulated winter snowpack in the mountains.

Winter quantities are always greater than any other season, but the range in amounts is notable. For example, Astoria, Oregon receives 13 times as much precipitation in December as does Yakima, Washington.

An important feature of climate that affects all agricultural and forestry, and some industrial operations is the extent and frequency of drought periods. Usually a drought may be considered a relative matter, in that rainfall sufficient for a normally dry area would be insufficient in a normally wet area. The "relative" definition is used here to show the differences between various parts of the region.

West of the Coast Range, dry months occur nearly every yr, but two-month dry periods occur only about once in 10 yr. In the Willamette-Puget Sound Trough there is 1 dry month (usually July or August) nearly every yr, a two-month drought about 1 yr in 3, and a three-month drought about 1 yr in 10. The Cascade Range has similar drought occurrences. In all of these areas, the droughts are more severe to the south. There rarely is enough rain from late June to mid-September to replenish soil moisture.

The Columbia Plateau and Oregon Closed Basin areas are very dry. One-month drought periods occur every yr, and two-month or three-month droughts are nearly as frequent. Droughts of 4-6 months' length occur from once in 4 yr in the drier parts, to once in 10 yr in the higher or more northerly sections.

Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.

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In the Northern Rocky Mountains, one-month drought periods occur nearly every yr, two-month droughts about 5 yr in 10, and three-month droughts only about 1 yr in 10. Droughts of longer duration are rare. The higher mountain valleys have a more humid climate; one-month droughts occur about 5 yr in 10 and two-month droughts about half that often.

The Snake River Plains and the bordering mountains normally have such low rainfall during the summer months that drought conditions are typical of the climate. Although summer convectional storms may locally reduce drought frequency during the growing season, drought periods of at least a month's duration occur every yr. Two-month droughts occur about every other yr, three-month droughts about 3 yr in 10, and droughts of 4 months or longer duration occur about 2 yr in 10.

Variation in total annual precipitation, entirely apart from seasonal drought occurrence, also affects water supplies. Dry years with less than two-thirds of normal precipitaion occur about once in 30 yr along the coast, about once in 20 yr in the Willamette-Puget Sound Trough, once in 30 yr in the Cascade Range, once in 15 yr in the Columbia Plateau and Oregon Closed Basin areas, once in 5 yr in the Snake River Plain, and once in 20 yr in the Northern Rocky Mountains. Dry years may come in groups; the period 1929-31 was abnormally dry

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Information Source: Ref. 4. Columbia-North Pacific Region Comprehensive Framework Study.

over most of the region. In the years 1889, 1905, 1915, 1920, 1924, 1926, 1937, 1941, 1944, and 1967 streamflows were generally low.

Temperature

West of the Cascade Range, temperatures in the lower-lying areas range from a January average of 36°F to a July average of 62°F. The frost-free season ranges from 200 to 240 days in length, covering the period from April to November. Mountain areas are colder year-round and have a much shorter growing season. Seasonal variations in mean daily temperature are about 15°F along the coast, 25°F in the interior valleys, and 30°F in the mountains in summer. Except in the southern part, temperatures above 100°F are rare. Temperatures below 0°F have occurred, but in the lower valleys temperatures below 10°F are unusual.

East of the Cascade Range, temperature patterns are quite different. Average January temperature ranges from 20°F in the mountains to 32°F in the warmest valley areas, and average July temperature similarly ranges from 60° to 76°F. Daily range in temperautre varies 15° to 30°F in January, and 30° to 50°F in July. Seasonal range in mean daily temperature is about 40°F. At most stations, temperatures well above 100°F have been recorded in summer, and temperatures of -30°F are fairly common in winter, with some below -50°F having been recorded. In the mountains and in the Oregon Closed Basin, the frost-free growing season is generally less than 100 days, extending from mid-June to mid-September. In the valleys and on the Columbia Plateau, the frost-free season is 140 to 200 days long, from late April to late September.

The Snake River Plain has a temperature regime similar to that of the plateau areas to the west. January average temperatures range from 12°F in the northern and eastern parts to 34°F at the western end. Temperatures below zero are recorded almost every year. Lowest temperature recorded is -63°F in the mountains on the eastern edge of the region. On the plain, the lowest of record is -46°F. July average temperatures range from 55°F in the mountains to 78°F in the valley areas. Seasonal range in daily temperature is about 50°F. Temperatures to 118°F have been recorded in summer. The frost-free growing season ranges from 40 days in the mountains around the rim to 180 days in the western

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Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.

valleys. Some mountain stations have recorded frost in every month. Most of the agricultural area has a growing season of 120 to 140 days, extending from the first week in May to the last week in September. The warmest part of the area has a growing season of 180 days.

At lower elevations on the western side of the Northern Rocky Mountains the average annual temperature is about 50°F, but at the higher elevations in the interior it is less than 40°F. Average January temperature ranges from below 20°F in the mountains to just above freezing in the lowermost western part. Average July temperature similarly ranges from 60° to 75°F. Lowest temperature of record is -52°F at the eastern edge of the area. Below-zero temperatures occur nearly every year throughout the area. Seasonal range in temperature is greater than 40°F. Daily range varies from 5° to 30°F in January, and from 20° to 50°F in July. Temperatures above 115°F have been recorded at some stations; over 100°F at nearly all stations. The frost-free growing season in the mountain valleys averages from 80 to 150 days long, increasing to 200 days in the lower elevations at the western edge of the area. Generally, the frost-free season extends from mid-May to mid-September, although in the higher mountains frost may occur in every month of the year.

There is a similarity of the temperature pattern over the region, with all stations showing strong seasonal differences from summer to winter. For stations west of the Cascades all months average well above-freezing, while on the east side 2-4 of the winter months usually average below-freezing. The variation between summer and winter temperatures in the eastern part of the basin is much greater than in the sections nearer the coast.

Wind

The region lies within a general west-to-east airflow that is associated with seasonal cyclonic storms which move over the region. Considerable moisture is picked up by these air masses in the Northern Pacific and Gulf of Alaska. The typical atmospheric wind patterns have been measured at 850 millibars of pressure (at approximately 5000 ft). Surface air flows also vary with the season and are highly complex. They contribute a diverse range of microclimates that influence vegetation and wildlife distribution.(1)

(1) Information Source: Ref. 20, BPA Role EIS

Although average wind velocities only range from 4-16 miles per hour (mph) at the various stations, maximum velocities of over 100 mph have been recorded all along the coast. These hurricane-force windstorms do considerable damage to timber stands, public utilities, and industrial developments. Such high winds do not normally occur in the Puget Sound-Willamette area, although occasionally there is serious wind damage during the winter season. The most spectacular occurrence was the Columbus Day Storm in 1962. Cold winds from the north and east often bring midwinter periods of below-freezing weather, while warm winds from the west and southwest accompany fall and winter storms. Warm winds in the spring season are a factor in melting the snow accumulated in the mountains during the winter. Hot, dry winds from the east in summer and fall cause the humidity to drop to very low levels, and bring on periods of extreme fire danger. Such conditions are also responsible for extensive damage to crops and range forage, and greatly increase the need for irrigation water.(1)

East of the Cascades, prevailing winds are westerly. Greatest wind movement occurs in spring, but the winds generally are light. Severe winds occur along the Columbia River in the center of the area, occasionally causing dust storms during the drier months.

In the Snake River Plain, winds occasionally reach destructive forces in localized areas. Over wide areas, however, velocities rarely exceed 40 mph. Wind movement is greatest in late winter and early spring, lowest in summer and fall, and averages from 6-9 mph.

In the Northern Rocky Mountains, previaling air movement is from the west, but the broken topography provides wide local variations in the direction of surface winds. Although the mountain ranges tend to moderate wind movement, rather high velocities sometimes occur for short periods. The highest recorded wind velocity is 72 mph, but averages at valley stations are from 6-9 mph; on mountain ridges the average is much higher.

Evapotranspiration

Evaporation, which is strongly affected by wind movement, humidity, and temperature, is one of the major causes of water loss. Only limited observations

(1) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study

on evaporation from snowpacks or from the soil have been made, but records of evaporation from Class A pans are available for several stations.

Lowest evaporation rates are those for the humid, mild climates near the coast, or for high, cold mountain stations. High rates for interior stations indicate warm, dry, sunny growing seasons. Under these conditions, transpiration rates from vegetation are also high, and demands upon soil moisture and ground water are great. On the watershed slopes, however, transpiration losses are limited to the supplies of soil moisture held over from rainfall and snowmelt. The amount lost may vary from 2 in. to more than 20 inches.

Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study

AIR QUALITY

The regulations for the Prevention of Significant Deterioration as promulgated in the Clean Air Act Amendments of 1977 impose severe constraints upon power plant and energy development in the vicinity of Class I areas, which currently include all national parks greater than 6000 acres and all wilderness areas over 5000 acres in size. Regulations also restrict power plant development in Class II areas, where meterological conditions are such that short-term maximum concentrations are high.(1)

Air quality is calculated by two major components: point sources, and non-point (or area) sources. Point sources are considered to be individual plant or stack releases that are emitted from a particular source. Non-point or area sources are the averages of emissions within a county or an air shed. Major pollutants are particulates (dust), automobiles, home space heating, commercial establishments, etc. Figure II-C-122 gives particulate concentrations and Figure II-C-123 gives SO_2 concentrations for Idaho, Oregon and Washington. Table II-C-33 summarizes the total emissions of point and non-point sources for the lower three states. This data shows that the predominant SO_2 emissions are in the state of Washington (notably in the Puget Sound Region). The three-state region's concentrations are caused by copper smelters, refineries, and a large coal-fired power plant. Point sources of SO_2 in the Willamette Valley of Oregon are primarily the result of the paper products industries. In northern Idaho the SO_2 concentrations are caused by a copper smelter.

The Puget Sound Air Pollution Control Agency publishes annual summaries of air quality measurements in the Puget Sound region. Their 1976 summary shows that no annual average SO_2 standards are exceeded, but that at a number of locations around the Seattle area, short-term maximum concentration standards have been exceeded at least once a year. Annual average total suspended particulate concentrations were exceeded in 1976 at stations in both Seattle and Tacoma. As shown in Figure II-C-49 , the Seattle-Tacoma region (#22) has been designated an Air Quality Maintenance Area (AQMA) because of its high particulate concentrations.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. 2.7.

The Portland-Vancouver interstate AQMA has also been identified as a potential region for exceeding SO_2 standards. This region is also sensitive to carbon monoxide and photochemical oxidant emissions.

All AQMAs designated for the Pacific Northwest come as the result of particulate concentrations, and are established to ensure that the special planning necessary to meet National Ambient Air Quality Standards by 1990 will be implemented. Additional data on particulate concentrations have been provided by the Region Ten EPA. They show a number of sites throughout the Pacific Northwest where average particulate concentrations approach or exceed standards. Some of the stations where total suspended particulate (TSP) standards are exceeded are located in semiarid climates; the relative contribution of fugitive dust emissions to the total concentration values could be quite high.

Two areas in the Pacific Northwest have received considerable study because of SO_2 emissions large enough to cause potential local health and aesthetic problems. These regions are near Tacoma, Washington and Kellogg, Idaho. These areas would also be poor candidates for additional emission sources from energy development.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. C.1, C.3.

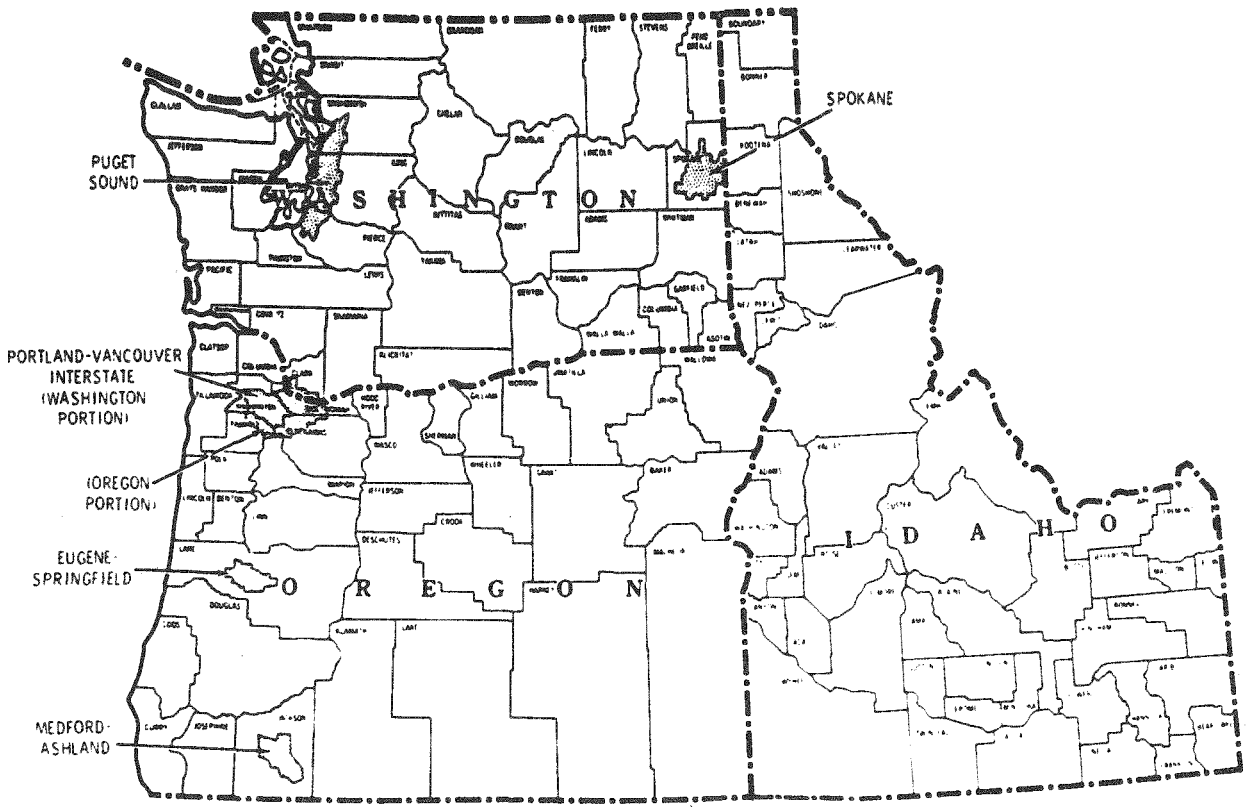


FIGURE II-C-49. Designated Air Quality Maintenance Areas (AQMAs) in the Pacific Northwest

Data Source: Ref. 22, An Approach to Valuing Visual Pollution from Western Electricity Production, p. 5.4.

TABLE II-C-23

NUMBERS AND NAMES OF AIR QUALITY CONTROL REGIONS IN THE WEST

State	Number	Name
WA	171	Olympic-Northwest Washington
WA	170	Northern Washington
WA	22	Puget Sound
WA	172	South Central Washington
OR/WA	35	Portland
OR	203	Northwest Oregon
OR	202	Southwest Oregon
OR	200	Central Oregon
OR	201	Eastern Oregon
ID/WA	83	Northern Idaho-Eastern Washington
ID	236	Idaho
ID	49	Metropolitan Boise
ID	173	Eastern Idaho

Data Source: Ref. 22, An Approach to Valuing Visual Pollution from Western Electricity Production, pg. B-1.

TABLE II-C-24.

1970 Households by Air Quality Control Region in the West

Air Quality Control Region	County	State	Households(a)
171	Clallam	WA	11,681
	Grays Harbor	WA	19,952
	Island	WA	8,400
	Jefferson	WA	3,666
	Mason	WA	6,768
	Pacific	WA	5,598
	San Juan	WA	1,514
	Skagit	WA	17,149
	Thurston	WA	25,186
	Whatcom	WA	26,720
	Total		126,634
170	Chelan	WA	14,396
	Douglas	WA	5,268
	Ferry	WA	1,113
	Okanogan	WA	8,486
	Pend Oreille	WA	2,030
	Stevens	WA	5,580
	Total		36,873
22	King	WA	391,759
	Kitsap	WA	32,856
	Pierce	WA	123,421
	Snohomish	WA	81,463
	Total		629,499
172	Benton	WA	20,520
	Franklin	WA	7,879
	Kittitas	WA	3,970
	Klickitat	WA	7,846
	Walla Walla	WA	13,438
	Yakima	WA	46,482
	Total		100,135
35	Benton	OR	15,898
	Clackamas	OR	51,677
	Columbia	OR	9,134
	Lane	OR	68,257
	Linn	OR	22,657
	Marion	OR	47,963
	Multnomah	OR	199,591
	Polk	OR	11,212

(a) Defined as total number of occupied housing units in County and City Data Book, 1972

Data Source: Ref. 22, An Approach to Valuing Visual Pollution From Western Electricity Production.

TABLE II-C-24 (contd)

Air Quality Control Region	County	State	Households[a]
35 (Continued)	Washington	OR	49,173
	Yamhill	OR	12,588
	Clark	WA	41,064
	Cowlitz	WA	22,140
	Lewis	WA	15,282
	Skamania	WA	1,841
	Wahkiakum	WA	1,150
	Total		569,627
203	Clatsop	OR	10,205
	Lincoln	OR	9,365
	Tillamook	OR	6,130
	Total		25,700
202	Coos	OR	18,325
	Curry	OR	4,384
	Douglas	OR	22,560
	Jackson	OR	31,384
	Josephine	OR	12,327
	Total		88,980
200	Crook	OR	3,366
	Deschutes	OR	10,101
	Hood River	OR	4,442
	Jefferson	OR	2,560
	Klamath	OR	16,307
	Lake	OR	2,053
	Sherman	OR	758
	Wasco	OR	6,475
	Total		46,062
201	Baker	OR	5,093
	Gilliam	OR	725
	Grant	OR	2,360
	Harney	OR	2,313
	Malheur	OR	6,964
	Morrow	OR	1,487
	Umatilla	OR	14,593
	Union	OR	6,427
	Wallowa	OR	2,117
	Wheeler	OR	660
	Total		42,739
83	Benewah	ID	2,053
	Kootenai	ID	11,561
	Latah	ID	7,676
	Nez	ID	9,973
	Shoshone	ID	6,340
	Adams	WA	3,553
	Asotin	WA	4,615
	Columbia	WA	1,467

Data Source: Ref. 22, An Approach to Valuing Visual Pollution From Western Electricity Production.

TABLE II-C-24. (contd)

Air Quality Control Region	County	State	Households[a]
83 (Continued)	Garfield	WA	985
	Grant	WA	12,584
	Lincoln	WA	3,356
	Spokane	WA	93,681
	Whitman	WA	10,728
	Total		168,572
236	Adams	ID	944
	Blaine	ID	1,977
	Boise	ID	578
	Bonner	ID	5,164
	Boundary	ID	1,999
	Camas	ID	211
	Cassia	ID	4,936
	Clearwater	ID	3,360
	Custer	ID	952
	Elmore	ID	4,758
	Gem	ID	2,993
	Gooding	ID	2,818
	Idaho	ID	3,845
	Jerome	ID	3,289
	Lemhi	ID	1,823
	Lewis	ID	1,246
	Lincoln	ID	936
	Minidoka	ID	4,428
	Owyhee	ID	1,872
	Payette	ID	4,145
	Twin Falls	ID	13,729
	Valley	ID	1,150
	Washington	ID	2,580
	Total		69,733
49	Ada County	ID	35,834
	Canyon County	ID	19,266
	Total		55,100
173	Bannock	ID	15,610
	Bear Lake	ID	1,791
	Bingham	ID	7,770
	Bonneville	ID	14,617
	Butte	ID	848
	Caribou	ID	1,837
	Clark	ID	208
	Franklin	ID	2,182
	Fremont	ID	2,487
	Jefferson	ID	3,201
	Madison	ID	2,952
	Oneida	ID	955
	Power	ID	1,428
	Teton	ID	638
	Total		56,524

Data Source: Ref. 22, An Approach to Valuing Visual Pollution From Western Electricity Production.

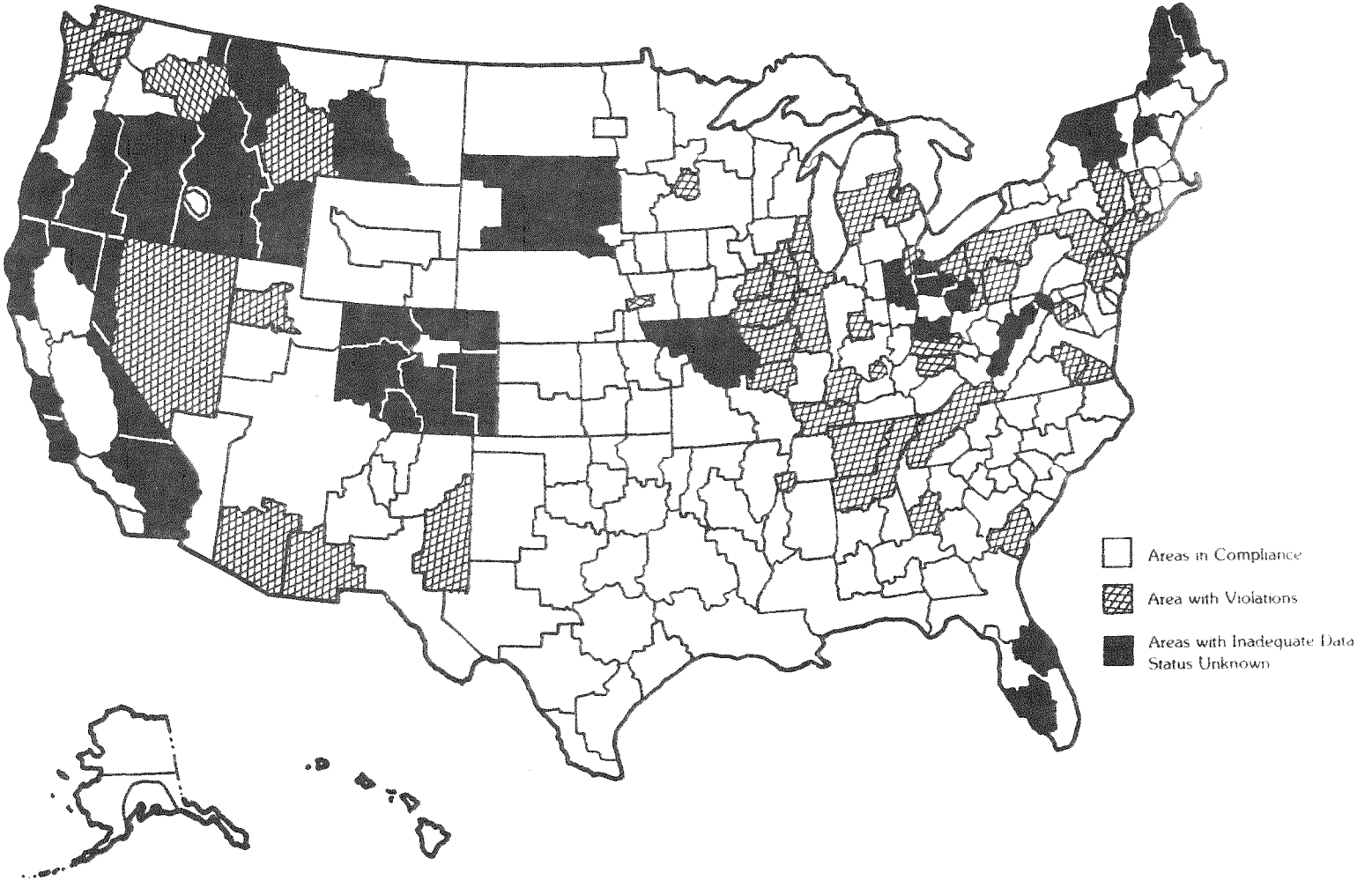


FIGURE II-C-50. Air Quality Control Regions. Status of Compliance with Ambient Air Quality Standards for Sulfur Dioxide

Data Source: Ref. 23, Energy/Environment Fact Book

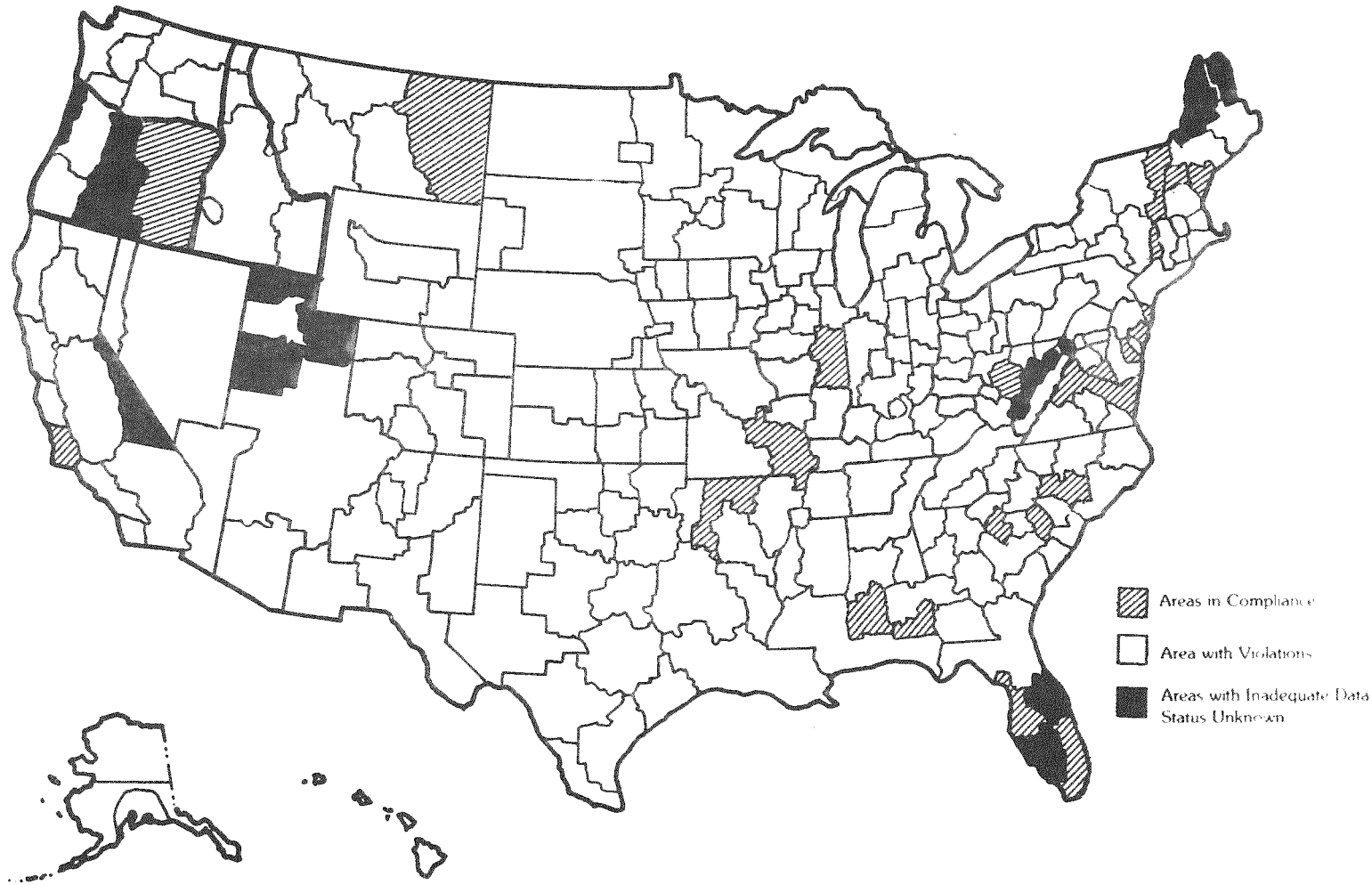


FIGURE II-C-51. Air Quality Control Regions. Status of compliance with ambient air quality standards for suspended particulates.

Data Source: Ref. 23, Energy/Environment Fact Book

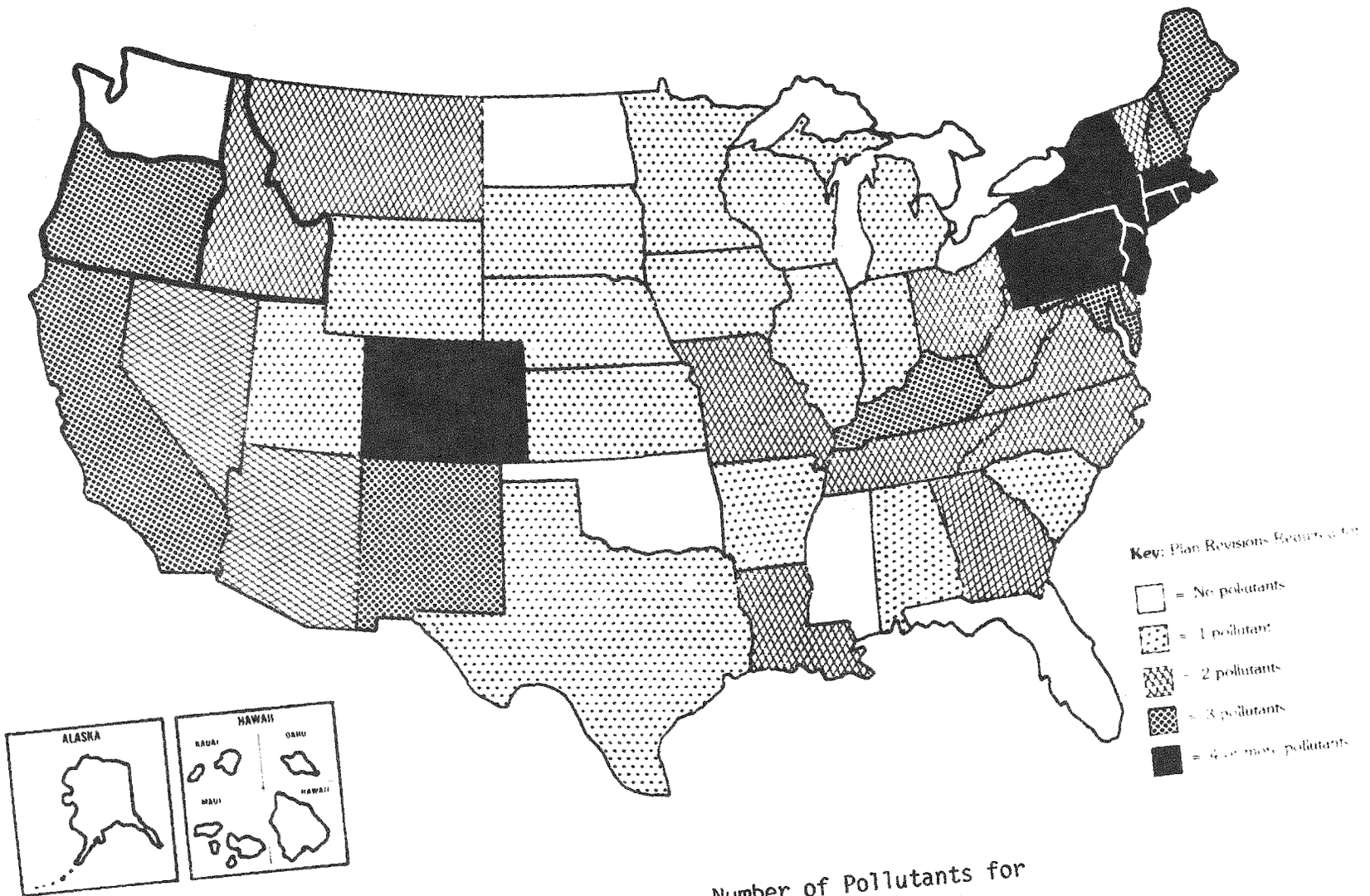


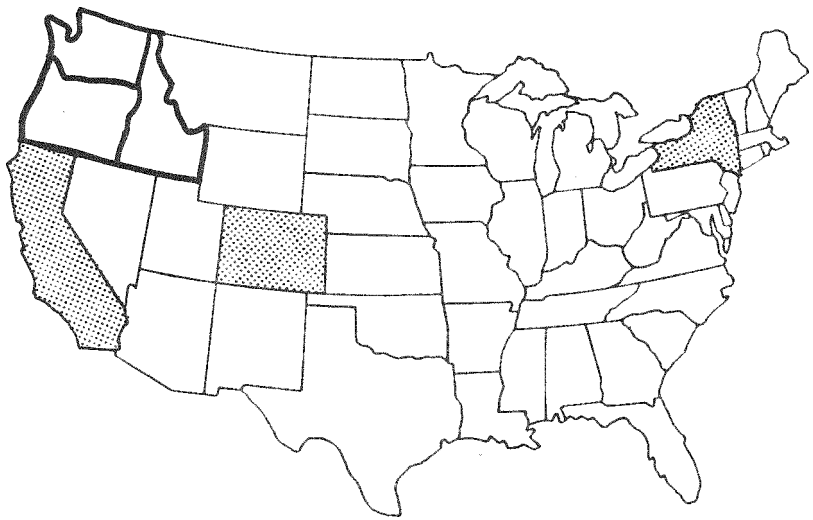
FIGURE II-C-52. Summary: Number of Pollutants for which Revisions are Necessary

Data Source: Ref. 23. Energy/Environment Fact Book

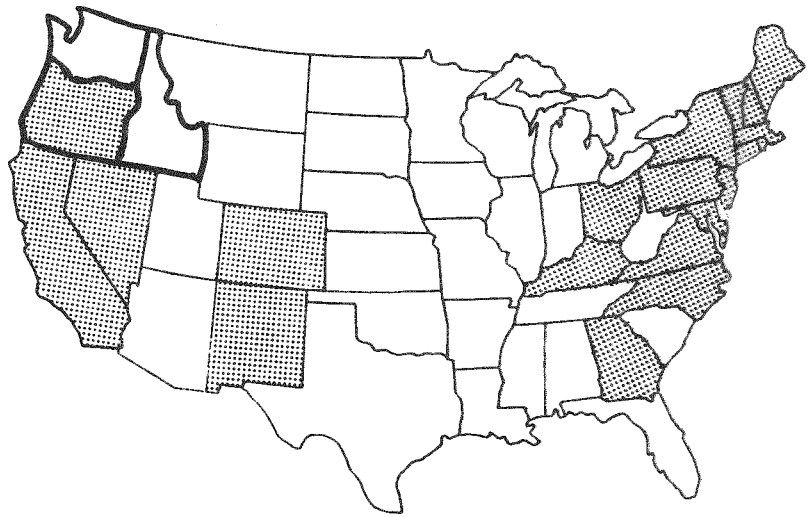
SIPs in the far West and in the East indicate widespread inadequacy to meet carbon monoxide standards. Nitrogen oxides are produced by stationary fuel combustion and, to a lesser extent, by transportation.

Combustion of fossil fuels in general, and of coal in particular, is a major source of sulfur oxides and particulates. Approximately 55% of human generated sulfur air emissions, and 25% of human generated particulate emissions, are from coal combustion for electricity.

Nitrogen Oxides



Carbon Monoxide



Oxidants

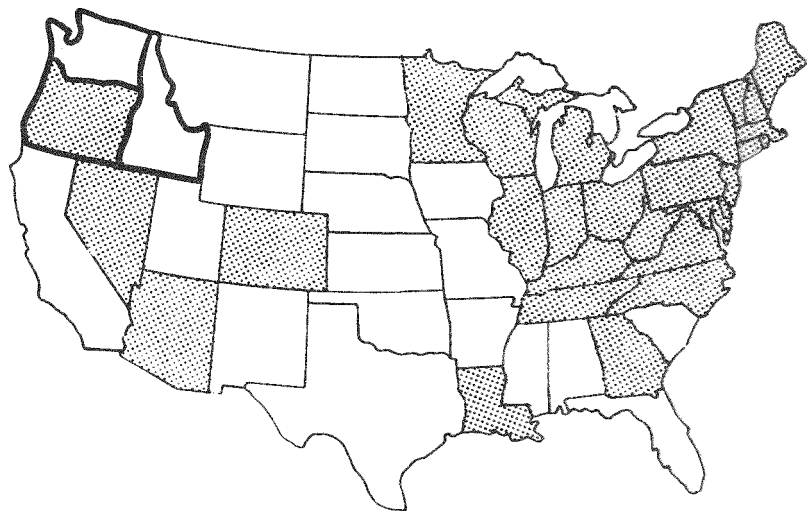
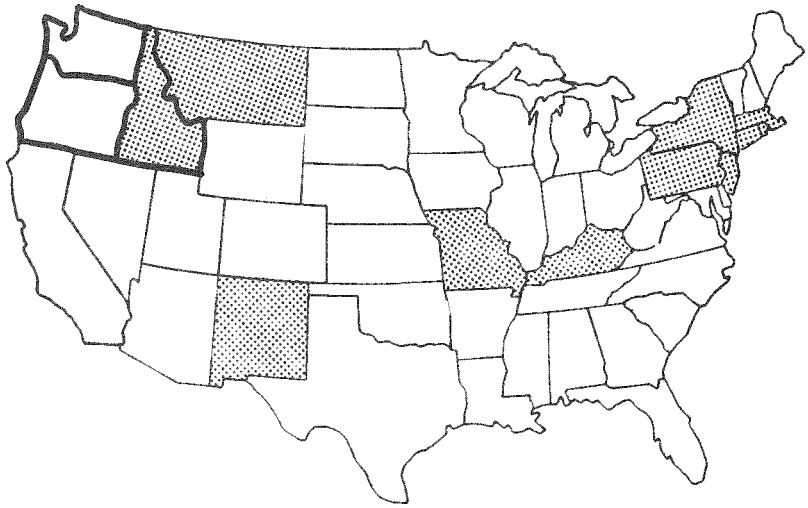


FIGURE II-C-53. States with Inadequate Air Quality Plans July 1, 1976

Sulfur Dioxide



Total Suspended Particulates

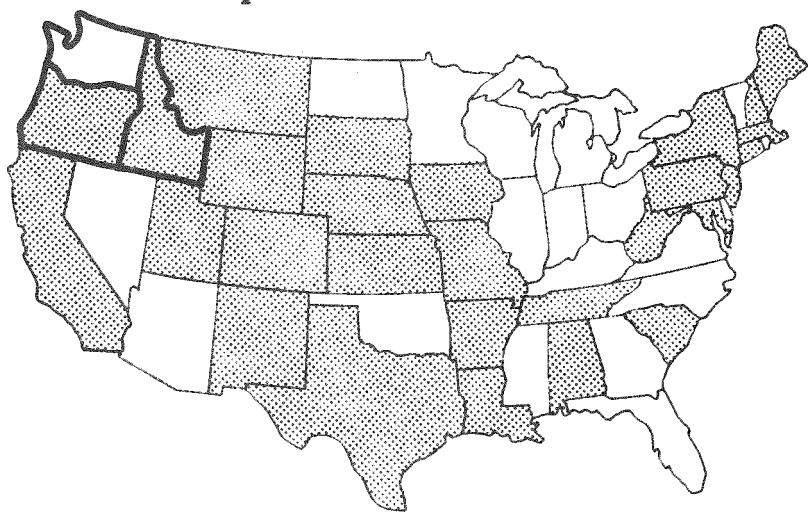


FIGURE II-C-53. (contd)

Data Source: Ref. 23, Energy/Environment Fact Book

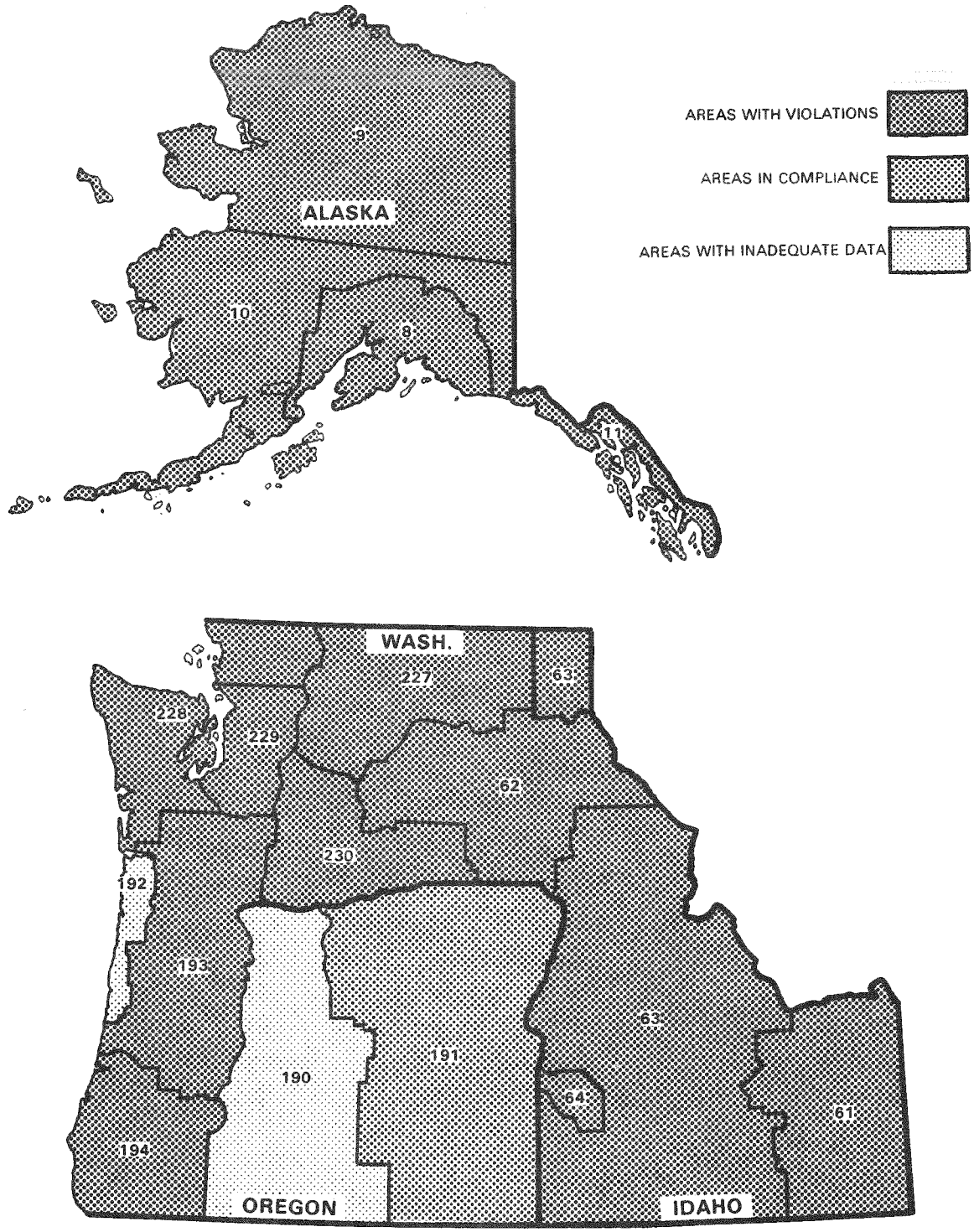


FIGURE II-C-54. Compliance with Ambient Air Quality Standards for Suspended Particulates

Data Source: Ref. 24, Environmental Science and Technology

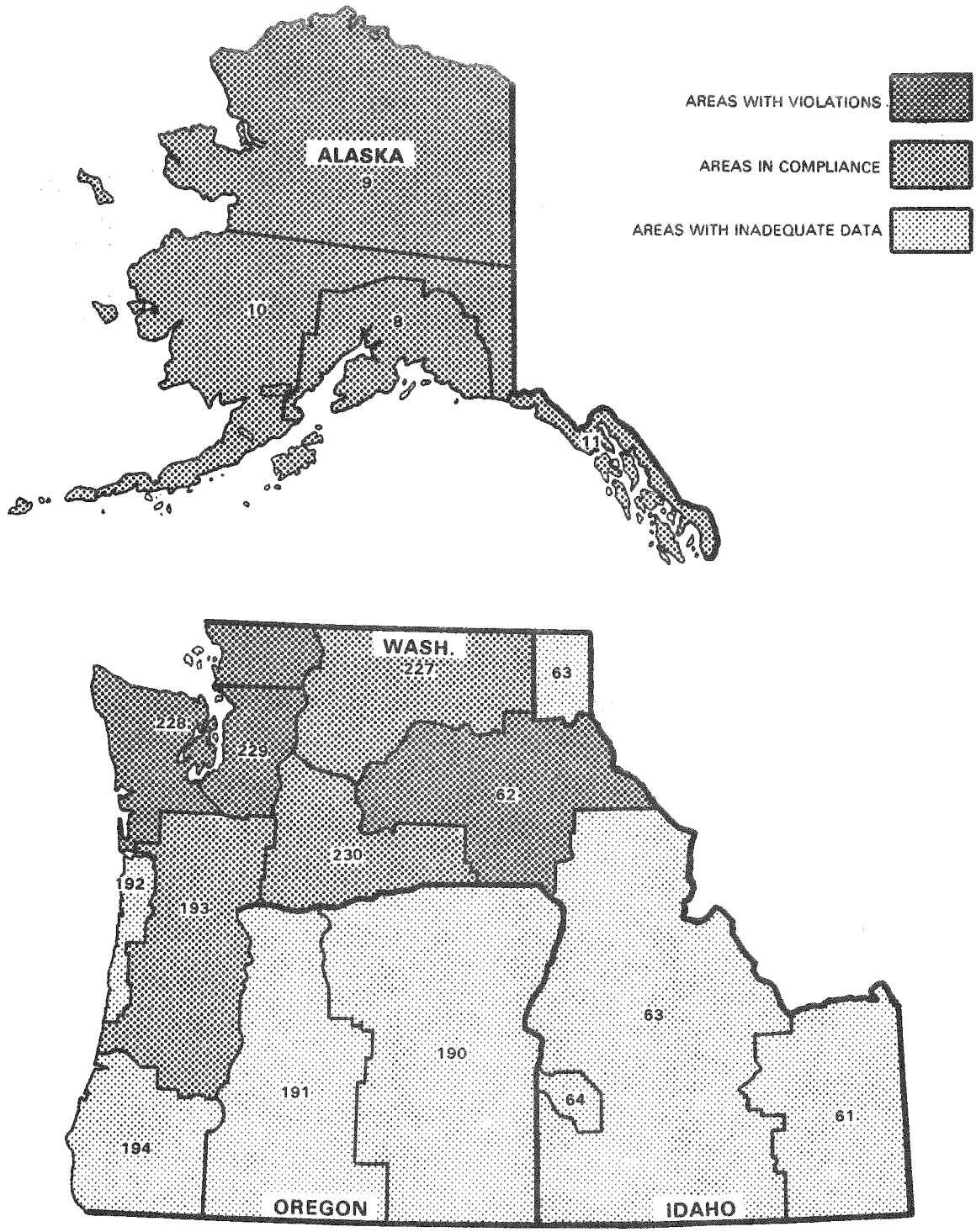


FIGURE II-C-55. Compliance with Ambient Air Quality Standards for Sulfur Dioxide

Data Source: Ref. 24, Environmental Science and Technology

COMPLIANCE WITH AMBIENT AIR QUALITY STANDARDS FOR NITROGEN DIOXIDE

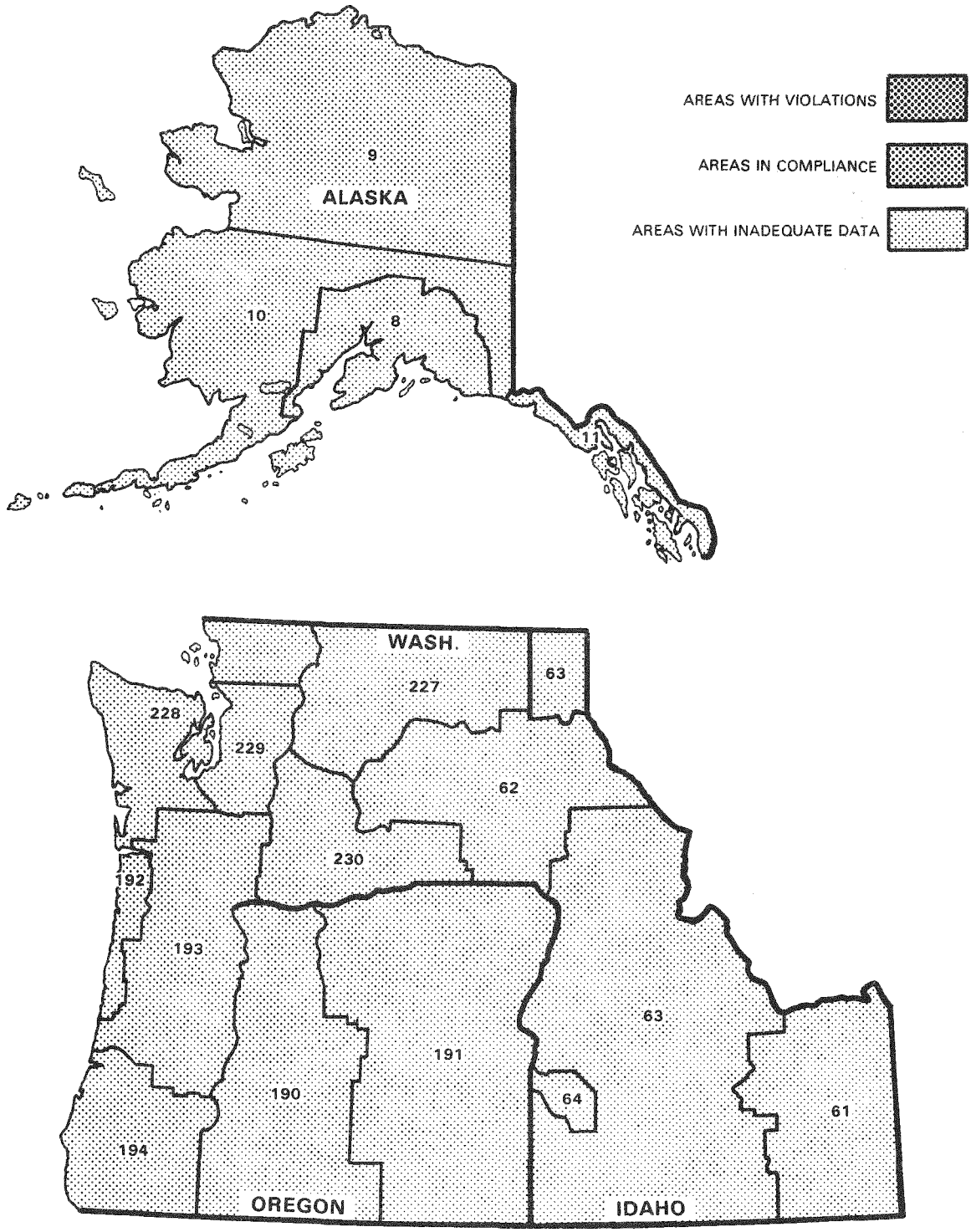


FIGURE II-C-56. Compliance with Ambient Air Quality Standards for Nitrogen Dioxide

Data Source: Ref. 24, Environmental Science and Technology.

COMPLIANCE WITH AMBIENT AIR QUALITY STANDARDS FOR OXIDANTS

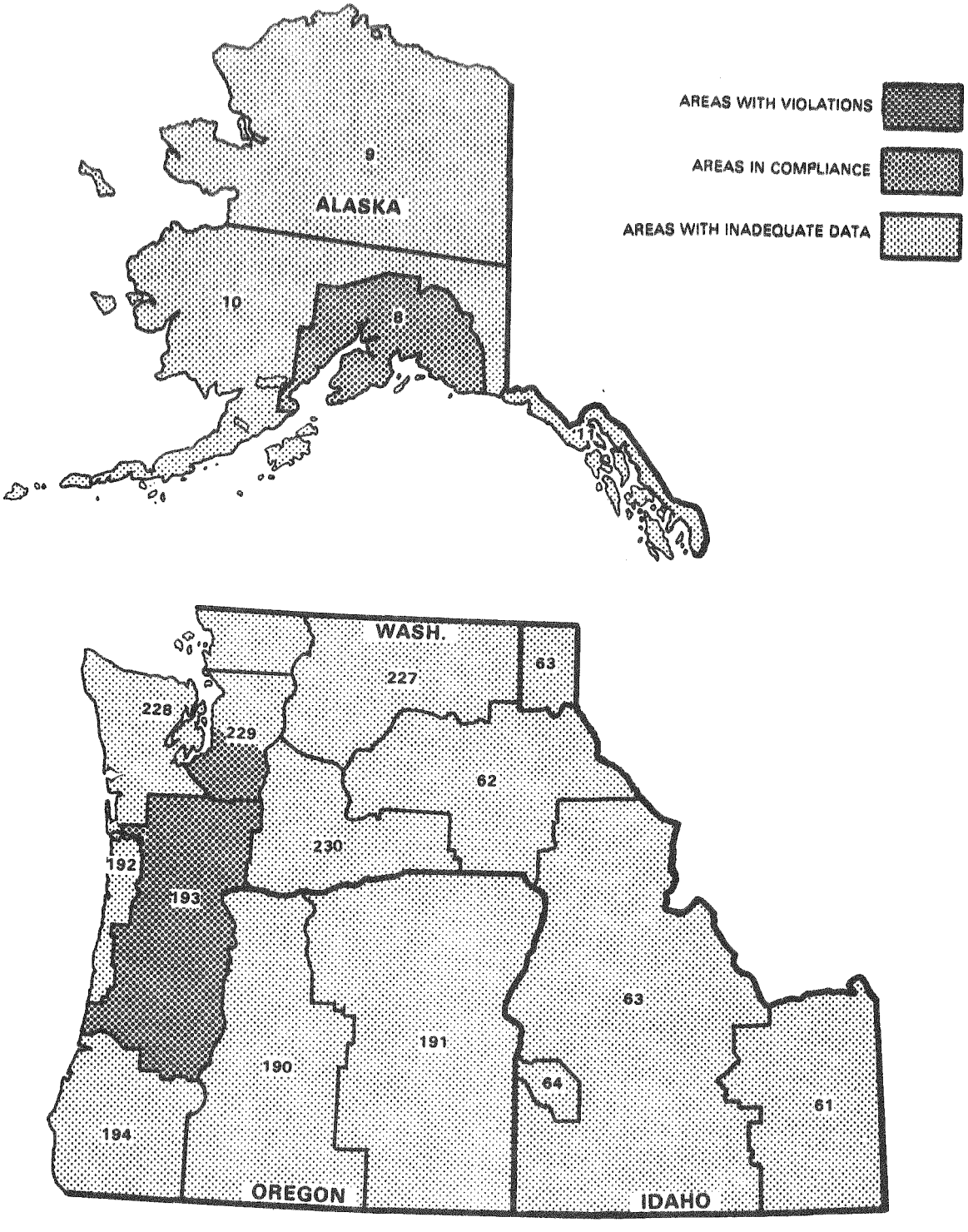


FIGURE II-C-57. Compliance with Ambient Air Quality Standards for Oxidants

Data Source: Ref. 24, Environmental Science and Technology.

TABLE II-C-25

PSD ATTAINMENT STATUS

State	Designated Area	Status
Alaska		
TSP	Entire state	Better than national standards
SO_2	Entire state	Better than national standards
O_x	Entire state	Cannot be classified or better than national standards
CO	Anchorage	Does not meet primary standards
	Fairbanks	Does not meet primary standards
	Remainder of state	Cannot be classified or better than national standards
NO_2	Entire state	Cannot be classified or better than national standards
Idaho		
TSP	Silver Valley	Does not meet primary standards
	Pocatello	Does not meet primary standards
	Soda Springs	Does not meet primary standards
	Lewiston	Does not meet primary standards
	Remainder of state	Better than national standards
SO_2	Silver Valley	Does not meet primary standards
	Pocatello	Does not meet primary standards
	Remainder of state	Better than national standards
O_x	Entire state	Cannot be classified or better than national standards
CO	Boise	Does not meet primary standards
	Remainder of state	Cannot be classified or better than national standards
NO_2	Entire state	Cannot be classified or better than national standards

TABLE II-C-25 (contd)

State	Designated Area	Status
TSP	Portland-Vancouver	Does not meet secondary standards
	Eugene-Springfield	Does not meet primary standards
	Medford-Ashland	Does not meet secondary standards
	Remainder of state	Better than national standards
SO_2	Entire state	Better than national standards
O_x	Portland-Vancouver	Does not meet primary standards
	Medford-Ashland	Does not meet primary standards
	Salem	Does not meet primary standards
	Eugene-Springfield	Does not meet primary standards
	Remainder of state	Cannot be classified or better than national standards
CO	Portland-Vancouver	Does not meet primary standards
	Eugene-Springfield	Does not meet primary standards
	Medford-Ashland	Does not meet primary standards
	City of Salem	Does not meet primary standards
	Remainder of state	Cannot be classified or better than national standard
NO_2	Entire state	Cannot be classified or better than national standard
Washington		
TSP	Seattle	Does not meet primary standard
	Seattle-Duwnmish	Does not meet secondary standard
	Renton	Does not meet secondary standard
	Kent	Does not meet secondary standard
	Tacoma	Does not meet primary standard
	Port Angeles	Does not meet secondary standard
	Long View	Does not meet secondary standard
	Vancouver	Does not meet primary standard
	Yakima	Does not meet primary standard
	Tri-Cities	Does not meet primary standard
	Walla-Walla	Does not meet primary standard
	Spokane	Does not meet primary standard

TABLE II-C-25 (contd)

Washington (contd)	Designated Area	Status
	Clarkston	Does not meet primary standard
	Remainder of state	Better than national standard
SO_2	Tacoma	Does not meet primary standard
	Remainder of state	Better than national standard
O_x	Greater Seattle	Does not meet primary standard
	Portland-Vancouver	Does not meet primary standard
	Spokane	Cannot be classified or better than national standard
	Remainder of state	Cannot be classified or better than national standard
CO	Greater Seattle-Tacoma	Does not meet primary standard
	Spokane	Does not meet primary standard
	Yakima	Does not meet primary standard
	Remainder of state	Cannot be classified or better than national standard
NO_2	Entire state	Cannot be classified or better than national standard

Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21.

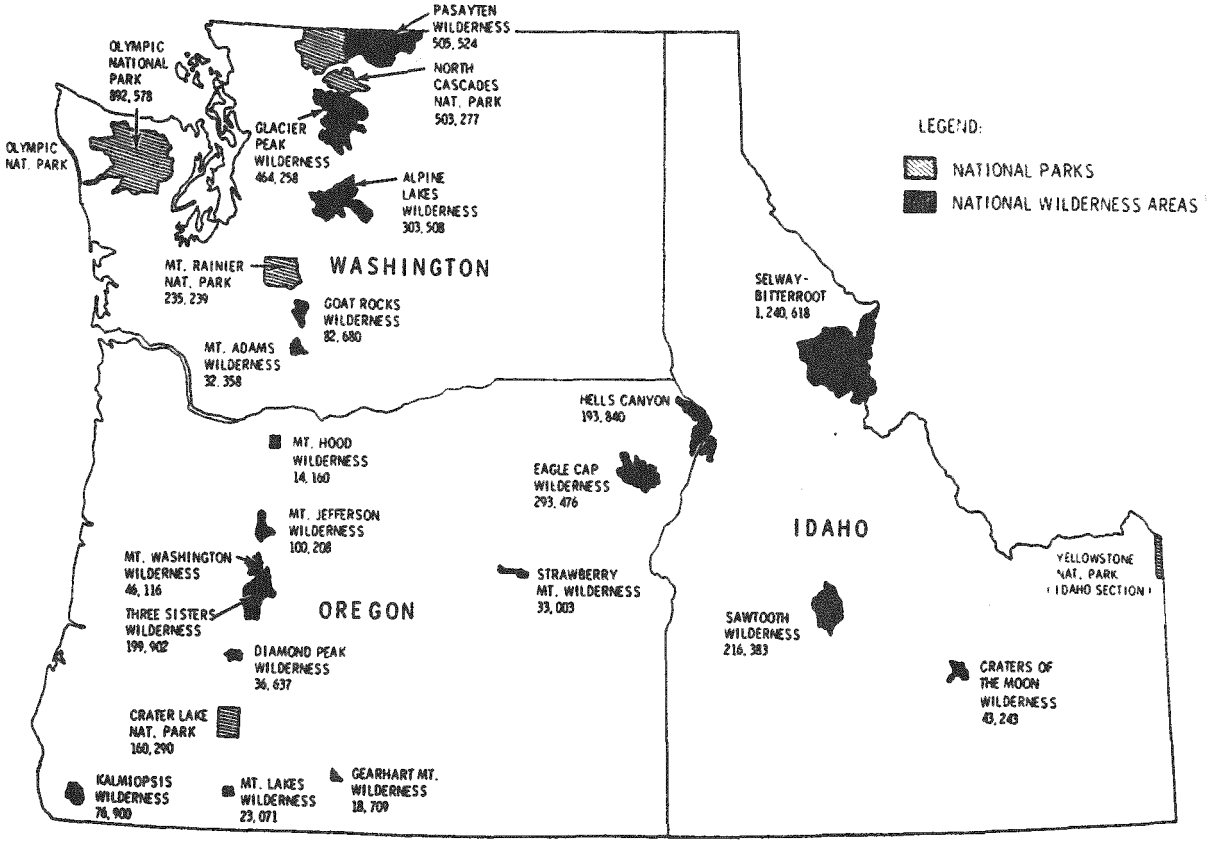


FIGURE II-C-58. Mandatory Class I Areas in the Pacific Northwest

Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, p. 5.5.

TABLE II-C-26

MANDATORY CLASS I AREAS IN THE PACIFIC NORTHWEST

State/Area	Total Acreage
Washington	
Mount Rainier National Park	235,239
North Cascades National Park	503,277
Olympic National Park	892,578
Alpine Lakes Wilderness Area	303,508
Glacier Peak Wilderness Area	464,258
Goat Rocks Wilderness Area	82,680
Mount Adams Wilderness Area	32,356
Pasayten Wilderness Area	505,524
Oregon	
Crater Lake National Park	160,290
Diamond Peak Wilderness Area	36,637
Eagle Cap Wilderness Area	293,476
Gearhart Mountain Wilderness Area	18,709
Kalmiopsts Wilderness Area	76,900
Mountain Lakes Wilderness Area	23,071
Mount Hood Wilderness Area	14,160
Mount Jefferson Wilderness Area	100,208
Mount Washington Wilderness Area	46,116
Strawberry Mountain Wilderness Area	33,033
Three Sisters Wilderness Area	199,902
Idaho	
Yellowstone National Park (Idaho Sector)	(a)
Craters of the Moon Wilderness Area	43,243
Hells Canyon Wilderness Area (Oregon)	193,840
Sawtooth Wilderness Area	216,383
Selway-Bitterroot	1,240,618(b)
Pacific Northwest Total:	5,716,006

(a) Total park acreage = 2,219,737; Idaho section acreage not given.
(b) Includes Montana section.

Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, p. 5.6.

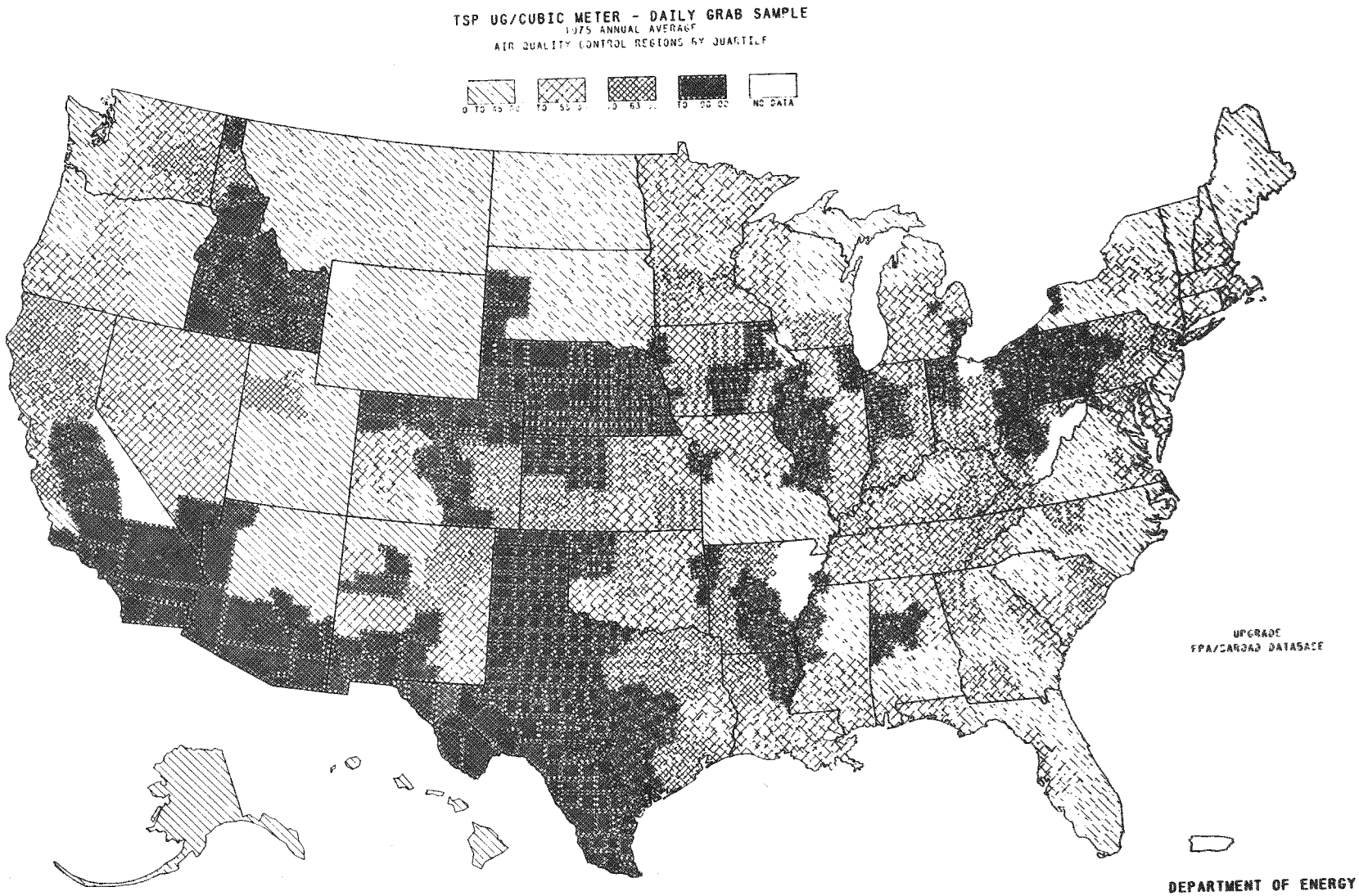


FIGURE II-C-59. Total Suspended Particles

Data Source: Ref. 25, AEROS User's Manual.

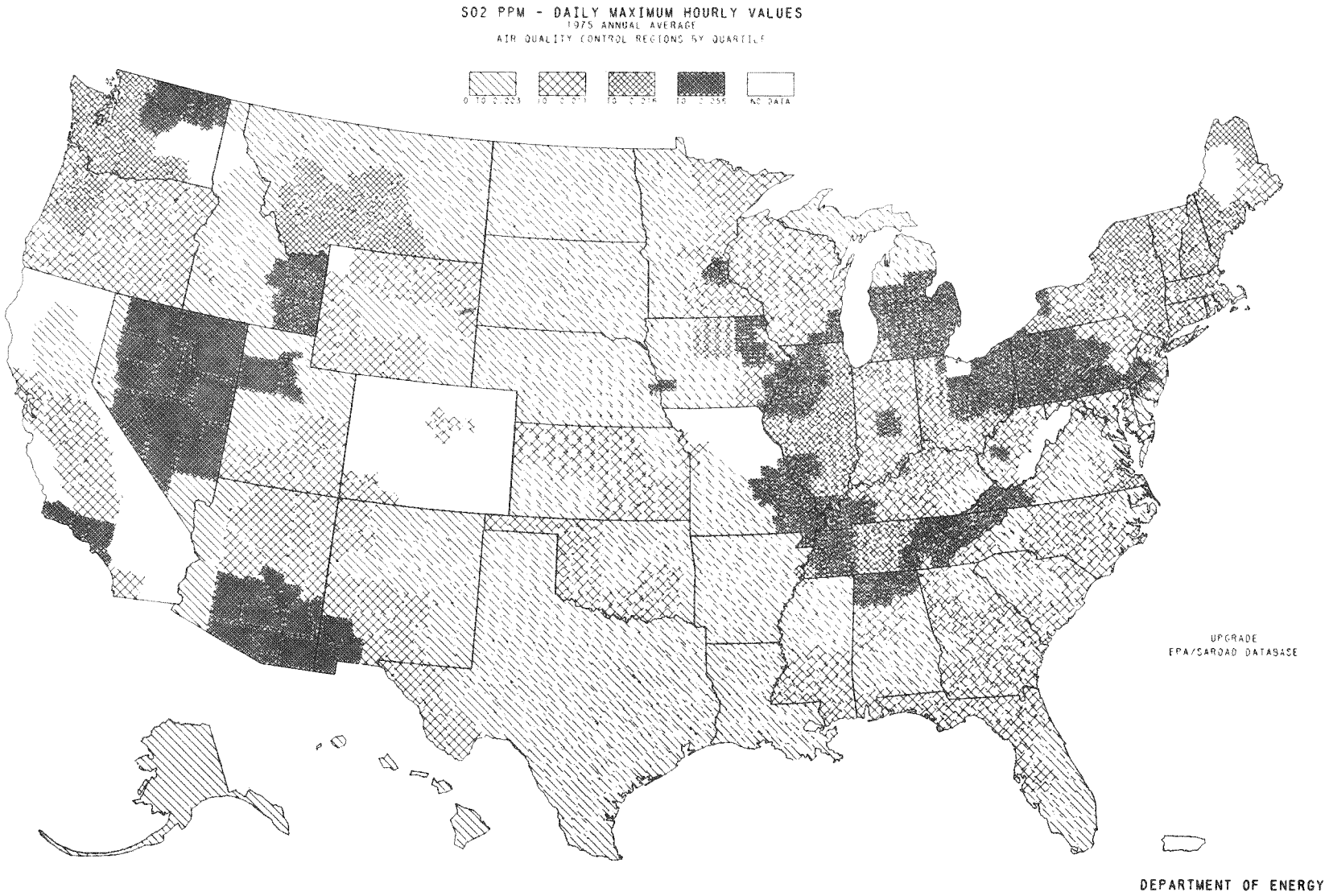


FIGURE II-C-60. Sulfur Dioxide (ppm)

Data Source: Ref. 25, AEROS User's Manual.

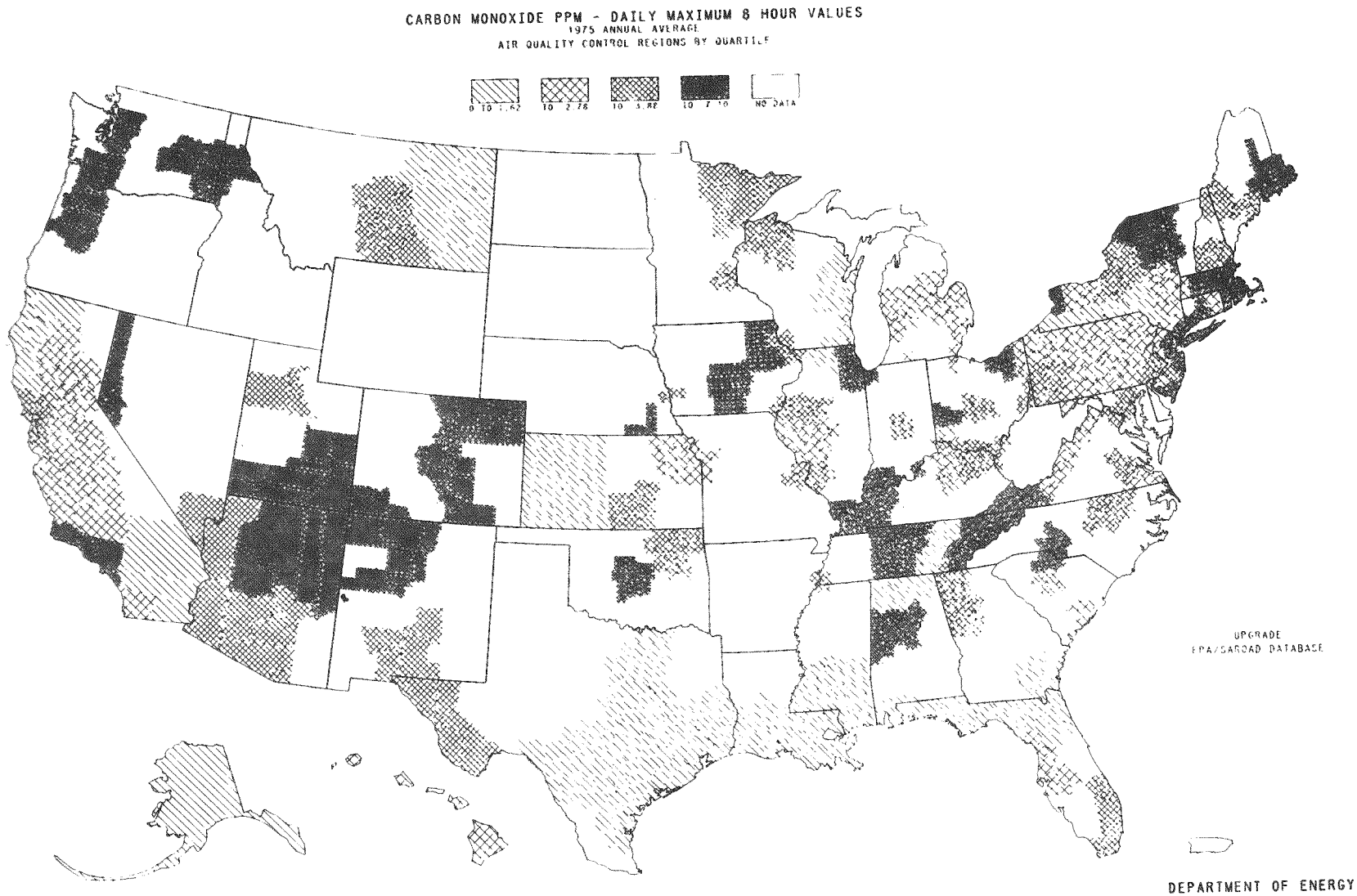


FIGURE II-C-61. Carbon Monoxide (ppm)

Data Source: Ref. 25, AEROS User's Manual.

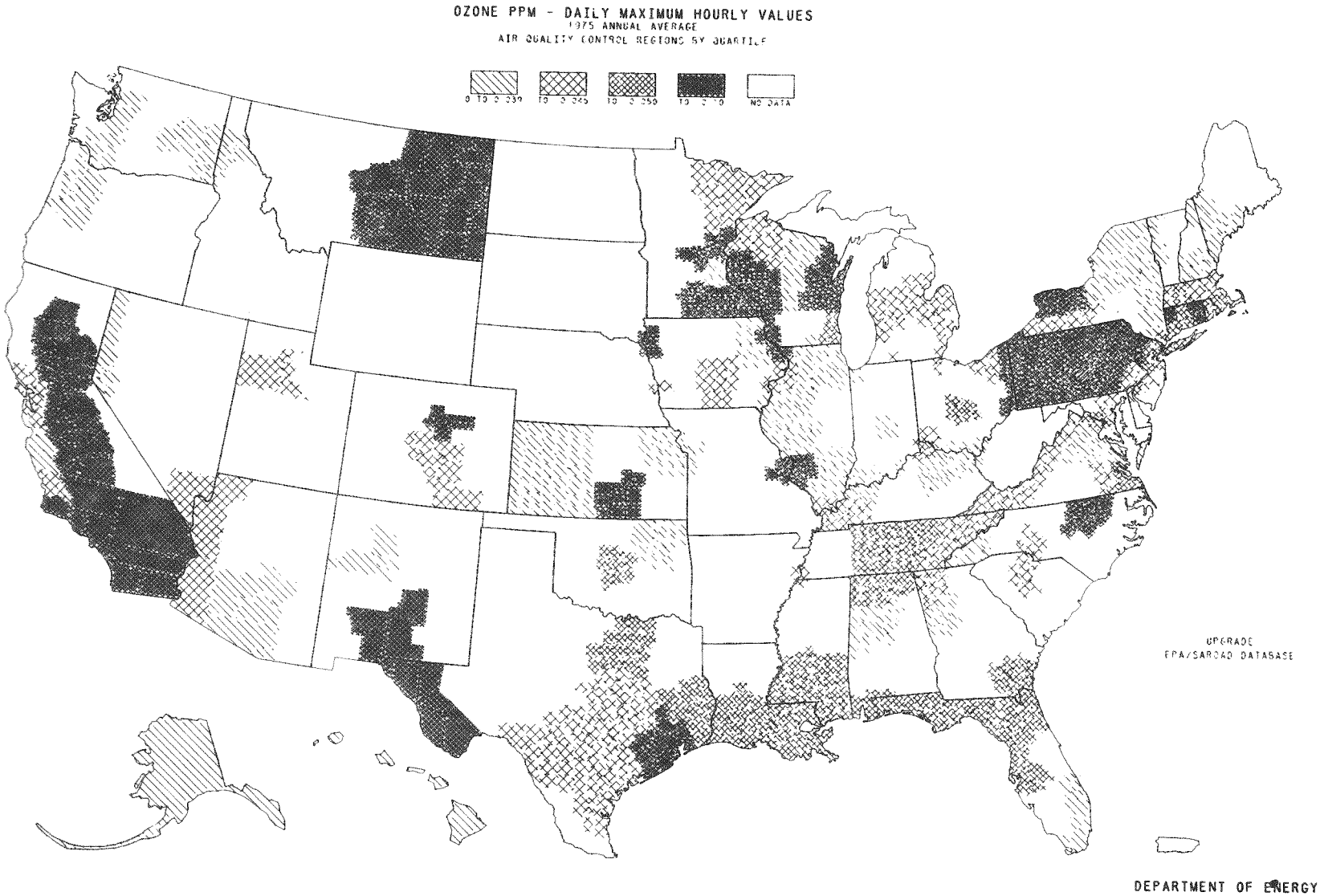


FIGURE II-C-62. Ozone (ppm)

Data Source: Ref. 25, AEROS User's Manual.

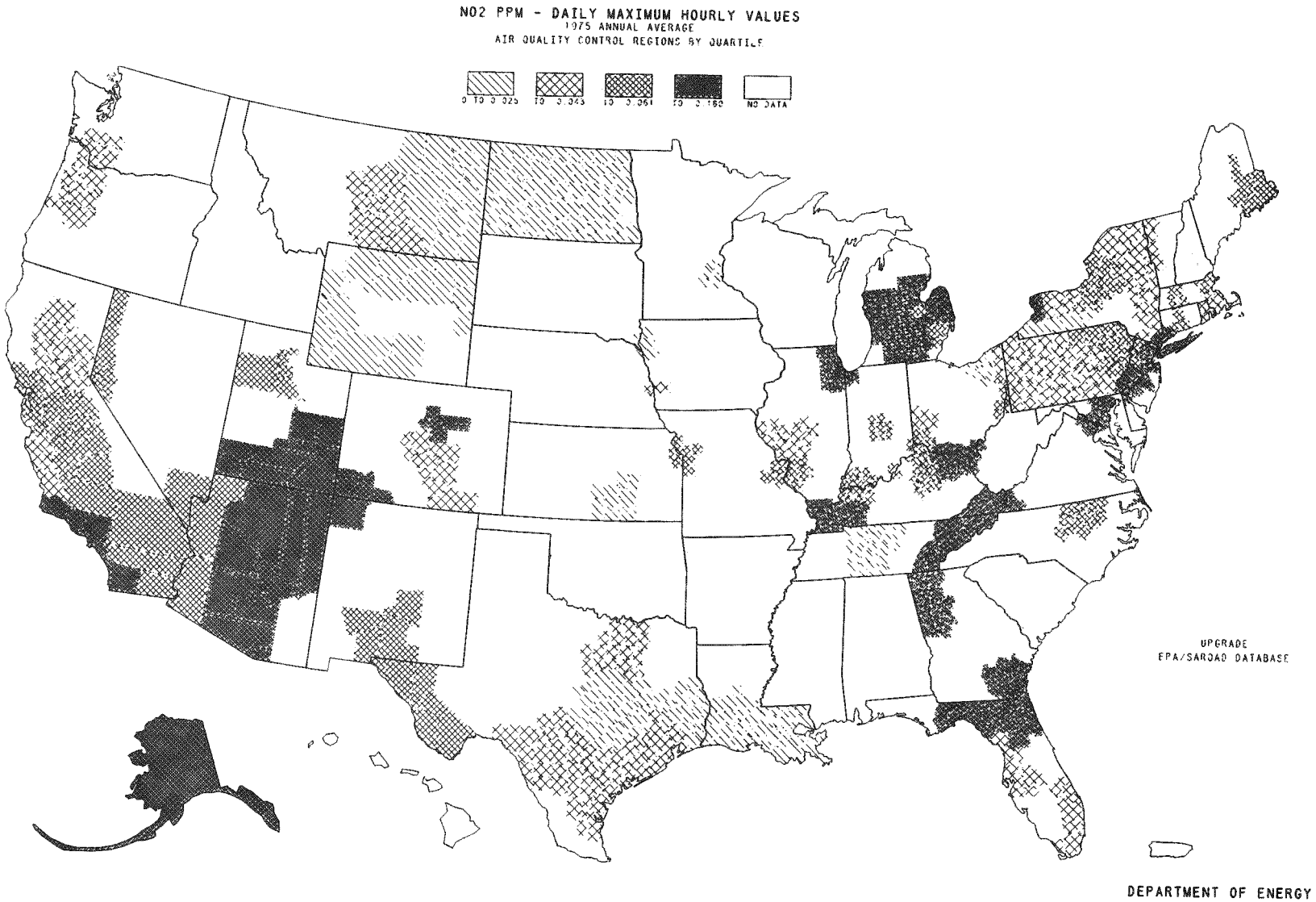


FIGURE II-C-63. Nitrogen Dioxide (ppm)

Data Source: Ref. 25, AEROS User's Manual.

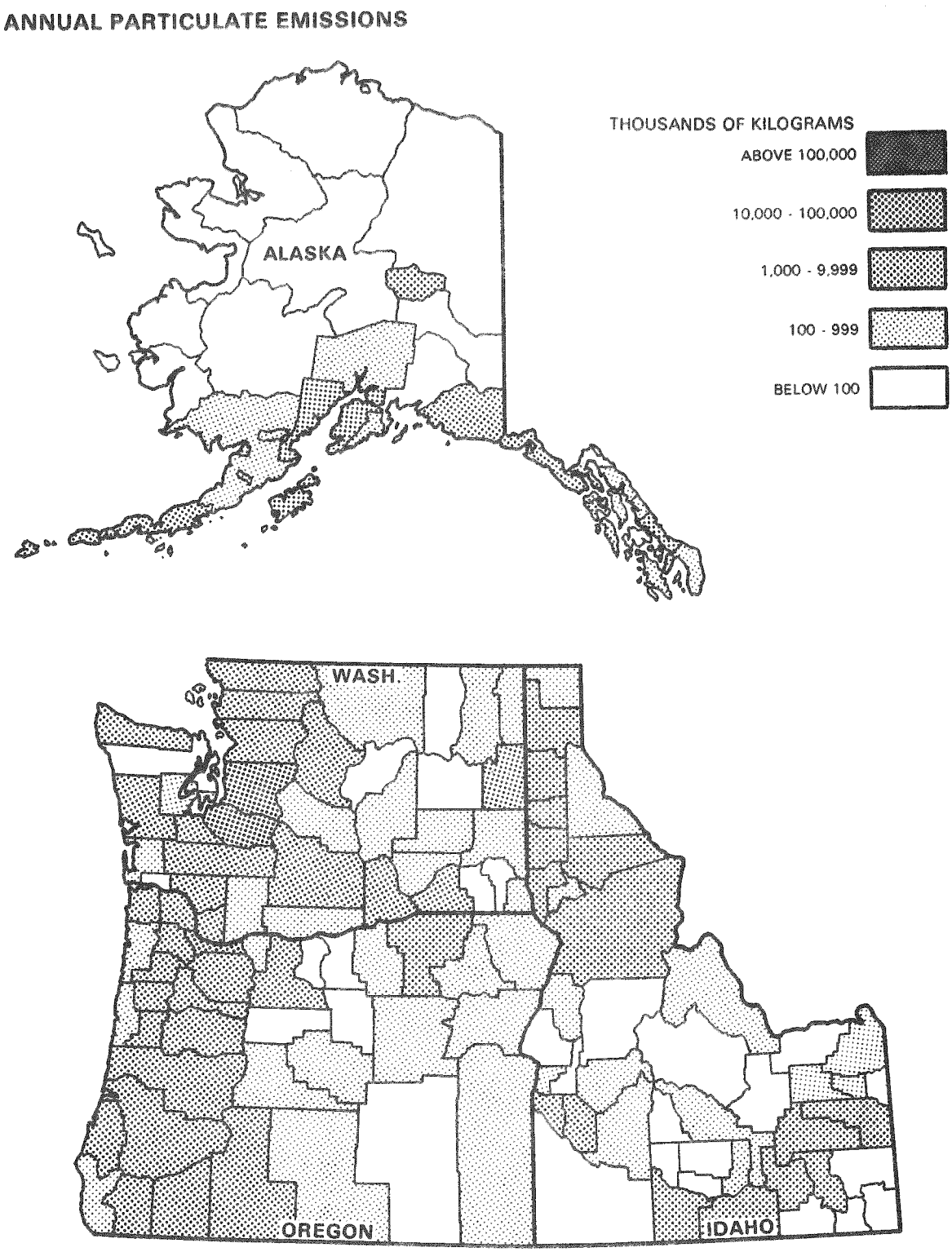


FIGURE II-C-64. Annual Particulate Emissions

Data Source: Ref. 26, Energetics.

ANNUAL SULFUR DIOXIDE EMISSIONS

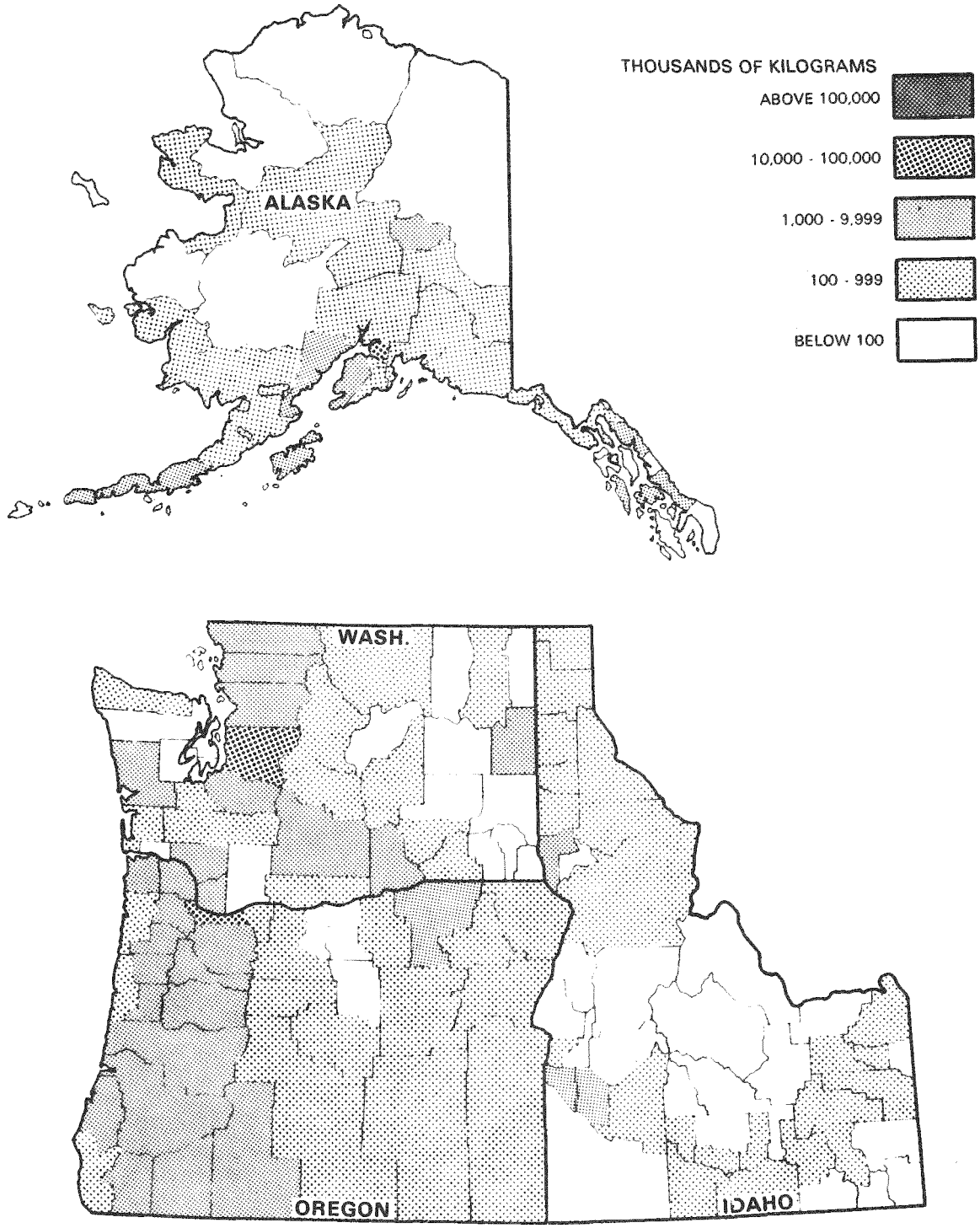


FIGURE II-C-65. Annual Sulfur Dioxide Emissions

Data Source: Ref. 26, Energetics.

ANNUAL NITROGEN EMISSIONS

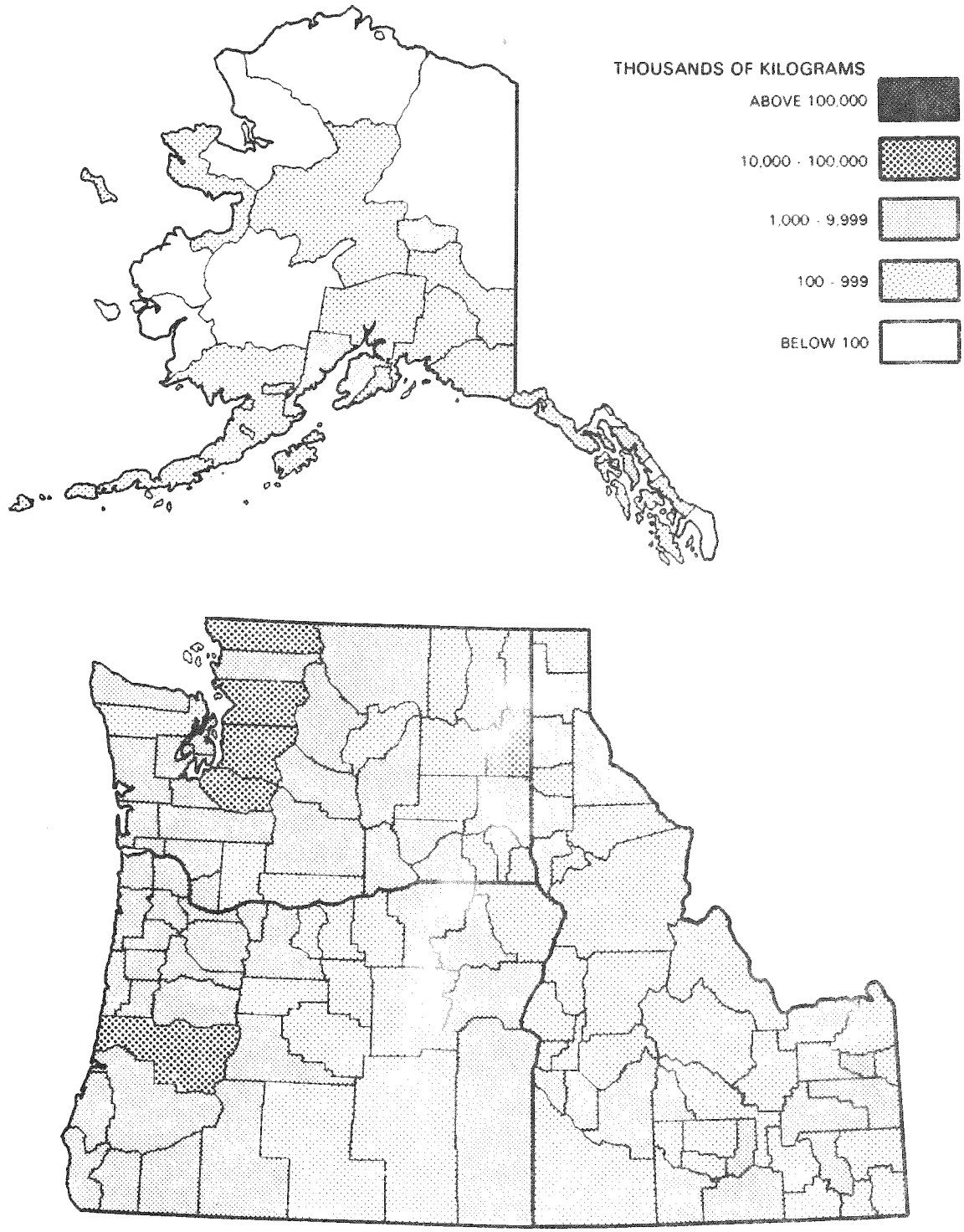


FIGURE II-C-66. Annual Nitrogen Emissions

Data Source: Ref. 26, Energetics.

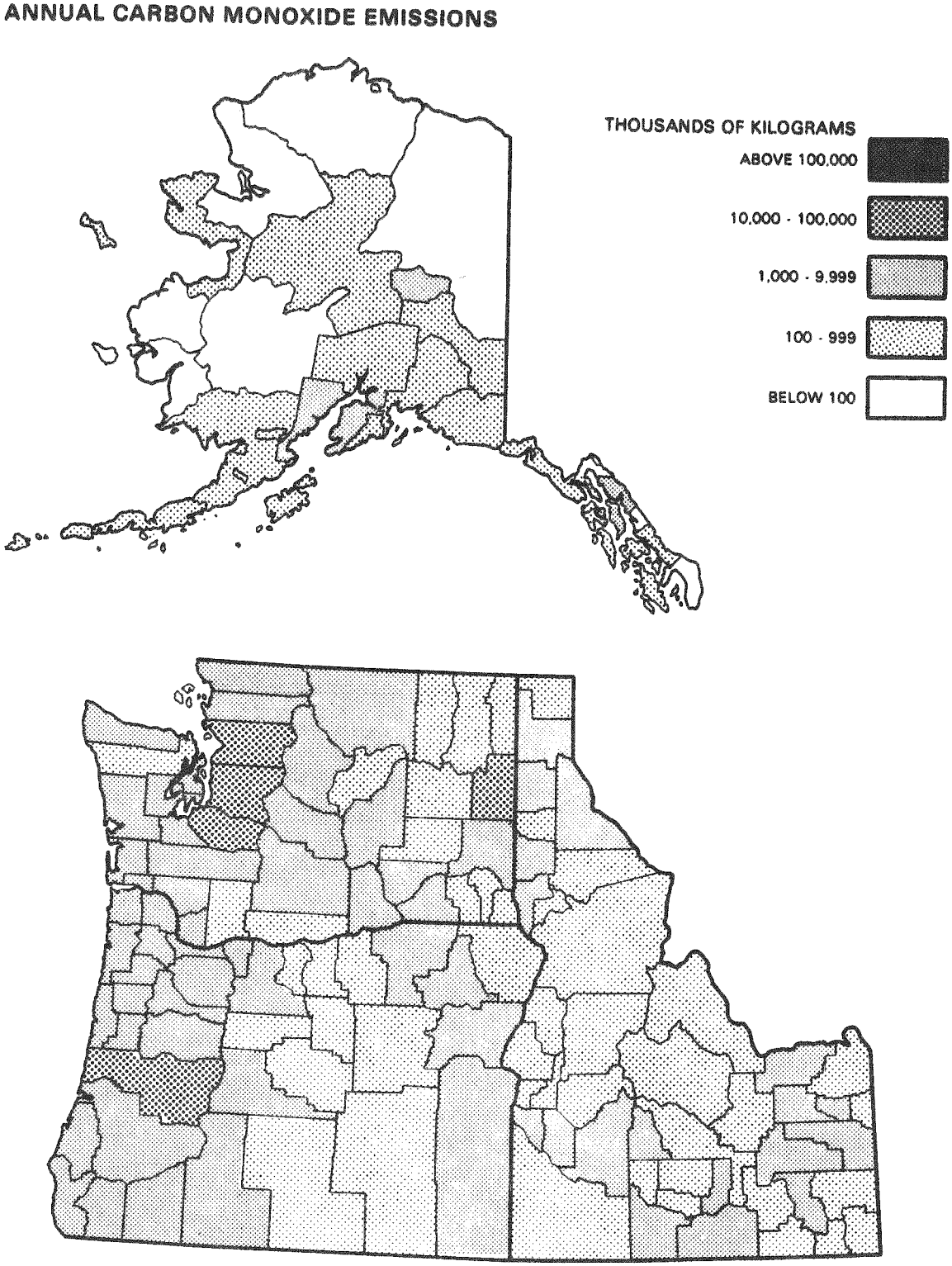


FIGURE II-C-67. Annual Carbon Monoxide Emissions

Data Source: Ref. 26, Energetics.

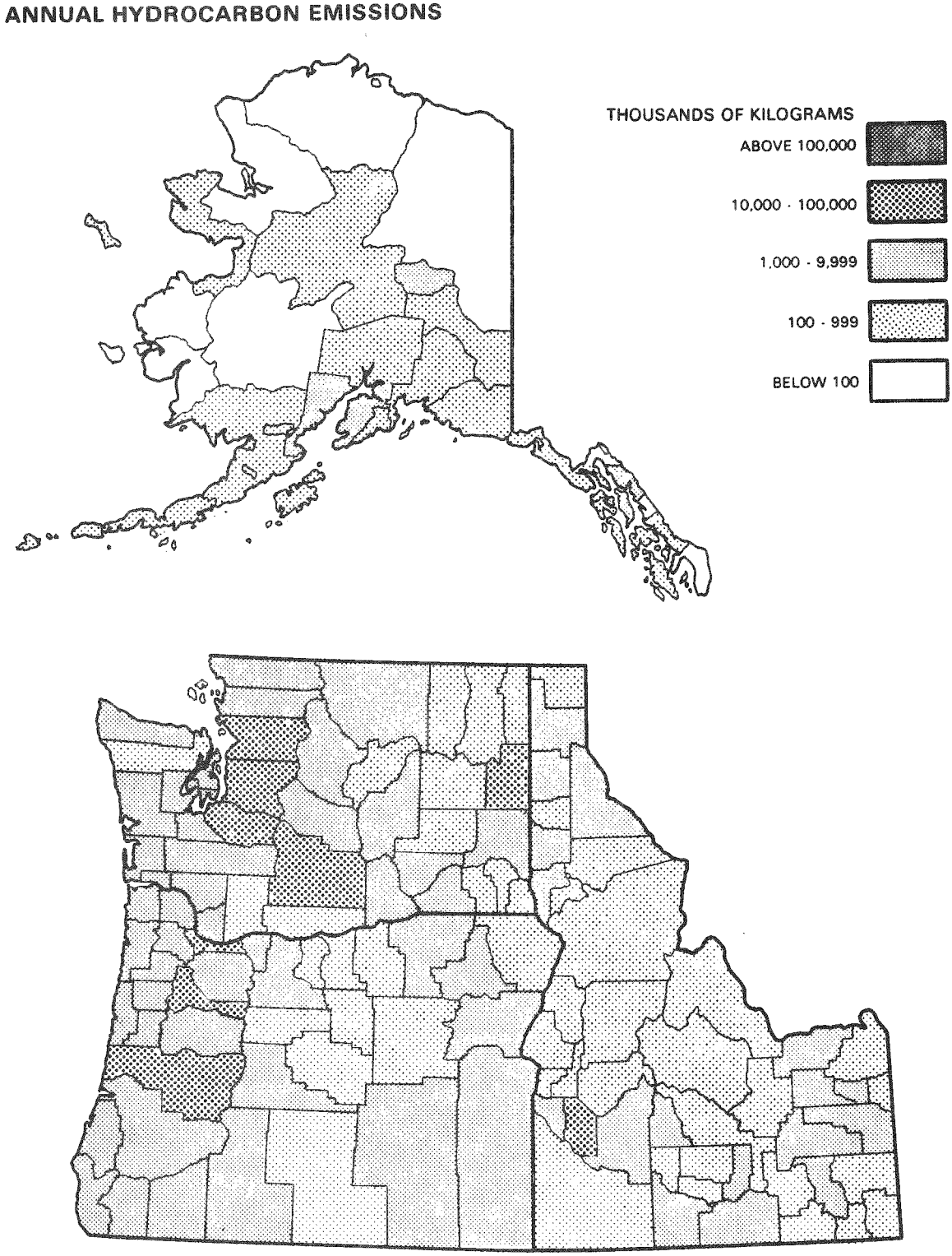


FIGURE II-C-68. Annual Hydrocarbon Emissions

Data Source: Ref. 26, Energetics.

FIGURE II-C-69. Sulfur Oxide Emissions

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-C-27

FUEL EMISSIONS BY COUNTY

Place Name	Annual Fuel Emissions, 1000s of kg					Emissions per Mile^2, 1000s of kg/yr				
	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons
Alaska										
Aleutian I	5,293	2,018	534	1,150	246	0	0	0	0	0
Anchorage	8,188	10,418	12,280	97,637	12,275	9	11	13	105	13
Angoon	697	229	44	38	18	0	0	0	0	0
Barrow	10	74	34	4	3	0	0	0	0	0
Bethel	19	146	67	8	5	0	0	0	0	0
Bristol Ba	2,138	743	153	120	55	4	1	0	0	0
Bristol Ba	631	280	153	982	133	0	0	0	0	0
Cordova-Mc	1,426	573	361	2,728	359	0	0	0	0	0
Fairbanks	1,580	3,150	3,993	31,870	4,006	0	0	1	5	1
Haines	8	64	29	3	2	0	0	0	0	0
Juneau	687	1,182	1,310	9,793	1,225	1	1	1	8	1
Kenai-Cook	3,218	2,805	4,175	19,489	4,950	0	0	0	2	0
Ketchikan	11,653	4,374	1,670	8,795	1,295	9	3	1	7	1
Kobuk	12	93	43	5	3	0	0	0	0	0
Kodiak	3,876	1,723	455	235	114	1	0	0	0	0
Kuskowim	9	49	59	442	55	0	0	0	0	0
Matanuska-	115	307	609	5,667	695	0	0	0	0	0
Nome	45	181	370	3,449	423	0	0	0	0	0
Outer-Ketc	7	52	24	3	2	0	0	0	0	0
Prince Od	301	202	67	21	11	0	0	0	0	0
Seward	193	169	245	2,197	272	0	0	0	1	0
Sitka	9,317	3,378	1,318	7,483	1,087	4	2	1	3	1
Skagway-Ya	1,921	736	430	3,214	427	0	0	0	0	0
Southeast	33	180	205	1,480	185	0	0	0	0	0
Upper Yuko	11	81	37	4	3	0	0	0	0	0
Valdez-Chi	68	182	673	7,076	861	0	0	0	0	0
Wade Hampt	8	62	29	3	2	0	0	0	0	0
Wrangell-P	5,378	1,997	639	2,607	422	1	0	0	0	0
Yukon-Koyu	37	204	224	1,576	197	0	0	0	0	0
Total	56,881	35,651	30,229	208,080	29,330	0	0	0	0	0
Idaho										
Ada	6,109	1,663	8,647	86,345	10,710	6	2	8	83	10
Adams	449	66	247	2,337	292	0	0	0	2	0
Bannock	2,249	670	4,845	51,011	6,252	2	1	4	46	6
Bear Lake	73	63	644	6,998	850	0	0	1	7	1
Benewah	1,101	157	521	4,785	602	1	0	1	6	1
Bingham	2,016	482	1,817	16,774	2,082	1	0	1	8	1
Blaine	117	79	316	2,886	355	0	0	0	1	0
Boise	318	41	133	1,230	155	0	0	0	1	0
Bonner	1,326	244	1,212	12,127	1,498	1	0	1	7	1
Bonneville	3,476	889	3,580	33,630	4,181	2	1	2	18	2
Boundary	538	100	476	4,712	583	0	0	0	4	1
Butte	34	35	369	4,023	489	0	0	0	2	0
Camas	4	11	30	232	29	0	0	0	0	0
Canyon	6,797	1,282	4,144	36,905	4,627	12	2	7	64	8
Caribou	54	85	512	5,142	627	0	0	0	3	0
Cassia	2,083	406	1,504	13,971	1,704	1	0	1	6	1
Clark	7	11	65	656	80	0	0	0	0	0
Clearwater	2,690	338	869	7,409	952	1	0	0	3	0
Custer	22	29	225	2,365	288	0	0	0	1	0
Elmore	115	166	1,125	11,543	1,406	0	0	0	4	1
Franklin	51	75	491	5,007	610	0	0	1	8	1

TABLE II-C-27 (contd)

Place Name	Annual Fuel Emissions, 1000s of kg					Emissions per Mile^2, 1000s of kg/yr				
	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons
Fremont	310	117	706	7,183	879	0	0	0	4	1
Gem	61	88	603	6,204	756	0	0	1	11	1
Gooding	80	105	812	8,503	1,035	0	0	1	12	1
Idaho	1,711	276	863	7,702	970	0	0	0	1	0
Jefferson	778	189	1,372	14,495	1,773	1	0	1	13	2
Jerome	66	130	568	5,271	645	0	0	1	9	1
Kootenai	2,378	511	2,030	19,123	2,373	2	0	2	15	2
Latah	1,274	347	1,671	16,359	2,014	1	0	2	15	2
Lemhi	362	88	604	6,331	775	0	0	0	1	0
Lewis	300	74	328	3,162	391	1	0	1	7	1
Lincoln	27	33	286	3,044	370	0	0	0	3	0
Madison	402	162	1,476	15,922	1,939	1	0	3	34	4
Minidoka	782	277	1,208	11,457	1,411	1	0	2	15	2
Nez Perce	9,268	1,186	2,805	22,987	2,974	11	1	3	27	4
Oneida	27	34	276	2,924	356	0	0	0	3	0
Owyhee	35	69	295	2,717	333	0	0	0	0	0
Payette	602	180	791	7,557	932	2	0	2	19	2
Power	4,492	492	803	5,458	750	3	0	1	4	1
Shoshone	130	169	1,327	13,938	1,696	0	0	1	5	1
Teton	16	24	151	1,526	186	0	0	0	3	0
Twin Falls	3,548	821	3,282	30,865	3,826	2	0	2	16	2
Valley	27	35	268	2,806	341	0	0	0	1	0
Washington	76	86	281	2,367	292	0	0	0	2	0
Total	56,380	12,379	54,577	527,985	65,422	0	0	0	6	0
Oregon										
Baker	463	497	1,362	14,080	1,721	0	0	0	5	1
Benton	1,390	1,498	3,446	34,597	4,241	2	2	5	52	6
Clackamas	4,905	5,055	8,078	74,715	9,230	3	3	4	40	5
Clatsop	1,533	1,173	2,295	22,750	2,799	2	2	3	28	4
Columbia	1,352	1,010	1,754	16,979	2,095	2	2	3	27	3
Coos	3,295	2,367	4,135	40,222	4,963	2	2	3	25	3
Crook	610	445	521	4,497	563	0	0	0	2	0
Curry	905	595	1,084	10,720	1,322	1	0	1	7	1
Deschutes	988	982	2,607	26,904	3,291	0	0	1	9	1
Douglas	4,290	2,901	5,816	58,466	7,194	1	1	1	12	1
Gilliam	38	81	387	4,225	514	0	0	0	4	0
Grant	141	199	363	3425	421	0	0	0	1	0
Harney	81	190	815	8,795	1,070	0	0	0	1	0
Hood River	592	527	1,205	12,184	1,494	1	1	2	23	3
Jackson	3,503	3,154	6,608	65,792	8,106	1	1	2	23	3
Jefferson	89	262	819	8,467	1,032	0	0	1	5	1
Josephine	1,375	1,144	3,012	31,283	3,829	1	1	2	19	2
Klamath	1,707	1,695	3,881	39,074	4,790	0	0	1	7	1
Lake	260	256	588	5,922	726	0	0	0	1	0
Lane	9,023	7,550	14,270	139,666	17,229	2	2	3	31	4
Lincoln	847	789	2,092	21,639	2,648	1	1	2	22	3
Linn	4,619	3,150	6,021	59,944	7,383	2	1	3	26	3
Malheur	977	965	1,304	11,478	1,426	0	0	0	1	0
Marion	4,281	4,623	9,584	94,262	11,574	4	4	8	81	10
Morrow	128	168	465	4,786	585	0	0	0	2	0
Multnomah	28,254	24,369	41,942	388,694	49,321	67	58	99	919	117
Polk	1,334	1,121	1,777	16,656	2,060	2	2	2	23	3
Sherman	21	58	198	2,076	253	0	0	0	3	0
Tillamook	838	669	1,188	11,499	1,418	1	1	1	10	1

TABLE II-C-27 (contd)

Place Name	Annual Fuel Emissions, 1000s of kg					Emissions per Mile^2, 1000s of kg/yr				
	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons	Particulates	Sulfur	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons
Umatilla	1,725	1,721	4,212	42,897	5,254	1	1	1	13	2
Union	697	651	1,697	17,501	2,142	0	0	1	9	1
Wallowa	161	188	740	7,986	973	0	0	0	3	0
Wasco	1,041	856	1,974	20,082	2,463	0	0	1	8	1
Washington	7,036	6,074	8,432	75,802	9,411	10	9	12	106	13
Wheeler	16	39	158	1,691	206	0	0	0	1	0
Yamhill	1,184	1,170	2,301	22,473	2,763	2	2	3	32	4
Total	89,697	78,190	147,128	1,422,226	176,508	0	0	1	14	1
Washington										
Adams	278	79	872	8,654	1,050	0	0	1	5	1
Asotin	131	31	872	9,418	1,146	0	0	1	15	2
Benton	4,771	1,404	4,024	37,677	4,702	3	1	2	22	3
Chelan	2,542	735	3,497	35,192	4,328	1	0	1	12	2
Clallam	1,892	557	1,834	17,212	2,135	1	0	1	10	1
Clark	7,784	2,301	6,130	55,789	6,955	12	4	10	89	11
Columbia	33	8	294	2,957	361	0	0	0	4	0
Cowlitz	6,173	1,821	4,496	41,927	5,225	5	0	0	37	5
Douglas	67	20	498	4,446	547	0	0	0	2	0
Ferry	75	22	121	1,154	142	0	0	0	1	0
Franklin	412	113	1,775	17,887	2,187	0	0	1	14	2
Garfield	18	5	146	1,381	169	0	0	0	2	0
Grant	972	277	2,660	26,183	3,210	0	0	1	10	1
Grays Harbor	4,593	1,350	3,910	37,294	4,628	2	1	2	20	2
Island	129	36	799	7,533	924	1	0	4	36	4
Jefferson	56	13	523	5,410	659	0	0	0	3	0
King	82,136	24,165	73,001	674,138	84,508	39	11	34	317	40
Kitsap	909	254	4,128	40,161	4,919	2	1	11	102	13
Kittitas	618	156	2,913	32,104	3,905	0	0	1	14	2
Klickitat	512	151	540	4,928	612	0	0	0	3	0
Lewis	1,944	551	3,640	37,981	4,650	1	0	2	16	2
Lincoln	96	22	929	9,801	1,193	0	0	0	4	1
Mason	111	26	1,045	10,842	1,321	0	0	1	11	1
Okanogan	679	195	1,399	13,780	1,692	0	0	0	3	0
Pacific	551	154	1,245	13,145	1,607	1	0	1	15	2
Pend Oreille	139	37	516	5,651	688	0	0	0	4	1
Pierce	13,176	4,189	21,870	206,680	26,306	8	3	13	123	16
San Juan	32	9	191	1,935	236	0	0	1	11	1
Skagit	5,079	4,439	9,456	35,886	11,487	3	3	5	21	7
Skamania	312	93	158	1,261	161	0	0	0	1	0
Snohomish	5,530	1,571	13,744	137,542	16,855	3	1	7	66	8
Spokane	9,232	2,668	14,580	141,623	17,600	5	2	8	81	10
Stevens	440	126	875	8,754	1,074	0	0	0	4	0
Thurston	2,633	757	4,739	47,443	5,825	4	1	7	66	8
Wahkiakum	18	4	165	1,707	208	0	0	1	7	1
Walla Walla	1,339	393	2,047	18,974	2,344	1	0	2	15	2
Whatcom	5,459	4,744	10,721	43,947	12,941	3	2	5	21	6
Whitman	259	72	1,560	14,840	1,819	0	0	1	7	1
Yakima	4,390	1,265	8,363	82,605	10,146	1	0	2	19	2
Total	165,518	54,813	210,273	1,895,752	250,462	2	0	3	28	3

Data Source: Ref. 26, Energetics.

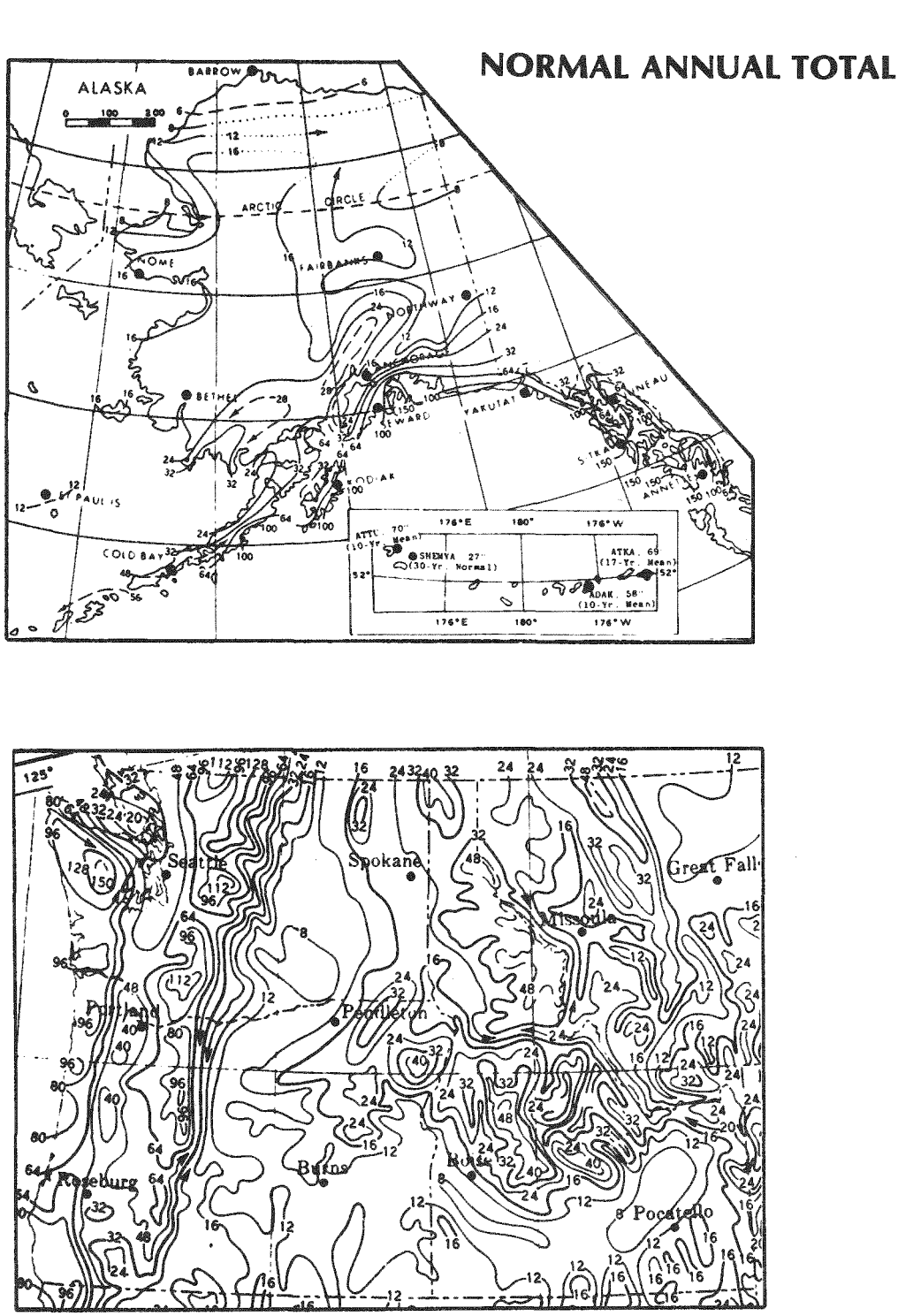


FIGURE II-C-70. Normal Annual Total Precipitation (inches)

Data Source: Ref. 27, Climatic Atlas.

TABLE II-C-28

PRECIPITATION

Normal Precipitation										Annual Average
	1	2	3	4	5	6	7	8	9	10
Al	93.9	89.8	40.8	18.7	21.7	24.6	17.0	13.7	8.2	
ID	28.1	22.9	22.9	28.1	12.5	11.8	9.7	9.4	11.1	15.9
OR	78.9	52.4	33.8	72.8	30.0	16.5	12.7	18.7	9.8	
WA	94.8	22.9	40.3	62.4	89.3	31.2	12.8	9.7	21.3	17.8
Maximum Precipitation										Annual Maximum
AL	93.9	89.8	40.8	18.7	21.7	24.6	17.0	13.7	8.2	
ID	28.1	22.9	22.9	28.1	12.5	11.8	9.7	9.4	11.1	15.9
OR	78.9	52.4	33.8	72.8	30.0	16.5	12.7	18.7	9.8	
WA	94.8	22.9	40.3	62.4	89.3	31.2	12.8	9.7	21.3	17.8
Minimum Precipitation										Annual Minimum
Al	93.9	89.8	40.8	18.7	21.7	24.6	17.0	13.7	8.2	
ID	28.1	22.9	22.9	28.1	12.5	11.8	9.7	9.4	11.1	15.9
OR	78.9	52.4	33.8	72.8	30.0	16.5	12.7	18.7	9.8	
WA	94.8	22.9	40.3	62.5	89.3	31.2	12.8	9.7	21.3	17.8

Data Source: Ref. 28, NOAA.

1-YEAR 1-HOUR RAINFALL (INCHES)

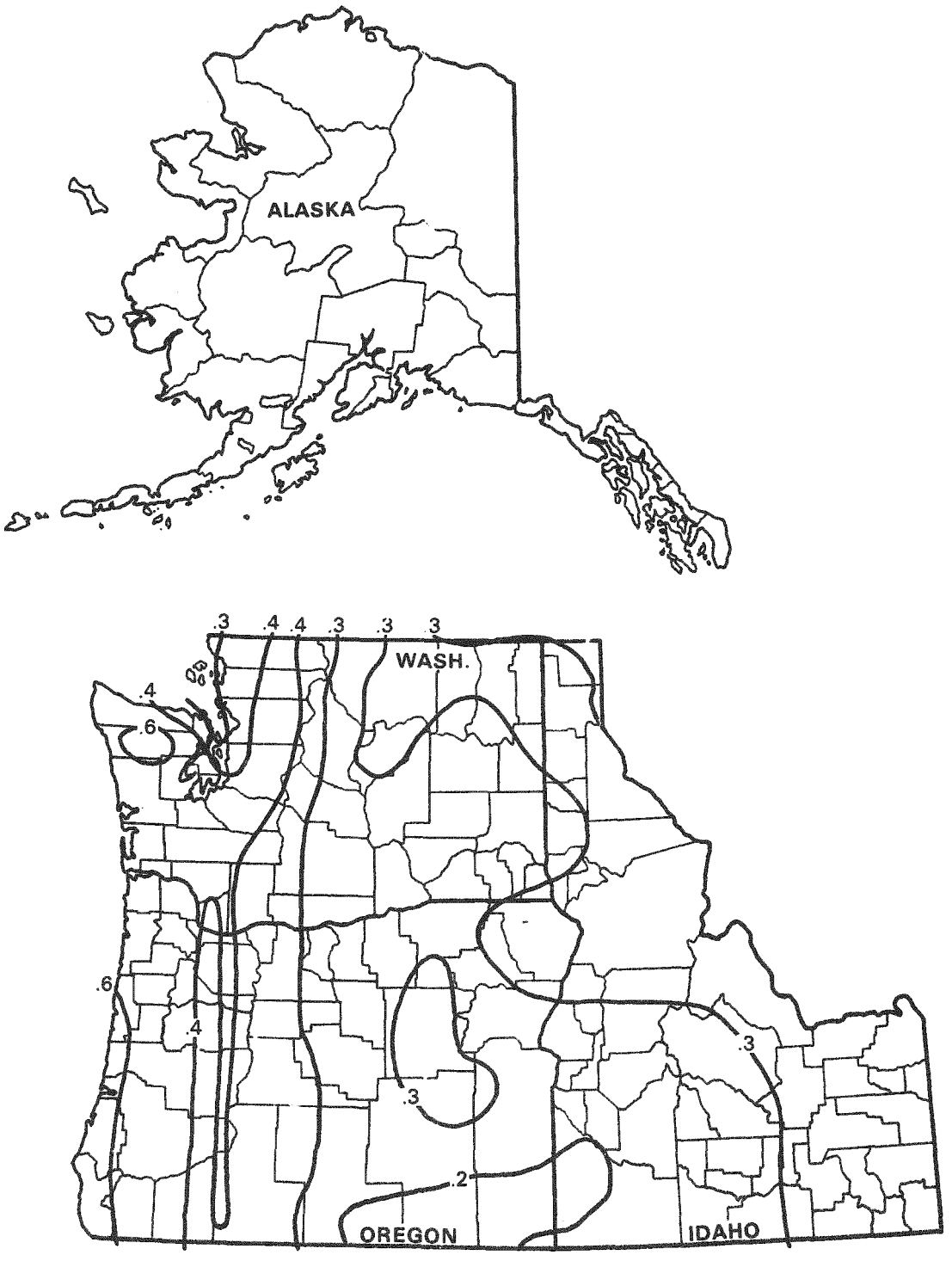


FIGURE II-C-71. Minimum Precipitation (inches)

Data Source: Ref. 29, Rainfall Frequency Atlas of the U.S.

50-YEAR 24-HOUR RAINFALL (INCHES)

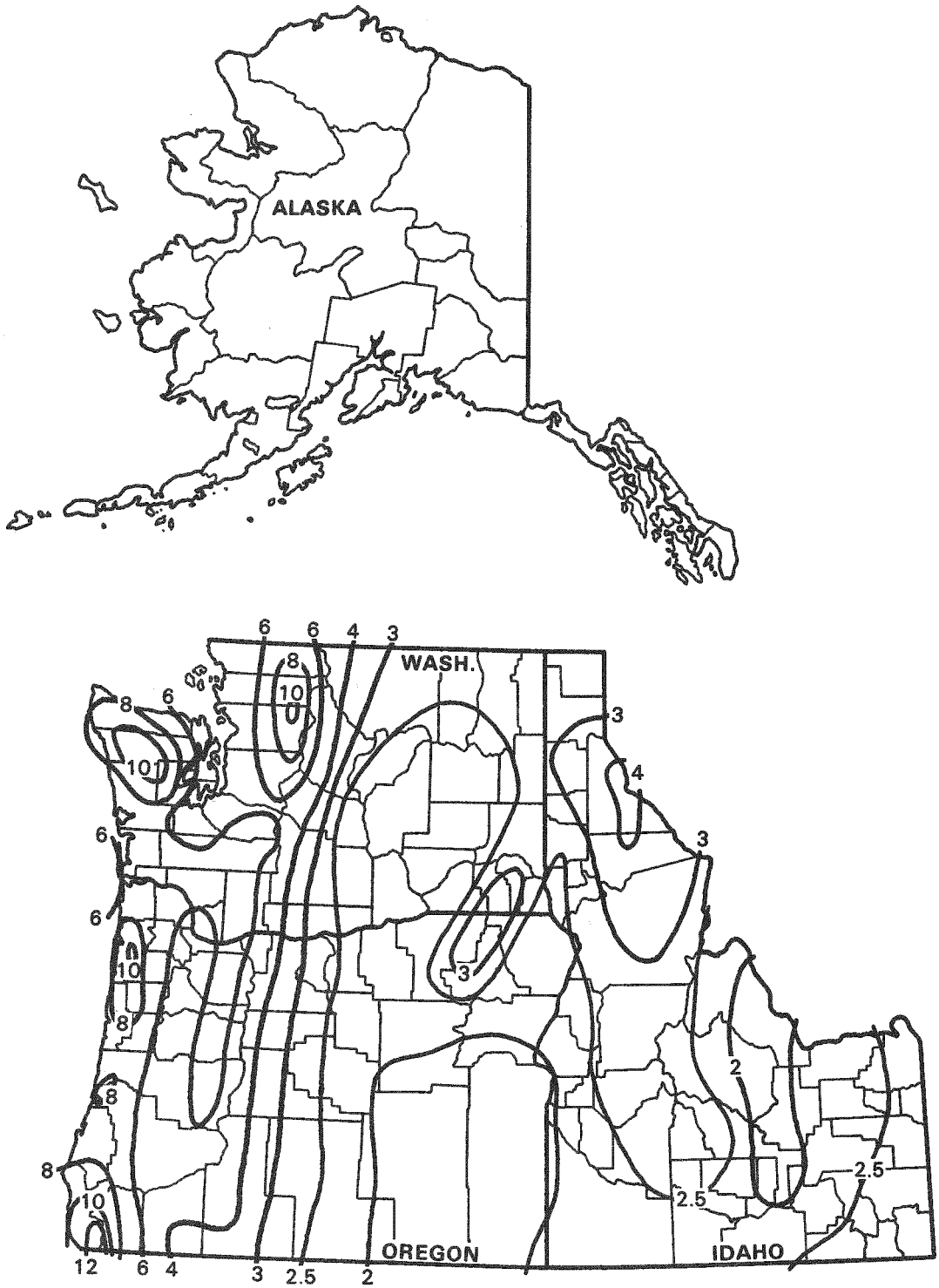


FIGURE II-C-72. Maximum Precipitation (inches)

Data Source: Ref. 29, Rainfall Frequency Atlas of the U.S.

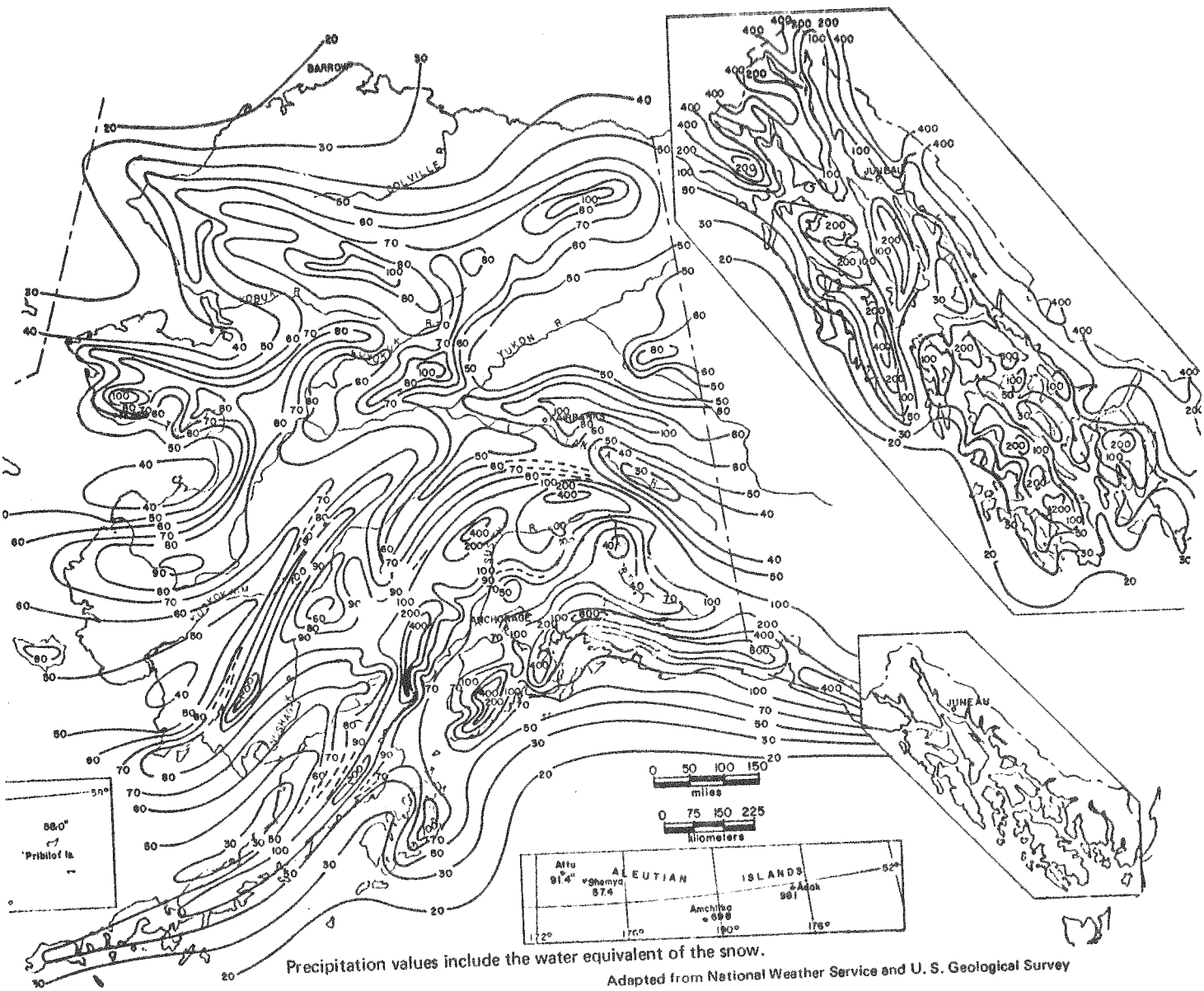
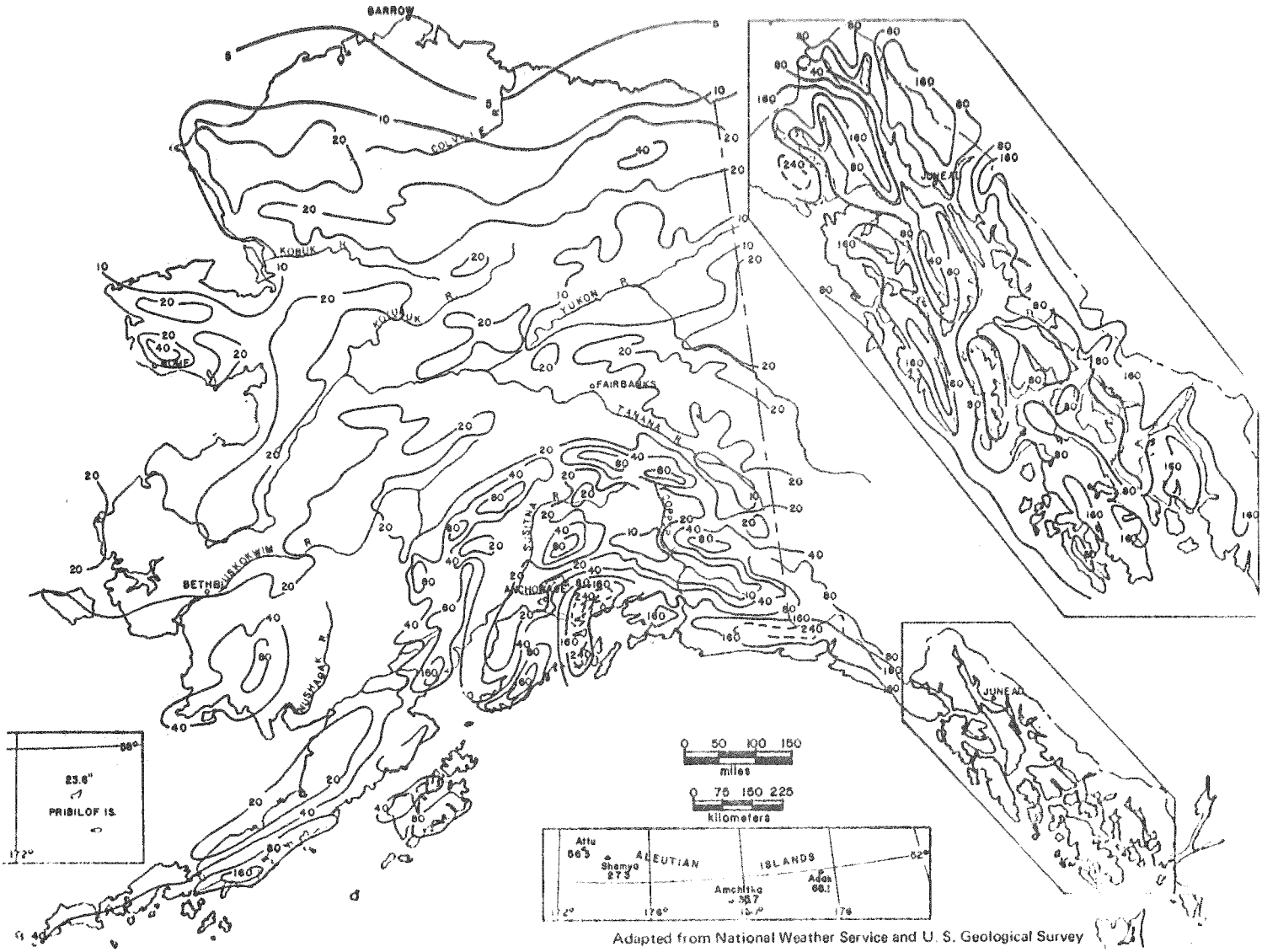


FIGURE II-C-73. Maximum Precipitation for Alaska (inches)

Data Source: Ref. 11, Alaska Regional Profiles.



Adapted from National Weather Service and U. S. Geological Survey

FIGURE II-C-74. Minimum Precipitation for Alaska (inches)

Data Source: Ref. 11, Alaska Regional Profiles.

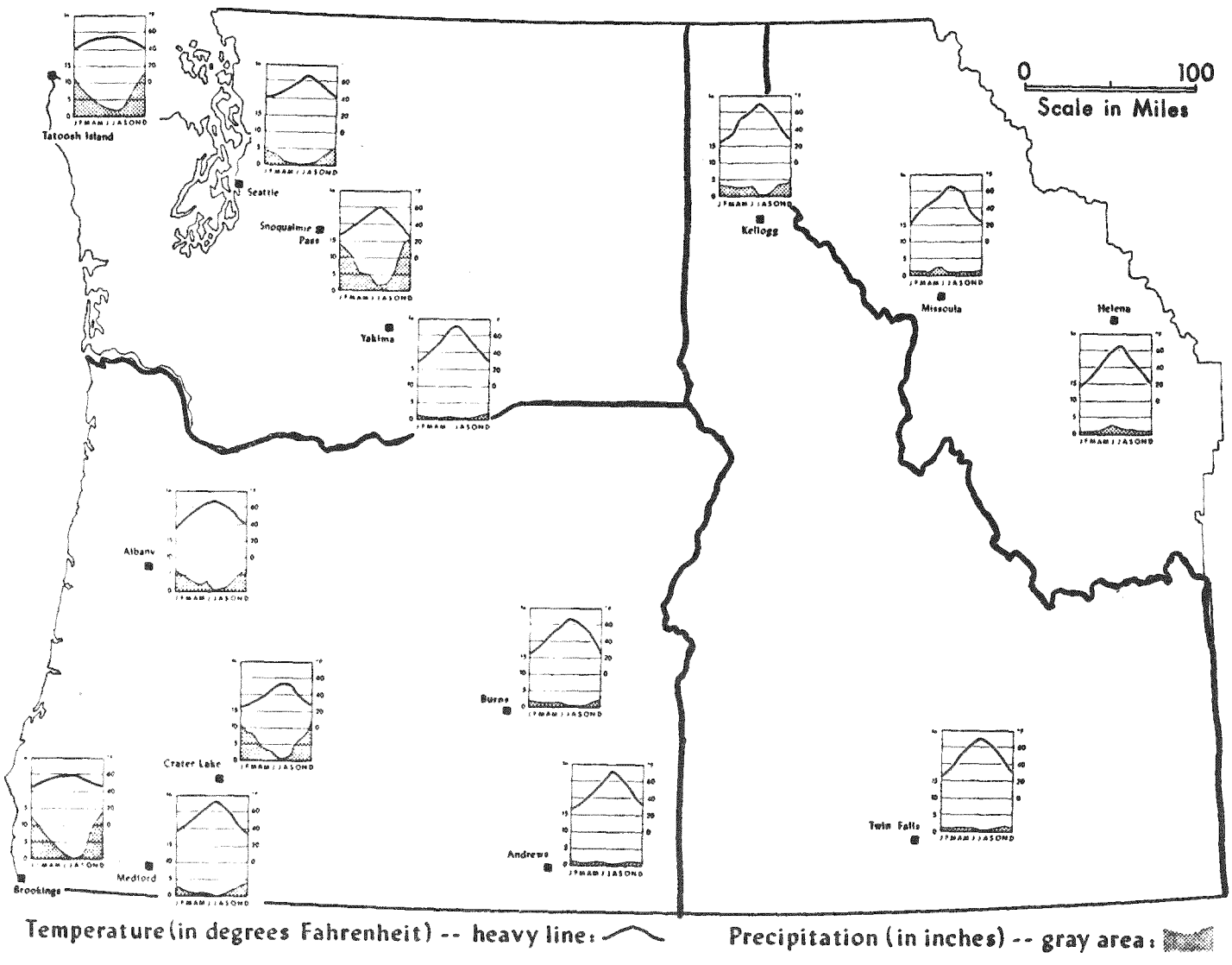


FIGURE II-C-75. Variations in Temperature and Precipitation

Data Source: Ref. 3, Atlas of the Pacific Northwest, p. 35.

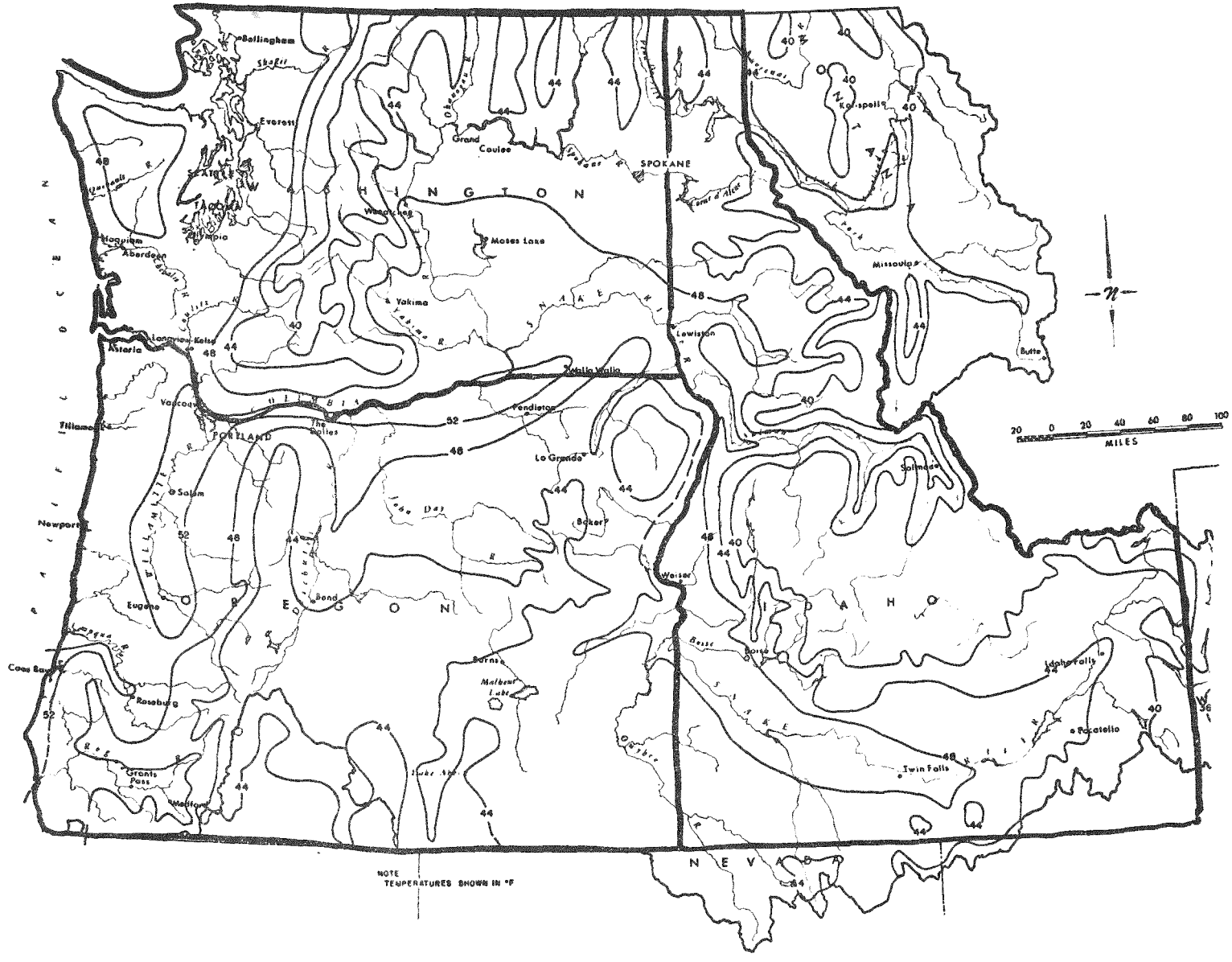


FIGURE II-C-76. Mean Annual Temperatures, 1931-1951

Data Source: Ref. 4, Columbia-North Pacific Comprehensive Framework Study, p. 58.

TABLE II-C-29

CLIMATE DATA FOR SELECTED STATIONS

Mean temperature in degrees Fahrenheit (light face type) and precipitation in inches (**bold face type**); these data are for the period 1931-1960. Other columns are for variable periods such as total of record (for temperature extremes); 1931-1965, and shorter periods where unavoidable. Designations such as WBAP (Weather Bureau Airport), and 2N (2 miles North) in the location column indicate which data set for a given city are listed. Data source is E.S.S.A. Weather Bureau.

Place and elevation in feet	Jan.	Feb.	Mar.	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Average annual snow	Days with 0.1" or more	Temperature extremes		Median dates for occurrence of 32° F.		
																Low	High	Last in Spring	First in Fall	Period
														Inches		Degrees F.	Degrees F.			Days
Albany, Oregon	39.4	42.9	46.7	52.2	57.5	62.1	67.1	66.5	62.3	53.9	45.3	41.8	53.1	6.7	92	−15	104	April 3	Nov. 6	217
212	**6.3**	**5.1**	**4.6**	**2.3**	**2.1**	**1.5**	**0.4**	**0.5**	**1.4**	**4.0**	**5.9**	**6.8**	**40.7**							
Astoria, Oregon WBAP	40.7	42.8	44.5	49.0	53.3	57.3	60.6	61.0	58.0	52.9	46.3	43.1	50.8	5.4	145	10	101	Mar. 12	Nov. 20	253
8	**11.7**	**9.9**	**8.9**	**5.2**	**3.2**	**3.0**	**1.3**	**1.5**	**3.1**	**7.8**	**11.2**	**13.6**	**80.4**							
Bellingham, Wash. 2N 6	36.8	39.5	43.0	48.0	53.2	57.8	61.0	60.6	56.7	50.1	43.1	39.6	49.1	9.6	91	− 4	97	May 11	Oct. 2	144
112	**4.1**	**3.2**	**3.1**	**2.3**	**1.8**	**1.9**	**1.0**	**1.1**	**2.0**	**3.6**	**4.5**	**4.9**	**33.6**							
Bend, Oregon	30.2	33.9	38.3	44.6	50.7	56.4	63.7	62.2	56.3	47.8	38.5	33.3	46.3	33.8	35	−26	104	June 24	July 28	34
3,599	**1.8**	**1.1**	**0.8**	**0.7**	**1.1**	**1.2**	**0.5**	**0.5**	**0.4**	**0.9**	**1.4**	**1.7**	**12.0**							
Boise, Idaho* WBAP	29.1	34.5	41.7	50.4	58.2	65.8	75.2	72.1	65.7	51.6	38.6	32.2	51.0	21.6	36	−17	111	May 4	Oct. 17	166
2,841	**1.3**	**1.3**	**1.3**	**1.2**	**1.3**	**0.9**	**0.2**	**0.2**	**0.4**	**0.8**	**1.2**	**1.3**	**11.4**							
Brookings, Oregon	47.1	48.0	48.9	51.1	54.6	57.7	58.9	58.9	59.5	56.0	51.7	48.8	53.4	.6	103	17	100	Feb. 22	Dec. 20	301
80	**13.2**	**11.1**	**10.2**	**5.4**	**4.3**	**2.5**	**0.6**	**0.6**	**1.8**	**7.3**	**10.8**	**13.8**	**81.4**							
Burns, Oregon WB city	24.8	29.7	37.4	46.0	53.4	59.8	69.5	67.2	58.8	48.4	36.1	29.1	46.7	46.5	36	−25	103	June 10	Sept. 18	100
4,151	**1.6**	**1.3**	**1.0**	**0.8**	**0.9**	**0.9**	**0.3**	**0.3**	**0.5**	**0.9**	**1.2**	**1.4**	**11.0**							
Centralia, Wash.	39.2	42.1	45.4	51.0	56.5	60.5	65.1	64.4	60.6	53.0	44.8	41.6	52.0	8.9	100	−16	105	April 26	Oct. 28	185
185	**6.4**	**5.5**	**4.7**	**2.7**	**1.9**	**1.9**	**0.7**	**1.0**	**1.9**	**4.5**	**6.7**	**7.8**	**45.5**							
Crater Lake, Oregon	24.9	26.2	28.5	34.4	40.5	47.0	56.5	55.7	50.3	41.8	33.5	28.0	38.9	540.9	110	−20	100	June 28	July 6	9
6,475	**11.6**	**8.8**	**8.2**	**4.5**	**3.5**	**2.7**	**0.7**	**0.6**	**2.0**	**6.2**	**8.2**	**11.8**	**68.6**							
Danner, Oregon	25.7	30.7	37.7	46.0	53.5	60.1	69.1	66.5	57.9	48.0	36.2	29.8	46.8	27.3	39	−46	109	June 12	Aug. 31	80
4,397	**1.2**	**1.1**	**1.0**	**1.0**	**1.4**	**1.1**	**0.3**	**0.2**	**0.6**	**0.9**	**1.1**	**1.3**	**11.0**							
Ephrata, Wash.	27.5	33.3	43.4	53.2	62.1	68.5	76.5	74.5	66.5	53.8	38.8	31.6	52.5	17.5	27	−23	113	April 10	Oct. 17	190
1,275	**1.1**	**0.7**	**0.7**	**0.6**	**0.7**	**0.9**	**0.2**	**0.3**	**0.5**	**0.8**	**1.0**	**1.1**	**8.4**							
Helena, Mont.* WBAP	18.6	23.2	31.4	43.3	52.9	59.5	68.4	66.2	56.0	45.6	31.6	24.2	43.4	47.9	30	−42	103	May 9	Sept. 21	135
3,750	**0.5**	**0.4**	**0.7**	**0.8**	**1.6**	**2.2**	**1.0**	**0.9**	**1.0**	**0.7**	**0.6**	**0.5**	**10.9**							
Kalispell, Mont.* WBAP	19.8	24.5	31.8	43.7	52.2	58.6	65.7	63.1	54.7	43.9	31.0	25.0	42.8	62.0	48	−28	100	May 6	Sept. 24	141
2,965	**1.4**	**1.0**	**1.0**	**1.0**	**1.7**	**2.2**	**1.0**	**1.1**	**1.0**	**1.2**	**1.4**	**1.3**	**15.4**							
Kellogg, Idaho	27.2	31.5	38.1	47.0	55.1	60.8	68.2	66.1	58.6	48.4	36.3	31.2	47.4	58.7	89	−27	109	May 12	Sept. 23	134
2,305	**3.6**	**2.9**	**3.0**	**2.4**	**2.4**	**2.4**	**0.8**	**0.8**	**1.7**	**3.2**	**3.7**	**4.0**	**31.0**							
Klamath Falls, Ore. 2SSW	29.4	33.8	39.5	46.9	53.7	60.1	68.7	66.9	60.4	50.0	38.5	32.2	48.3	45.3	43	−24	105	May 19	Sept. 25	129
4,098	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**	**1.0**	**0.3**	**0.3**	**0.6**	**1.2**	**1.6**	**2.2**	**14.1**							
Lewiston, Idaho* WBAP	30.7	35.9	42.6	50.8	58.4	64.8	73.8	71.7	63.5	52.0	39.8	34.9	51.6	18.3	37	−22	109	April 19	Oct. 17	181
1,413	**1.1**	**1.0**	**1.2**	**1.1**	**1.6**	**1.7**	**0.4**	**0.4**	**0.9**	**1.2**	**1.2**	**1.4**	**13.2**							
Medford, Oregon WBAP	35.4	40.1	44.3	50.6	57.5	64.2	72.0	70.7	64.2	53.0	42.4	36.9	52.6	7.9	50	1	115	May 18	Oct. 23	158
1,312	**3.1**	**2.4**	**1.8**	**1.1**	**1.5**	**1.0**	**0.2**	**0.2**	**0.6**	**1.9**	**2.6**	**3.4**	**19.8**							
Missoula, Mont.* 2WNW	22.4	27.5	36.0	46.4	54.6	60.5	68.3	66.3	57.4	46.2	33.4	26.8	45.5	38.0	41	−42	104	May 15	Sept. 22	130
3,172	**0.9**	**0.9**	**0.7**	**1.0**	**1.9**	**2.0**	**0.9**	**0.7**	**1.0**	**1.0**	**0.9**	**1.1**	**12.8**							
Moscow, Idaho	28.2	32.5	38.9	47.1	54.4	60.0	67.3	65.6	59.2	49.5	37.8	32.4	47.7	46.9	68	−30	105	May 8	Sept. 24	139
2,660	**2.8**	**2.1**	**2.1**	**1.7**	**1.6**	**1.7**	**0.5**	**0.5**	**1.2**	**2.0**	**2.6**	**3.2**	**22.2**							
Oroville, Wash.	26.2	30.8	41.1	51.5	59.4	65.3	72.3	70.4	62.2	50.4	37.2	30.6	49.8	25.0	38	−19	111	April 24	Oct. 13	172
1,060	**1.2**	**0.9**	**0.8**	**0.8**	**1.0**	**1.5**	**0.6**	**0.7**	**0.6**	**1.0**	**1.4**	**1.3**	**11.8**							
Pendleton, Ore. WBAP	32.2	37.4	45.1	52.0	59.6	65.8	73.6	71.9	64.2	53.7	41.3	36.5	52.8	16.5	40	−22	110	May 1	Sept. 20	152
1,492	**1.4**	**1.2**	**1.2**	**1.1**	**1.1**	**1.2**	**0.2**	**0.3**	**0.6**	**1.2**	**1.4**	**1.5**	**12.4**							
Pocatello, Idaho*	22.3	27.2	35.8	46.5	55.1	62.8	72.4	70.1	60.3	49.1	35.0	27.4	47.0	36.6	32	−31	103	May 10	Sept. 23	136
4,444	**1.2**	**0.9**	**1.0**	**1.1**	**1.1**	**1.0**	**0.5**	**0.6**	**0.6**	**0.9**	**1.0**	**1.0**	**10.9**							
Portland, Ore. WB city	40.2	43.8	47.7	53.5	59.1	63.4	68.6	68.1	64.5	56.5	47.2	43.1	54.6	8.5	97	− 2	107	Mar. 27	Dec. 3	251
30	**6.3**	**4.9**	**4.8**	**2.5**	**2.1**	**1.7**	**0.4**	**0.7**	**1.7**	**3.9**	**6.0**	**7.4**	**42.4**							
Roseburg, Ore. WBAP	40.3	43.3	46.6	51.5	56.5	61.5	67.9	67.6	62.8	54.4	46.1	42.0	53.4	5.8	74	− 6	109	April 2	Nov. 11	223
505	**5.5**	**4.2**	**3.4**	**1.9**	**1.9**	**1.5**	**0.2**	**0.3**	**1.0**	**3.0**	**4.5**	**5.7**	**33.1**							
Salmon, Idaho	17.9	24.7	35.1	45.7	53.9	60.2	67.8	65.6	56.6	45.8	31.8	22.5	44.0	19.7	31	−37	106	June 2	Sept. 11	101
3,949	**0.6**	**0.5**	**0.5**	**0.6**	**1.4**	**1.4**	**0.8**	**0.6**	**0.7**	**0.7**	**0.6**	**0.6**	**8.9**							
Seattle, Wash. city	41.2	43.6	46.4	51.8	57.4	61.4	65.6	65.0	61.2	54.4	46.9	43.8	53.2	7.9	93	3	100	Mar. 1	Nov. 24	268
14	**5.2**	**3.9**	**3.3**	**2.0**	**1.6**	**1.4**	**0.6**	**0.7**	**1.7**	**3.3**	**5.0**	**5.4**	**34.1**							
Sequim, Wash. city	37.9	40.1	42.8	47.8	53.1	57.2	60.4	60.8	57.4	50.6	43.6	40.2	49.3	4.5	51	− 3	99	April 21	Oct. 28	190
180	**2.2**	**1.7**	**1.3**	**0.9**	**1.0**	**1.2**	**0.5**	**0.6**	**1.0**	**1.6**	**2.3**	**2.7**	**16.8**							
Snoqualmie Pass, Wash.	26.3	28.9	34.4	40.6	46.2	51.2	57.8	57.2	52.7	44.1	33.6	28.9	41.8	435.7	131	−17	101	May 25	Sept. 22	120
3,020	**14.8**	**12.7**	**11.7**	**6.4**	**4.7**	**4.9**	**1.7**	**2.0**	**4.8**	**10.5**	**15.4**	**18.1**	**17.8**							
Spokane, Wash. AP	25.3	30.0	38.1	47.3	56.2	61.9	70.5	68.0	60.9	49.1	35.7	30.1	47.8	44.7	57	−24	102	April 28	Oct. 9	164
2,357	**2.4**	**1.9**	**1.5**	**0.9**	**1.2**	**1.5**	**0.4**	**0.4**	**0.8**	**1.6**	**2.2**	**2.4**	**17.2**							
Tatoosh Island, Wash	42.0	43.1	44.2	47.5	51.1	53.9	55.5	56.0	54.8	51.9	47.2	44.4	49.3	8.5	135	7	88	Feb. 1	....	....
101	**10.8**	**8.7**	**8.3**	**5.2**	**3.0**	**2.8**	**2.3**	**2.0**	**3.6**	**8.2**	**10.5**	**12.2**	**77.7**							
The Dalles, Oregon	33.9	39.0	46.4	54.2	61.5	67.4	73.7	72.3	66.0	55.2	42.9	38.0	54.2	22.9	41	−30	115	April 3	Oct. 30	210
102	**2.6**	**1.8**	**1.4**	**0.5**	**0.6**	**0.7**	**0.1**	**0.2**	**0.5**	**1.2**	**2.0**	**2.4**	**13.8**							
Twin Falls, Idaho 2NNE	27.3	32.7	39.9	49.2	57.4	64.4	72.9	69.9	61.3	51.0	38.1	31.6	49.6	17.2	28	−30	106	May 13	Sept. 22	132
3,770	**1.0**	**0.7**	**0.8**	**0.9**	**1.0**	**0.8**	**0.2**	**0.2**	**0.5**	**0.8**	**0.9**	**0.9**	**8.7**							
Yakima, Wash. AP	27.5	34.0	42.0	50.5	58.5	64.4	71.0	68.6	61.3	50.5	37.4	31.5	49.8	25.4	28	−25	105	April 17	Oct. 18	184
1,061	**1.2**	**0.9**	**0.6**	**0.5**	**0.5**	**0.8**	**0.1**	**0.2**	**0.4**	**0.6**	**1.0**	**1.1**	**7.9**							

* Computed 30-year normal, 1931-60.

Data Source: Ref. 3, Atlas of the Pacific Northwest.

TABLE II-C-30

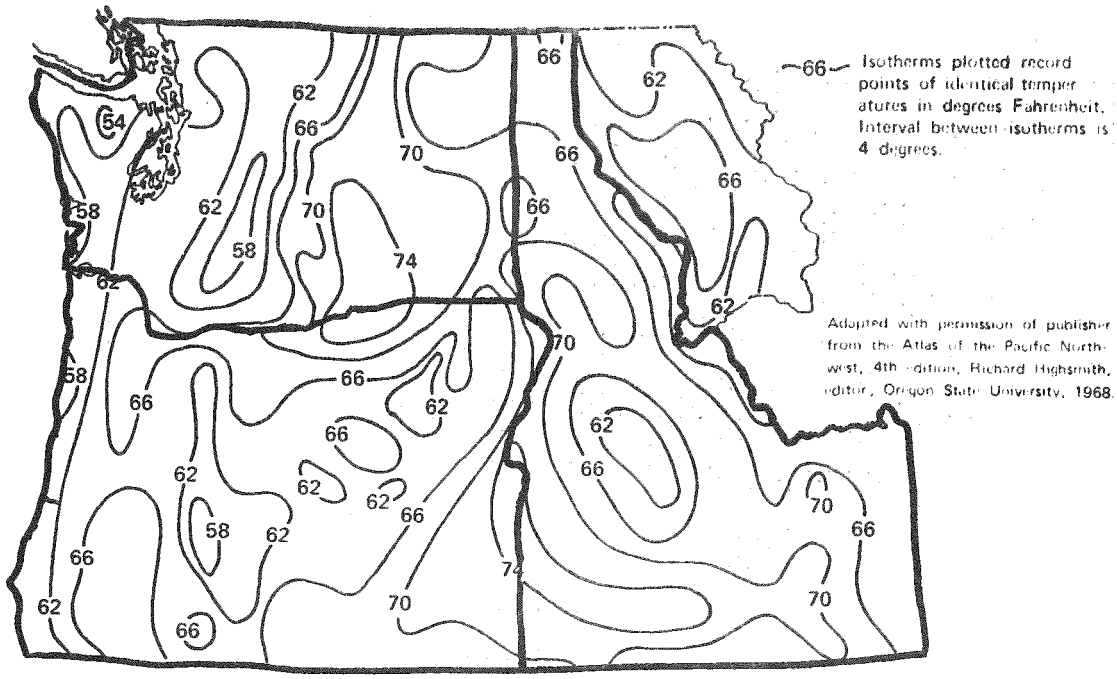
TEMPERATURES

Normal Temperature	1	2	3	4	5	6	7	Annual Average 8	9	10
A1	42.7	39.7	38.4	28.0	34.2	32.7	27.0	24.1	14.7	
ID	45.9	45.8	51.9	42.2	50.8	45.9	48.3	41.9	44.0	42.3
OR	51.9	51.7	51.9	47.8	42.5	50.8	46.5	45.7	49.8	
WA	49.7	49.8	50.9	49.8	43.4	44.8	47.7	51.3	45.2	49.3

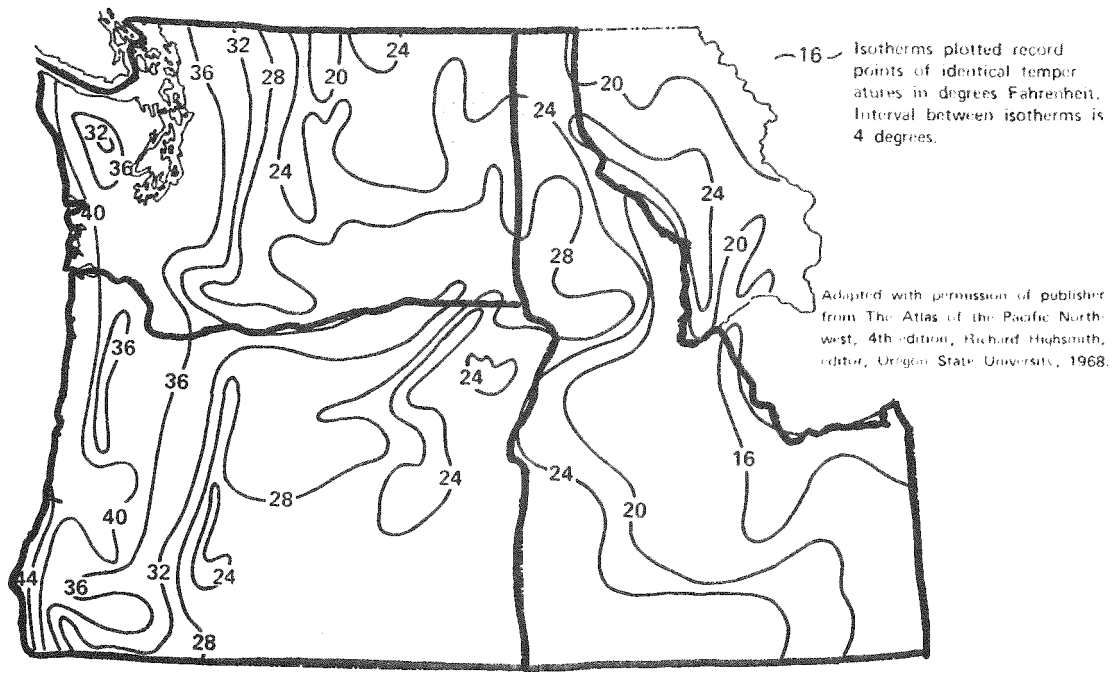
Maximum Temperature								Annual Average		
A1	42.7	39.7	38.4	28.0	34.2	32.7	27.0	24.1	14.7	
ID	45.9	45.8	51.9	42.2	50.8	45.9	48.3	41.9	44.9	42.3
OR	51.9	51.7	51.9	47.8	42.5	50.8	46.5	45.7	49.8	
WA	49.7	49.8	50.9	49.8	43.4	44.8	47.7	51.3	45.2	49.3

Minimum Temperature								Annual Minimum		
A1	42.7	39.7	38.4	28.0	34.2	32.7	27.0	24.1	14.7	
ID	45.9	45.8	51.9	42.2	50.8	45.9	48.3	41.9	44.0	42.3
OR	51.9	51.7	51.9	47.8	42.5	50.8	46.5	45.7	49.8	
WA	49.7	49.8	50.9	49.8	43.4	44.8	47.7	51.3	45.2	49.3

Data Source: Ref. 25, NOAA.



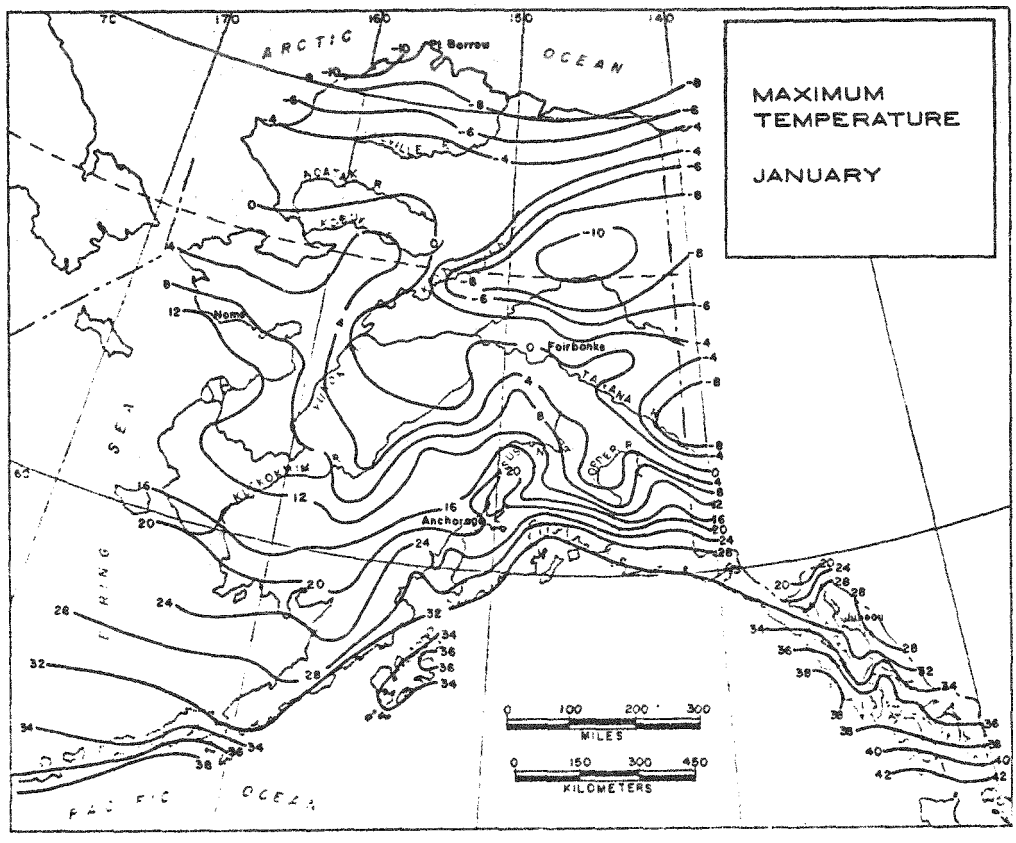
AVERAGE JULY TEMPERATURES



AVERAGE JANUARY TEMPERATURES

FIGURE II-C-77. Average July and January Temperatures

Data Source: Ref. 20, BPA Role EIS, p. III-14.



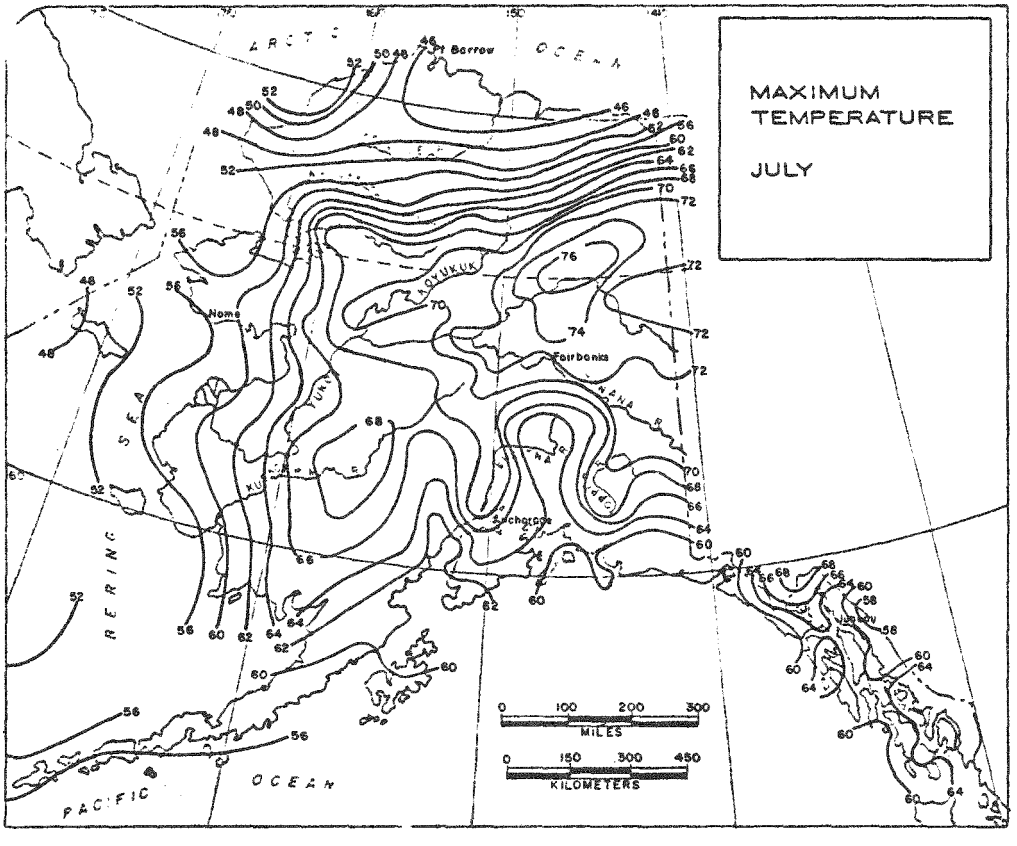
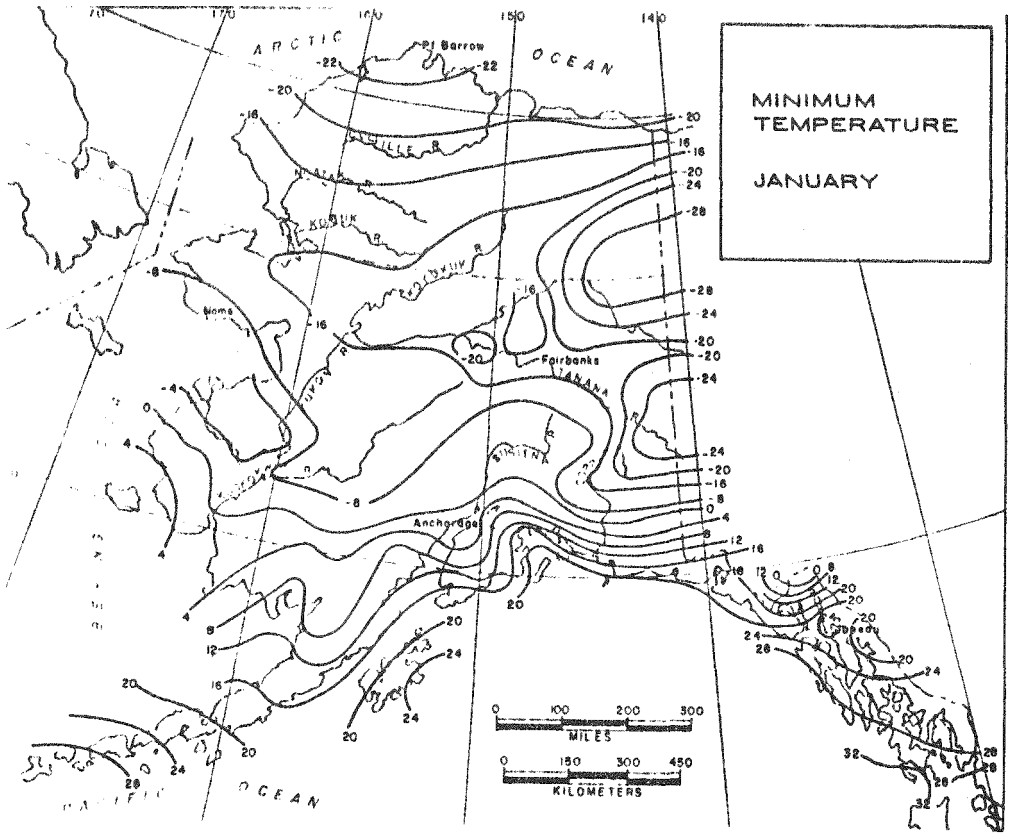


FIGURE II-C-78. Maximum January and July Temperatures for Alaska

Data Source: Ref. 11, Alaska Regional Profiles.



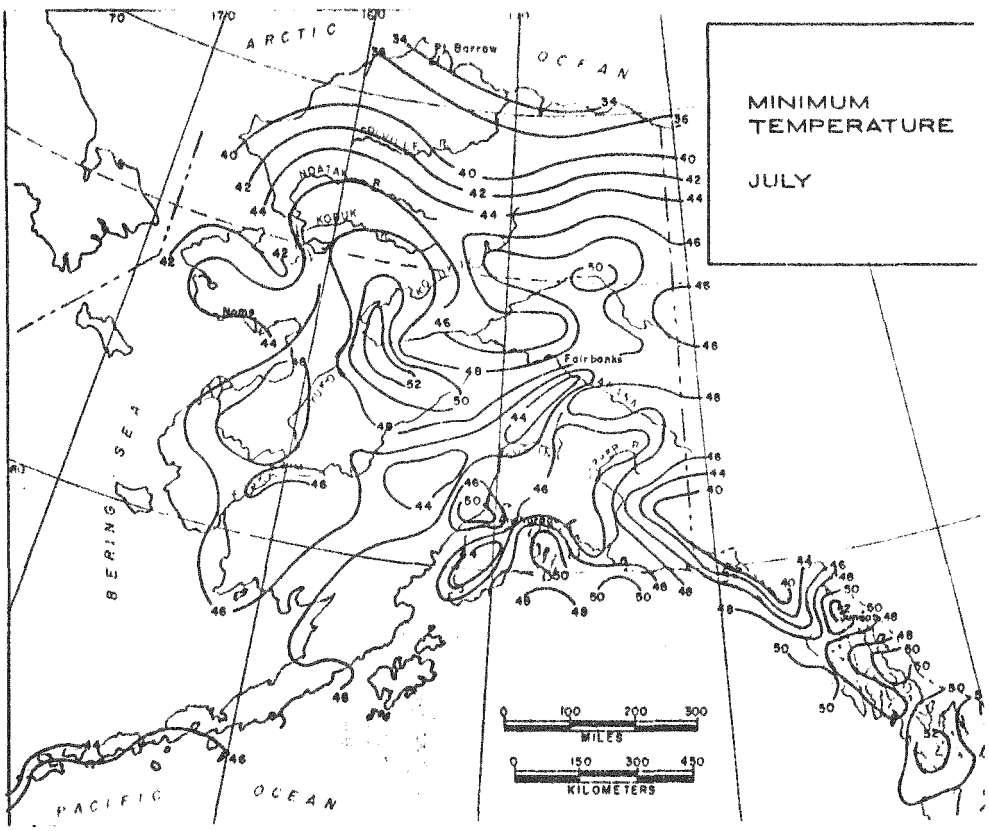
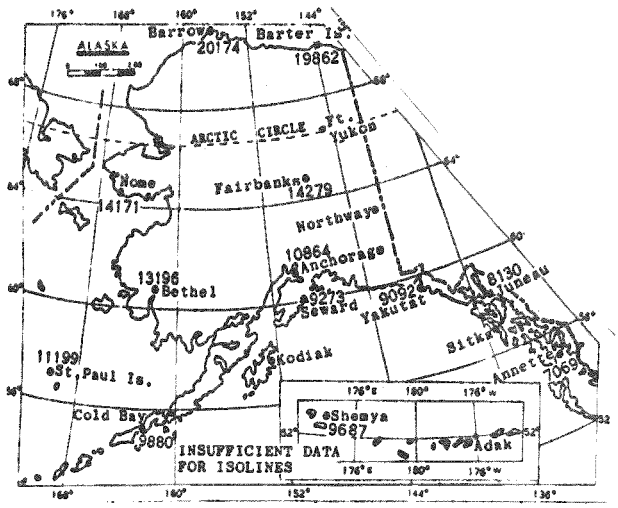
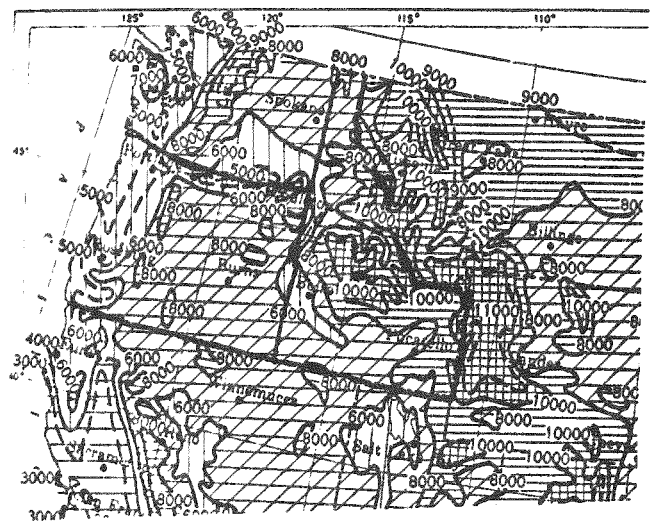


FIGURE II-C-79. Minimum January and July Temperatures for Alaska

Data Source: Ref. 11, Alaska Regional Profiles.





NOTE.--CAUTION SHOULD BE USED IN INTERPOLATING ON THESE GENERALIZED MAPS, PARTICULARLY IN MOUNTAINOUS AREAS.

ALBERS EQUAL AREA PROJECTION STANDARD PARALLELS 29½° AND 45½°

BASED ON 30-YEAR PERIOD, 1931-60.

SCALE OF SHADES

0 — 2000
2000 — 4000
4000 — 6000
6000 — 8000
8000 — 10000
Over 10000

FIGURE II-C-80. Normal Total Heating Degree Days

Data Source: Ref. 27, Climatic Atlas.

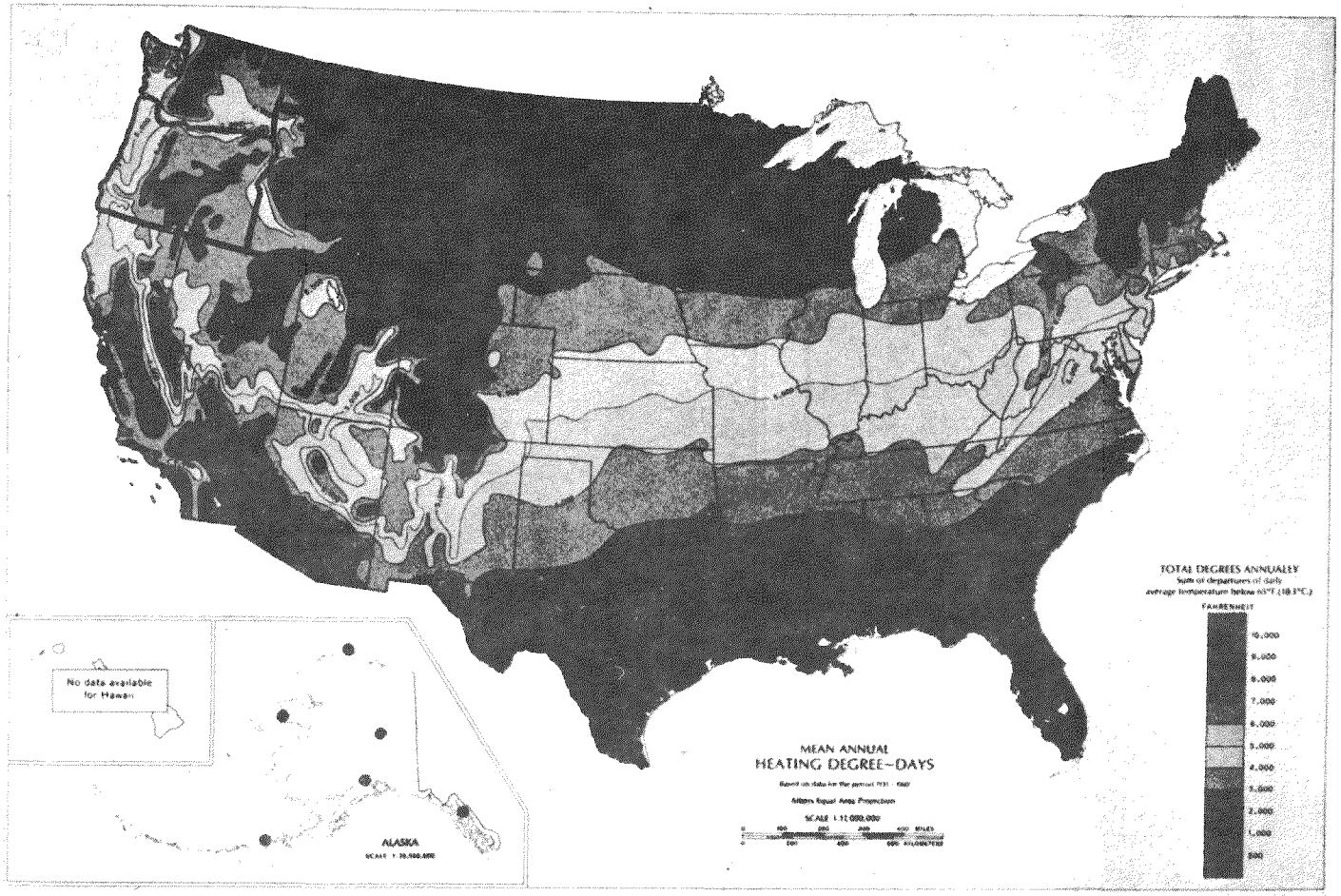


FIGURE II-C-81. Mean Annual Heating Degree Days

Data Source: Ref. 13, National Atlas.

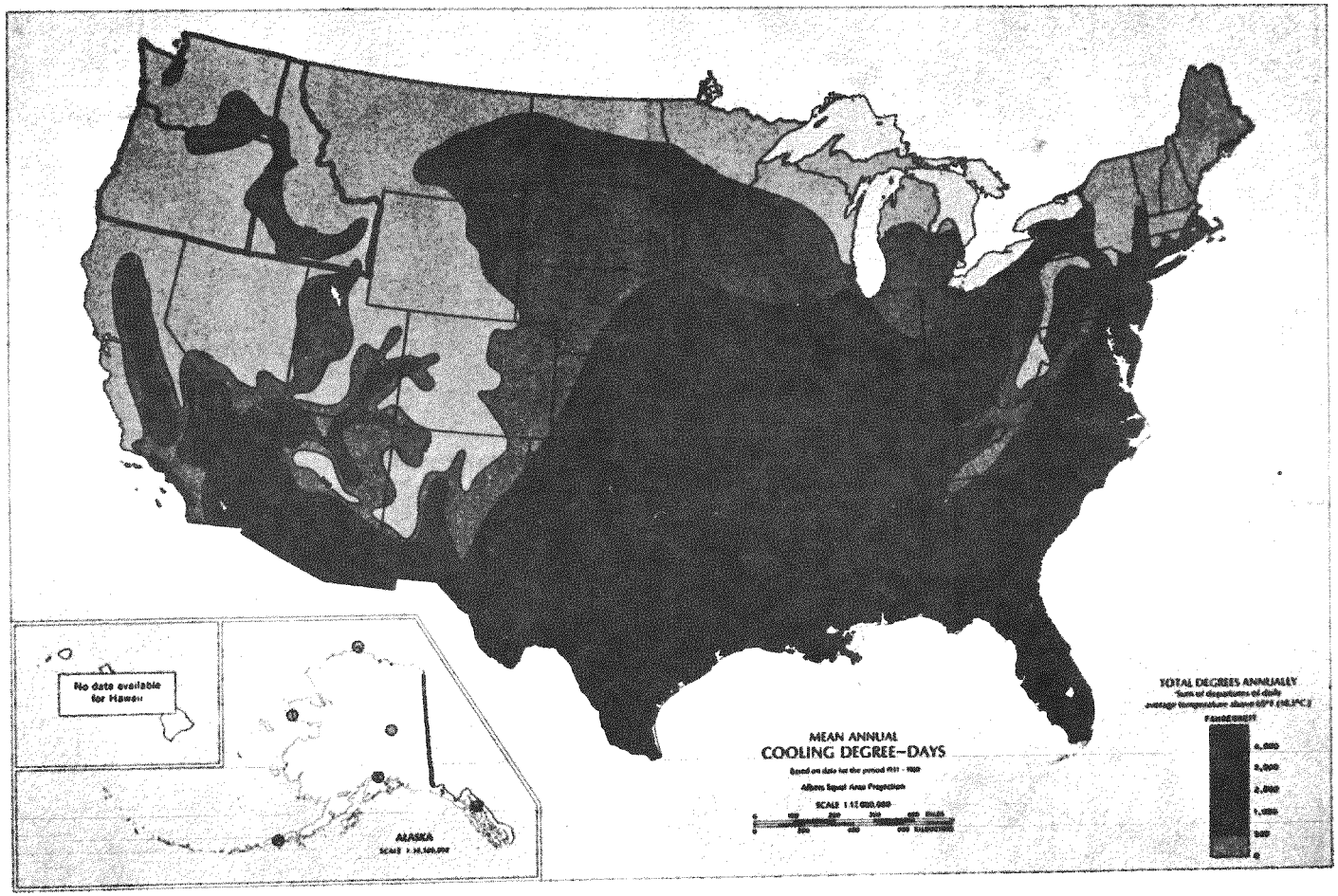


FIGURE II-C-82. Mean Annual Cooling Degree Days

Data Source: Ref. 13, National Atlas.

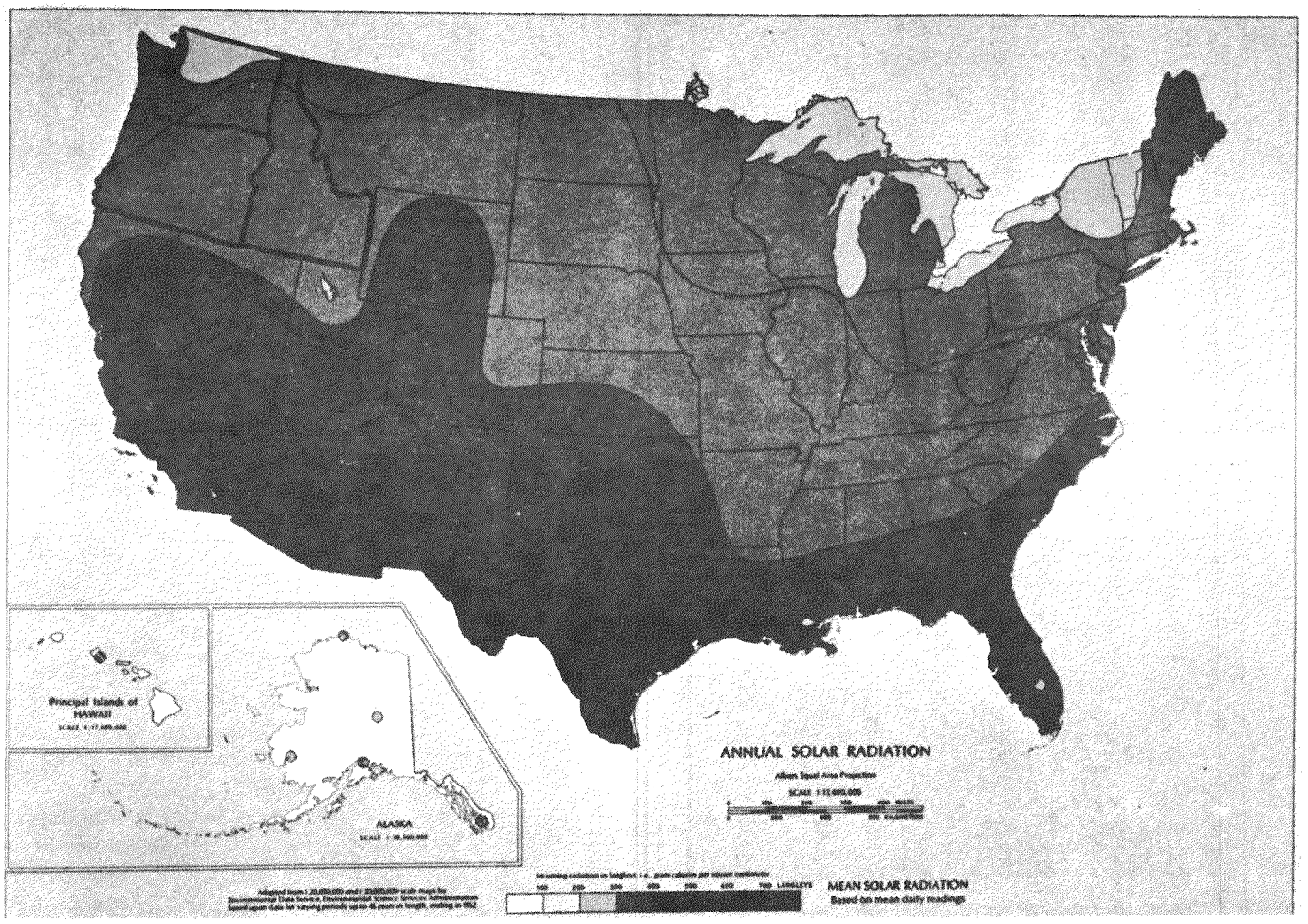


FIGURE II-C-83. Annual Solar Radiation

Data Source: Ref. 13, National Atlas.

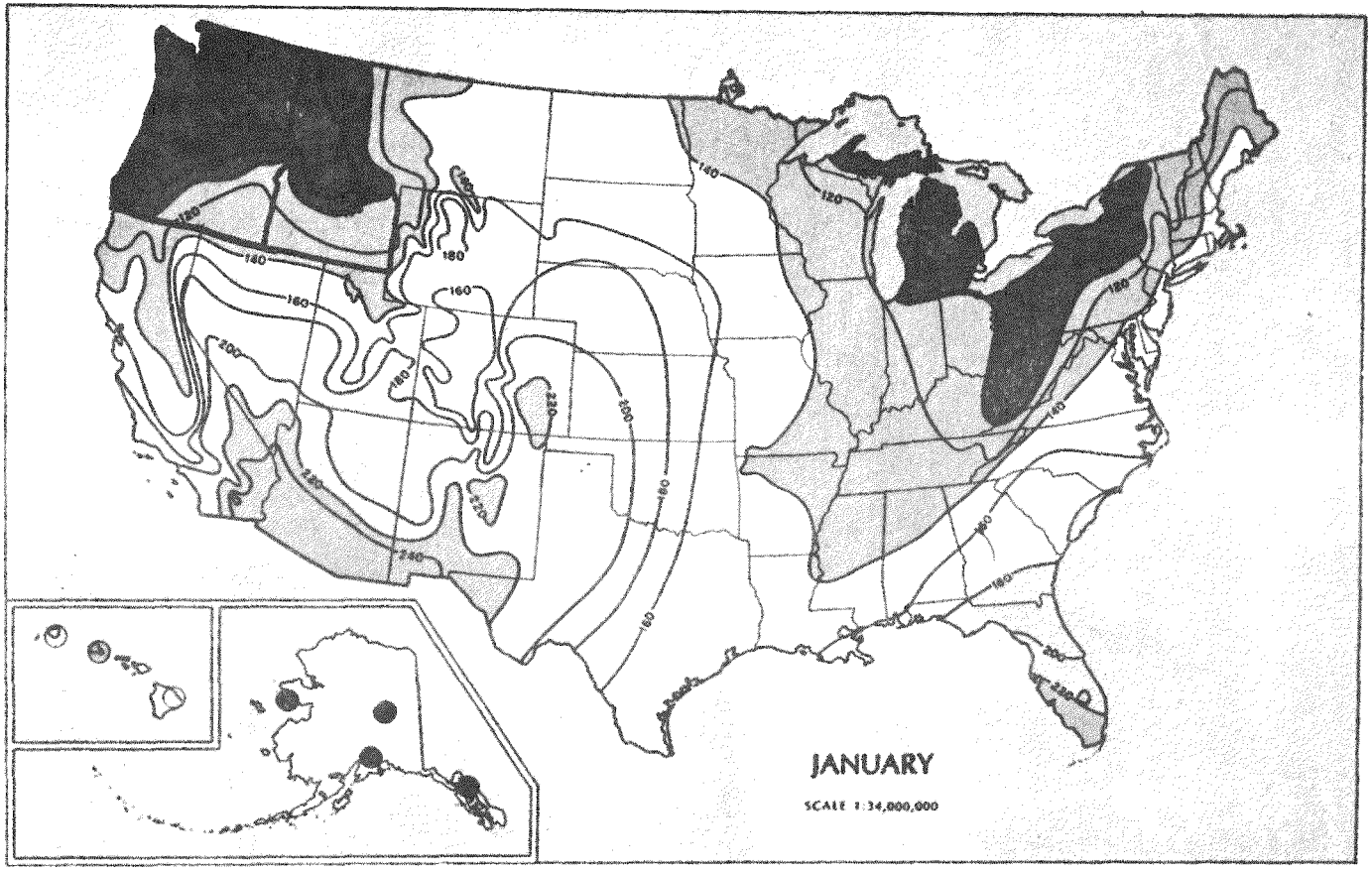


FIGURE II-C-84. Solar Radiation - January

Data Source: Ref. 13, National Atlas.

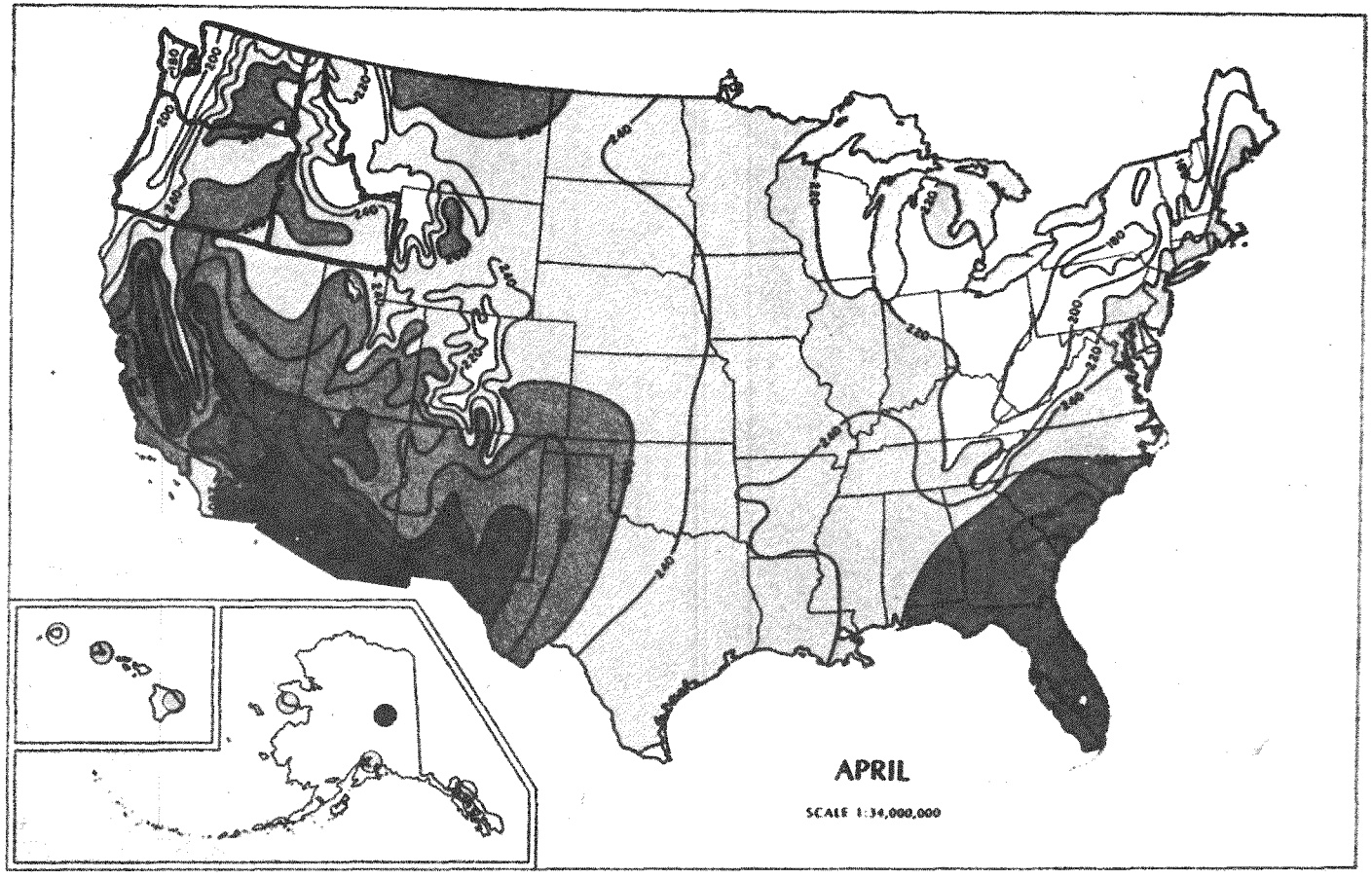


FIGURE II-C-85. Solar Radiation - April

Data Source: Ref. 13, National Atlas.

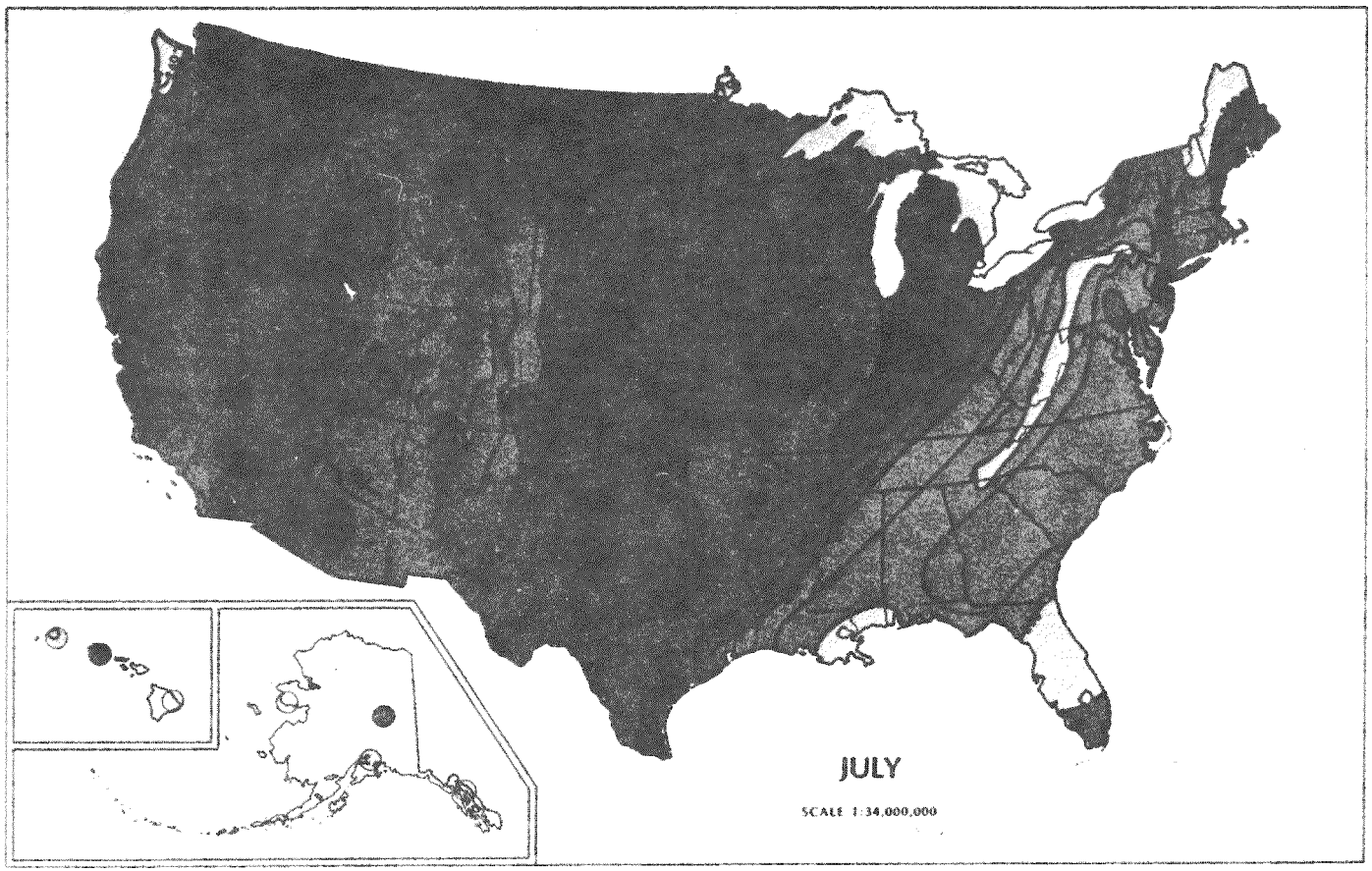


FIGURE II-C-86. Solar Radiation - July

Data Source: Ref. 13, National Atlas.

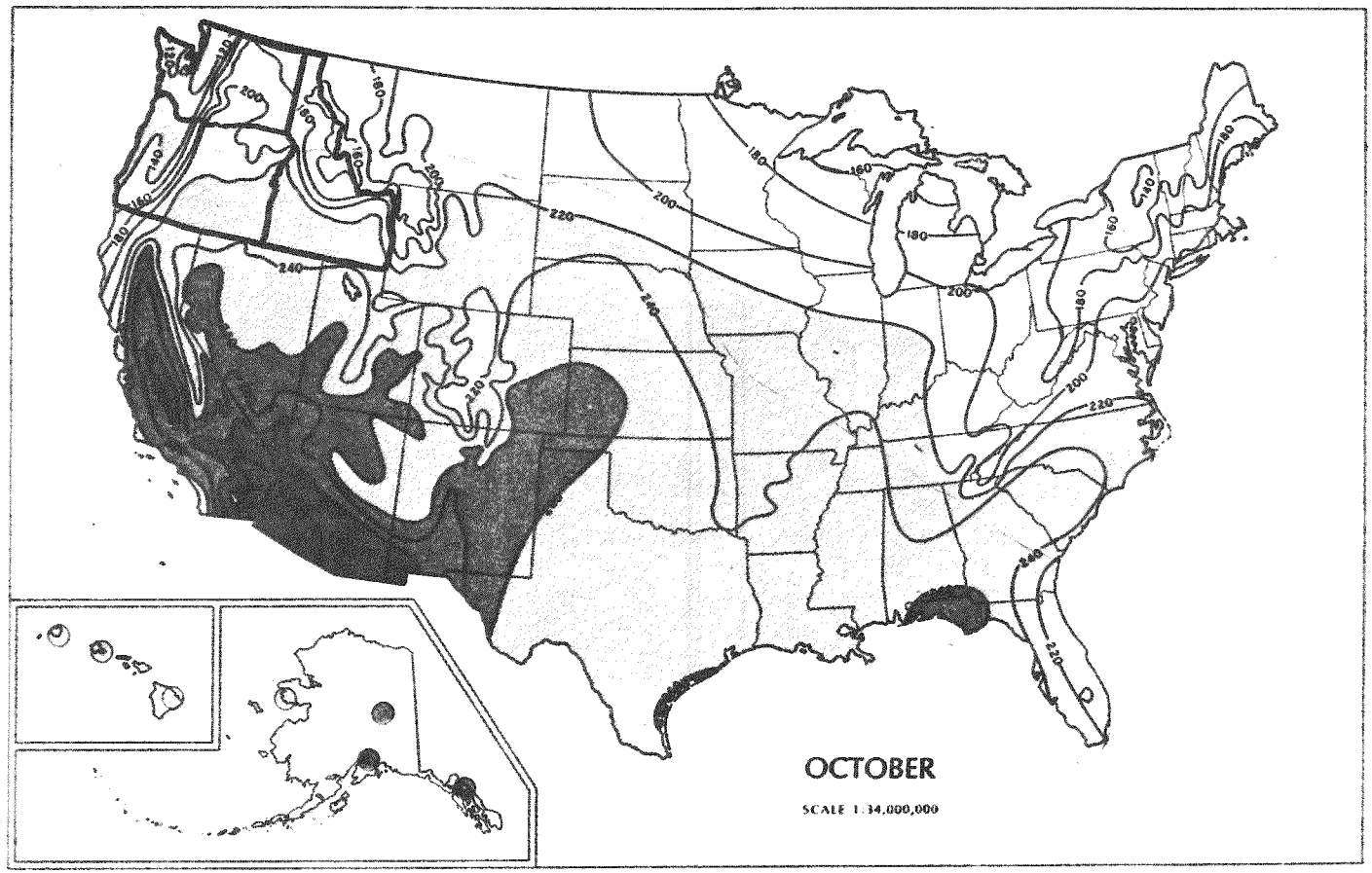


FIGURE II-C-87. Solar Radiation - October

Data Source: Ref. 13, National Atlas.

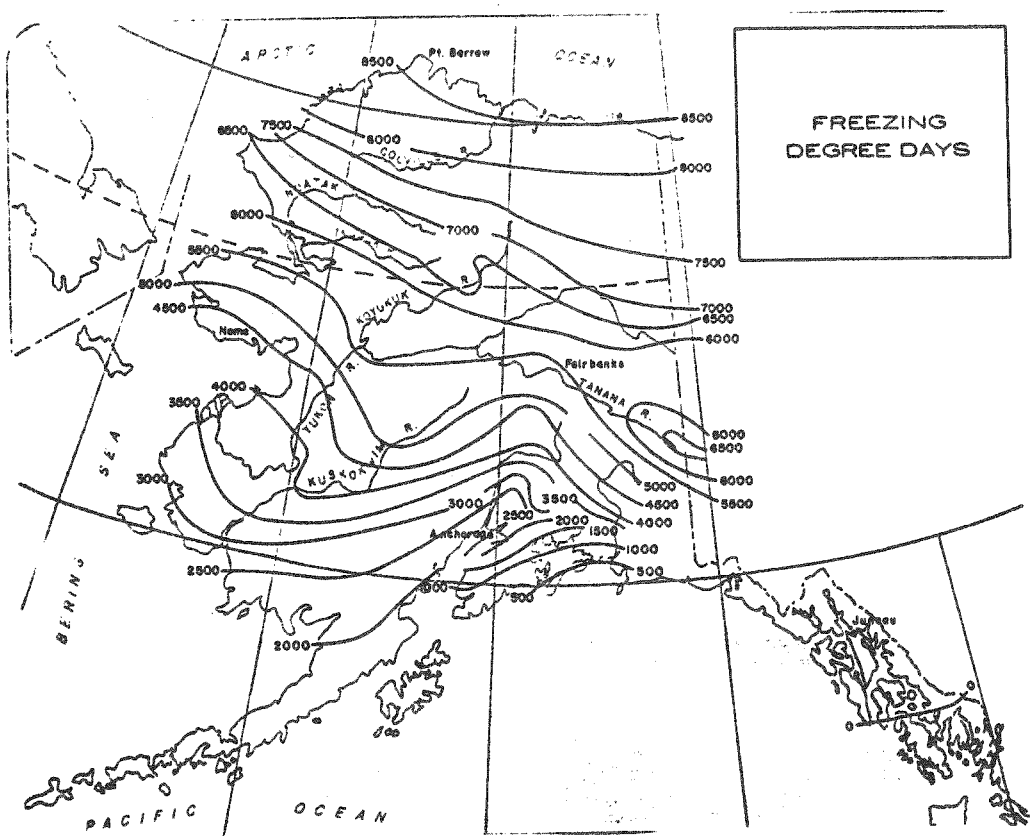


FIGURE II-C-88. Freezing Degree Days for Alaska

Data Source: Ref. 11, Alaska Regional Profiles.

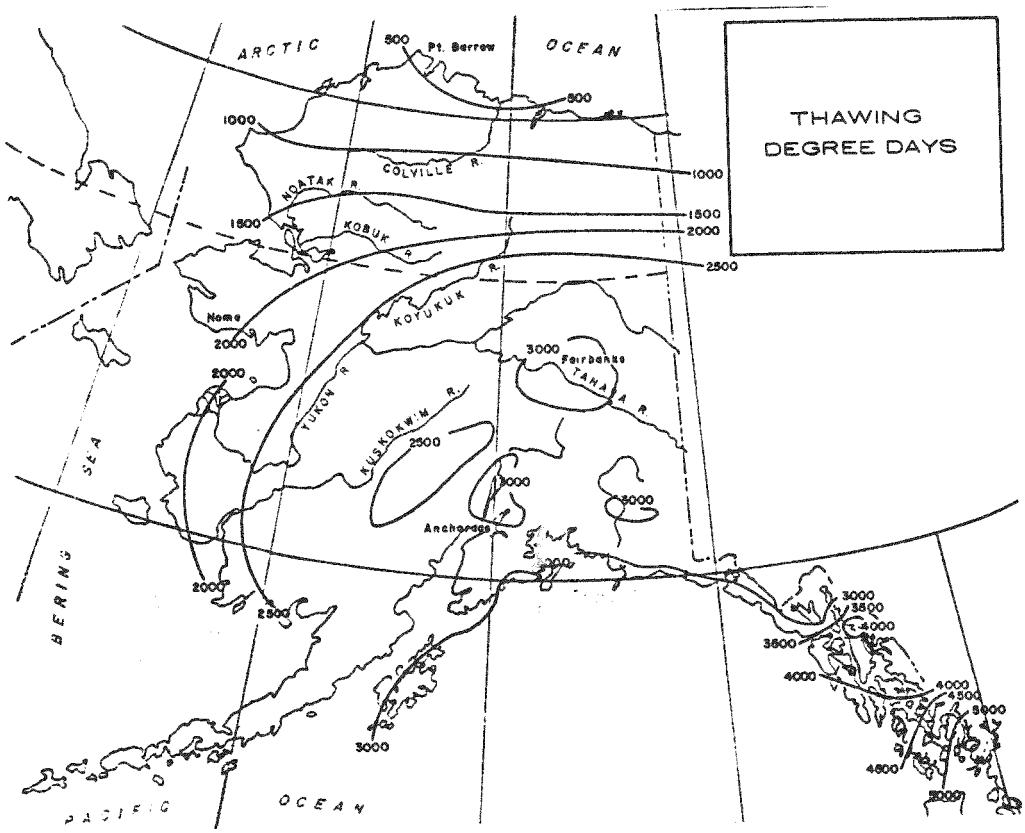


FIGURE II-C-89. Thawing Degree Days for Alaska

Data Source: Ref. 11, Alaska Regional Profiles.

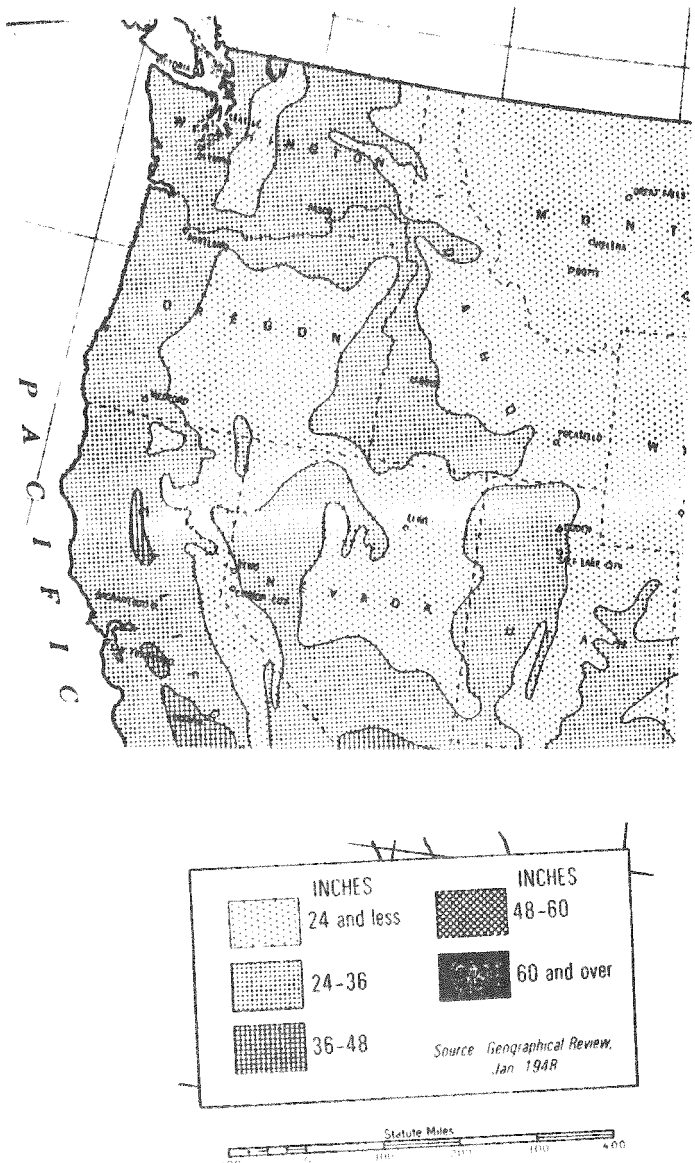


FIGURE II-C-90. Potential Evapotranspiration (Average Annual)

Data Source: Ref. 9, Water Atlas.

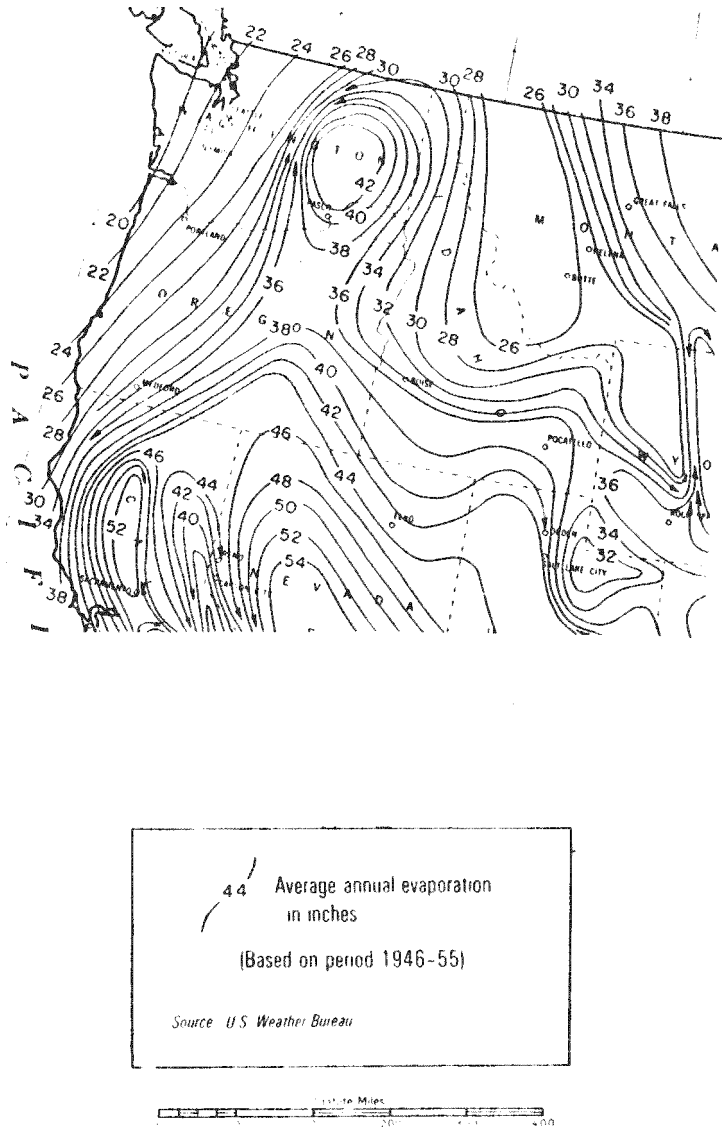


FIGURE II-C-91. Evaporation from Open-Water Surfaces (Average Annual)

Data Source: Ref. 9, Water Atlas.

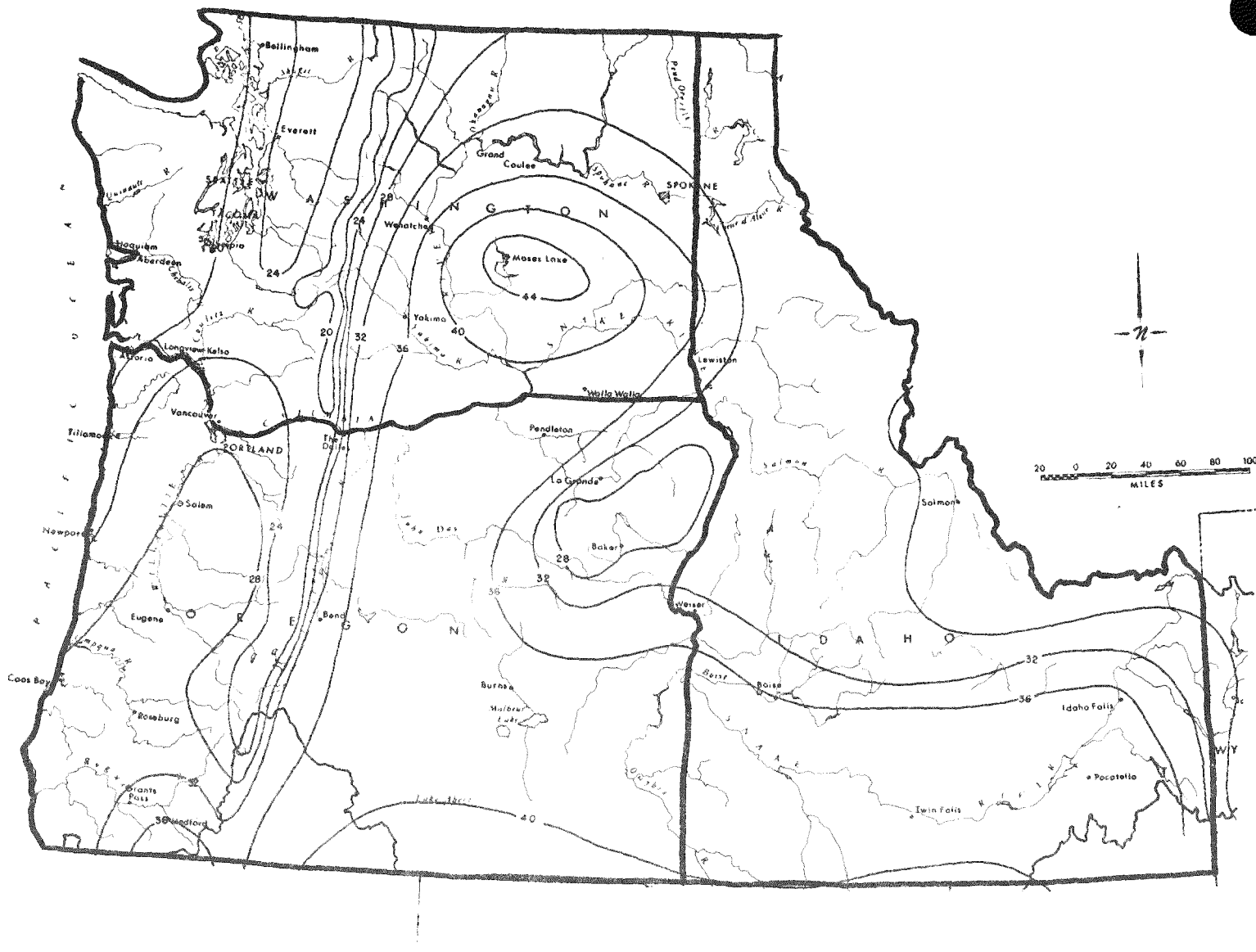


FIGURE II-C-92. Mean Annual Lake Evaporation in Inches, 1946-1955

Data Source: Ref. 4, Columbia-North Pacific Comprehensive Framework Study, The Region, p. 60.

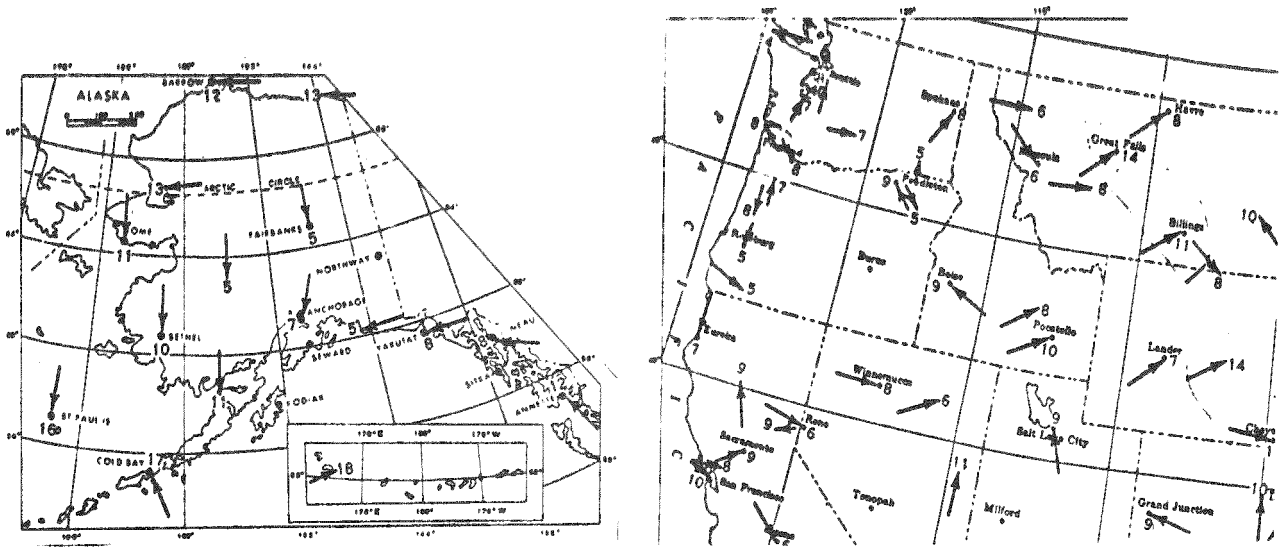


FIGURE II-C-93. Prevailing Direction and Mean Speed of Wind[a]

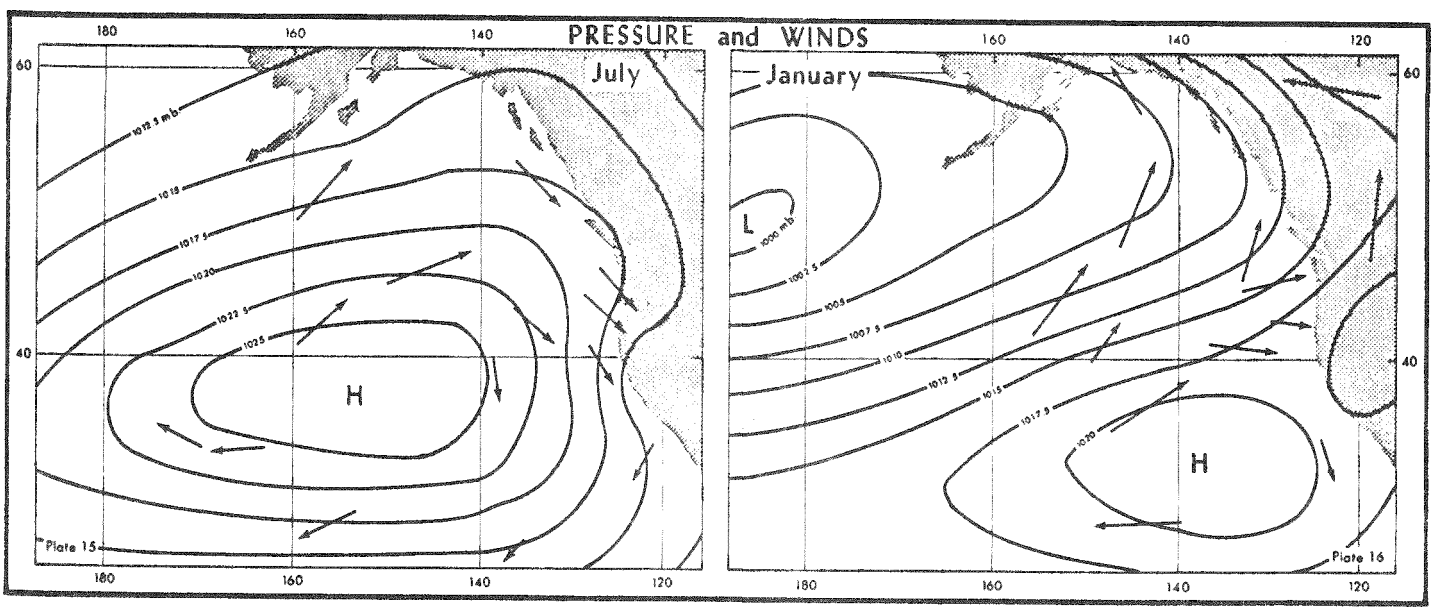


FIGURE II-C-94. Pressure and Winds Along the Coastlines[b]

(a) Data Source: Ref. 27, Climatic Atlas.
(b) Data Source: Ref. 3, Atlas of the Pacific Northwest, p. 33.

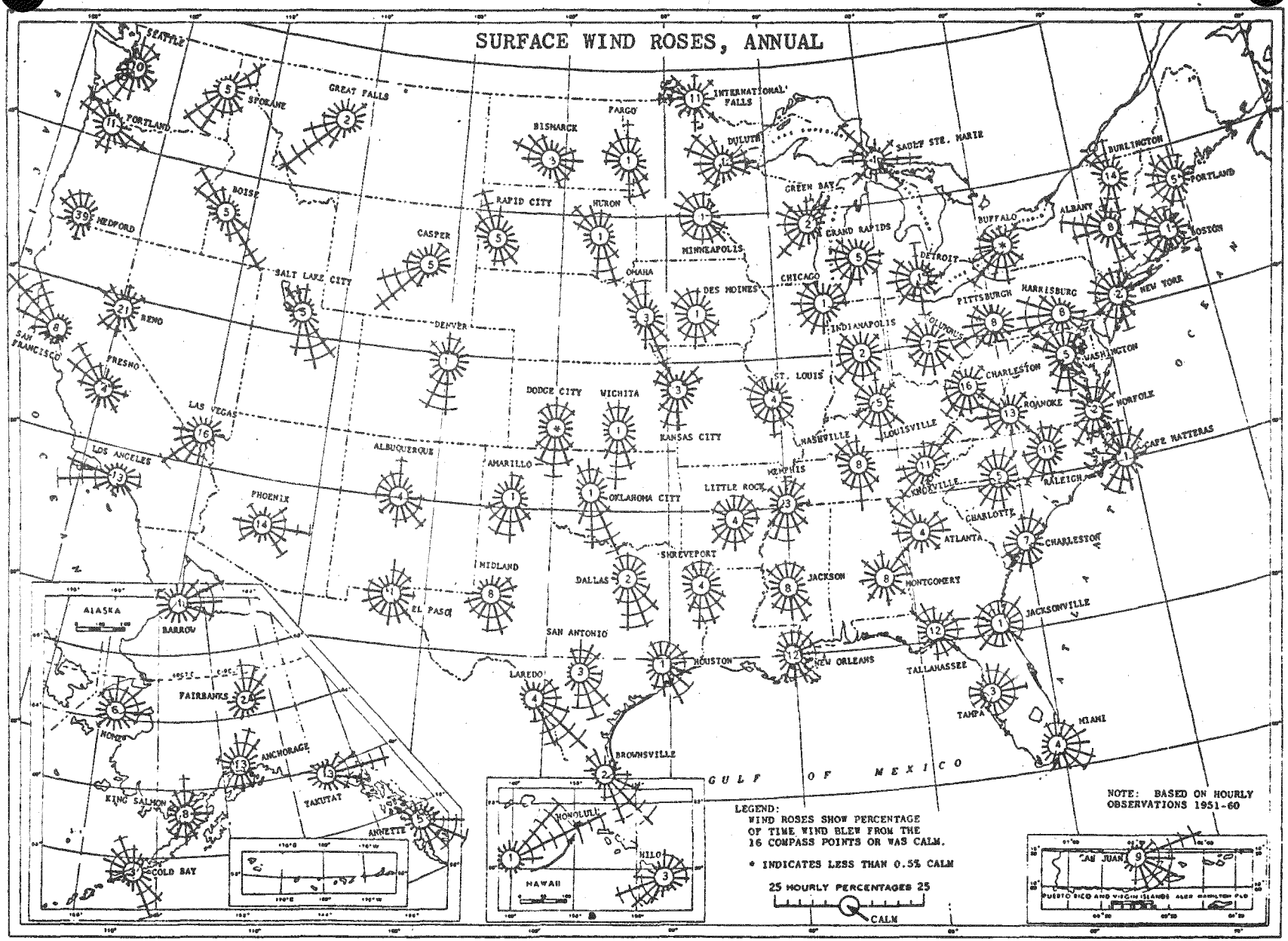


FIGURE II-C-95. Surface Wind Roses, Annual

Data Source: Ref. 27, Climatic Atlas, p. 249.

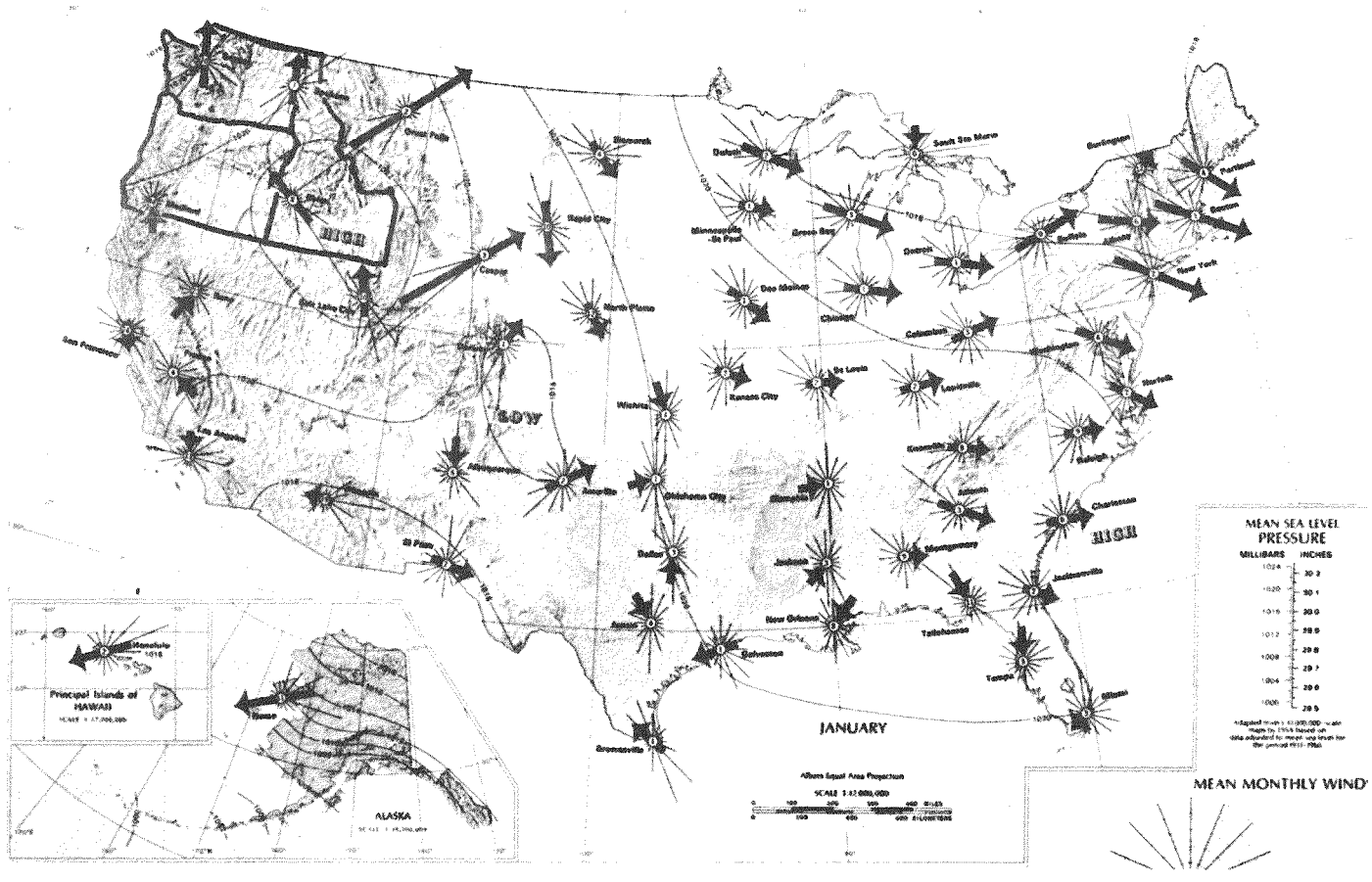


FIGURE II-C-96. Winds by Quarter - January

Data Source: Ref. 13, National Atlas.

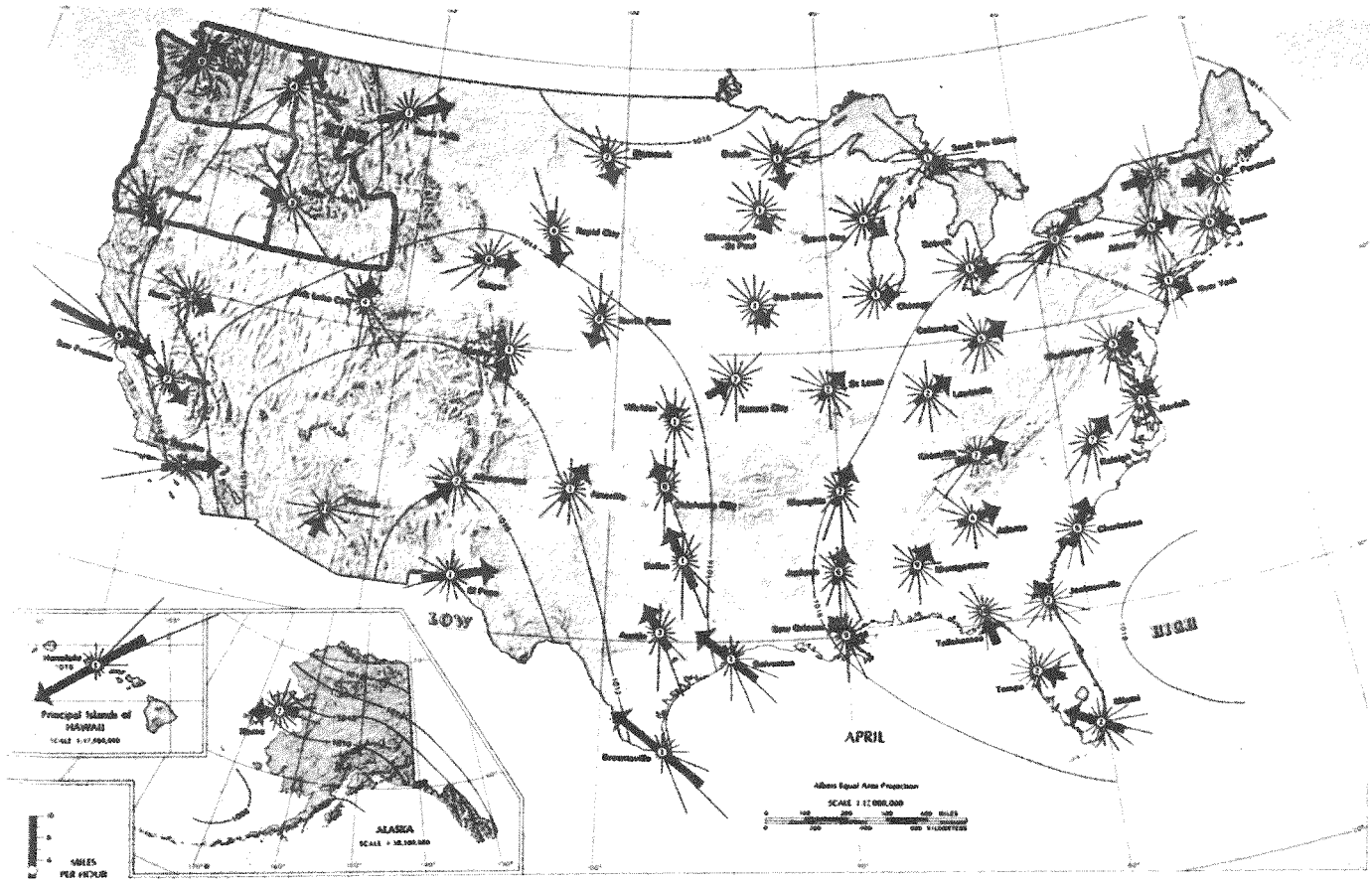


FIGURE II-C-97. Winds by Quarter - April

Data Source: Ref. 13, National Atlas.

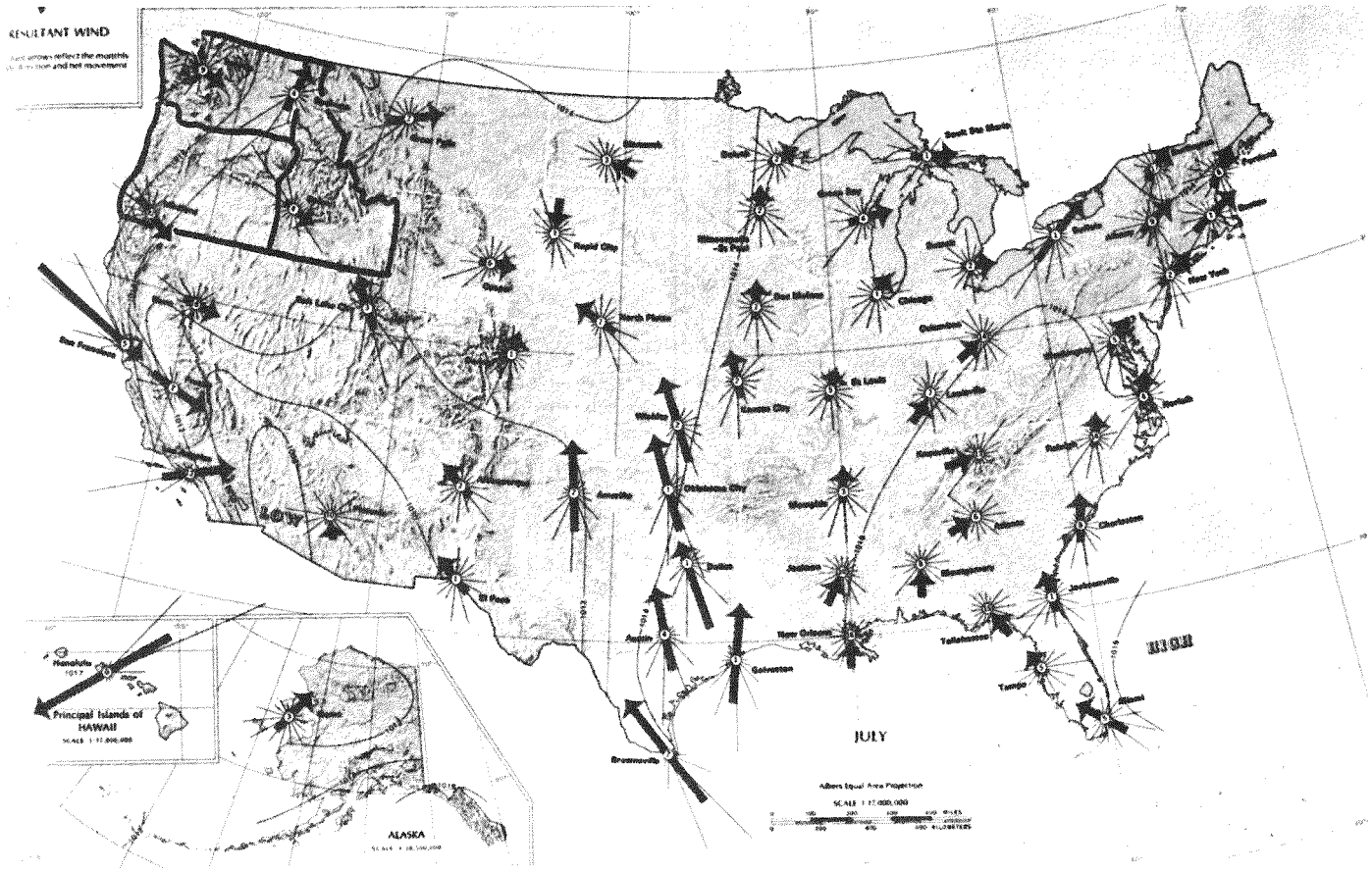


FIGURE II-C-98. Winds by Quarter - July

Data Source: Ref. 13, National Atlas.

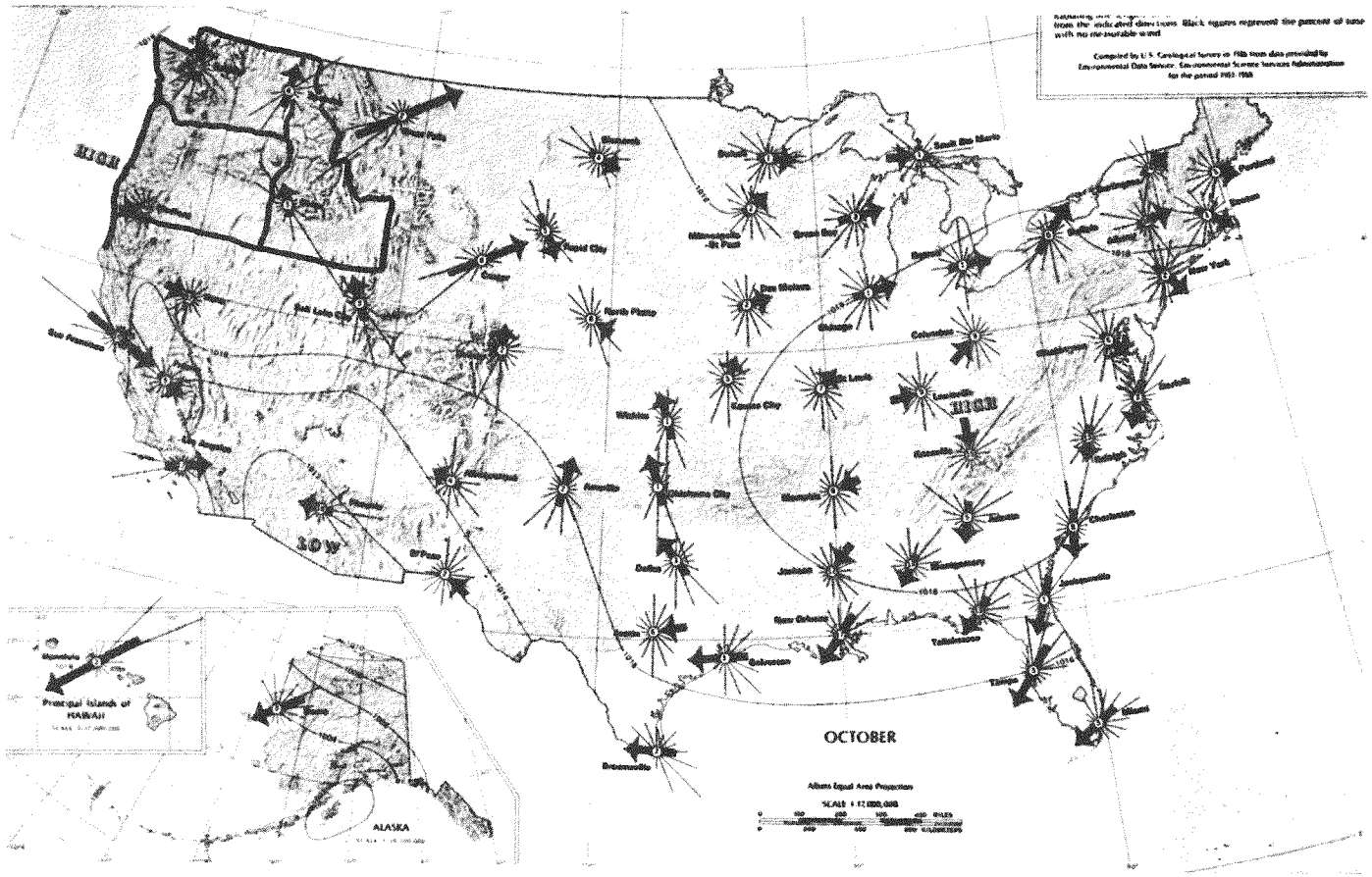
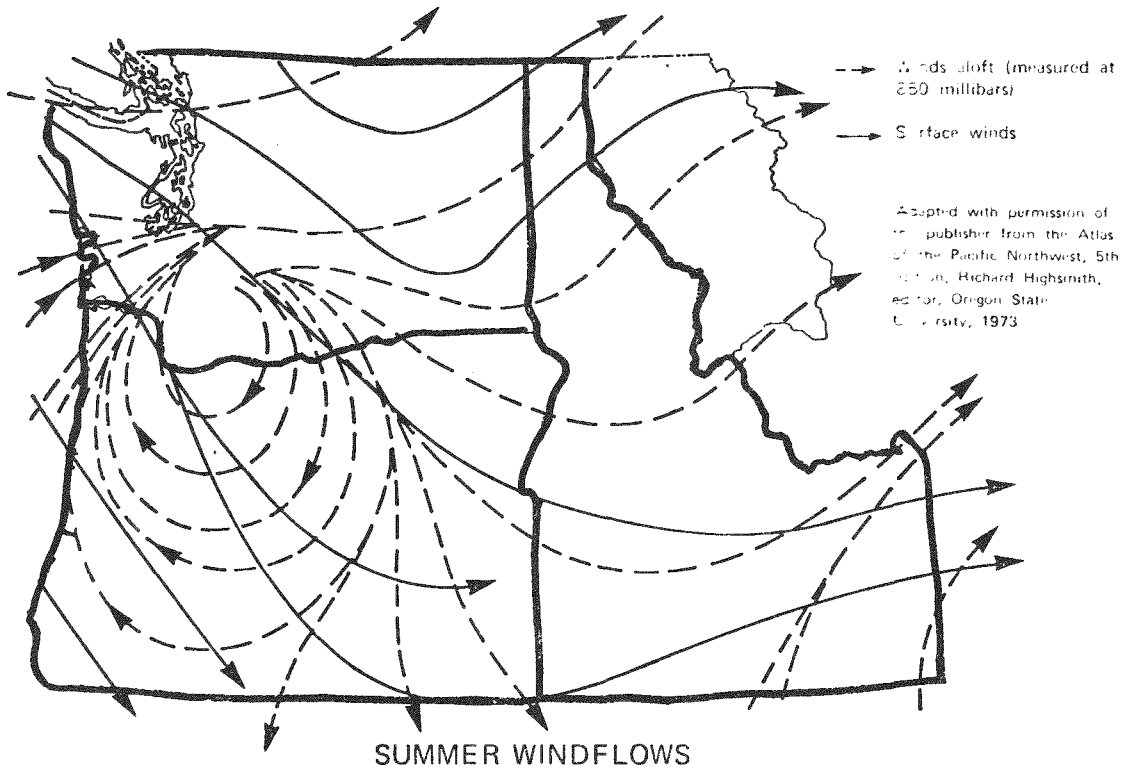
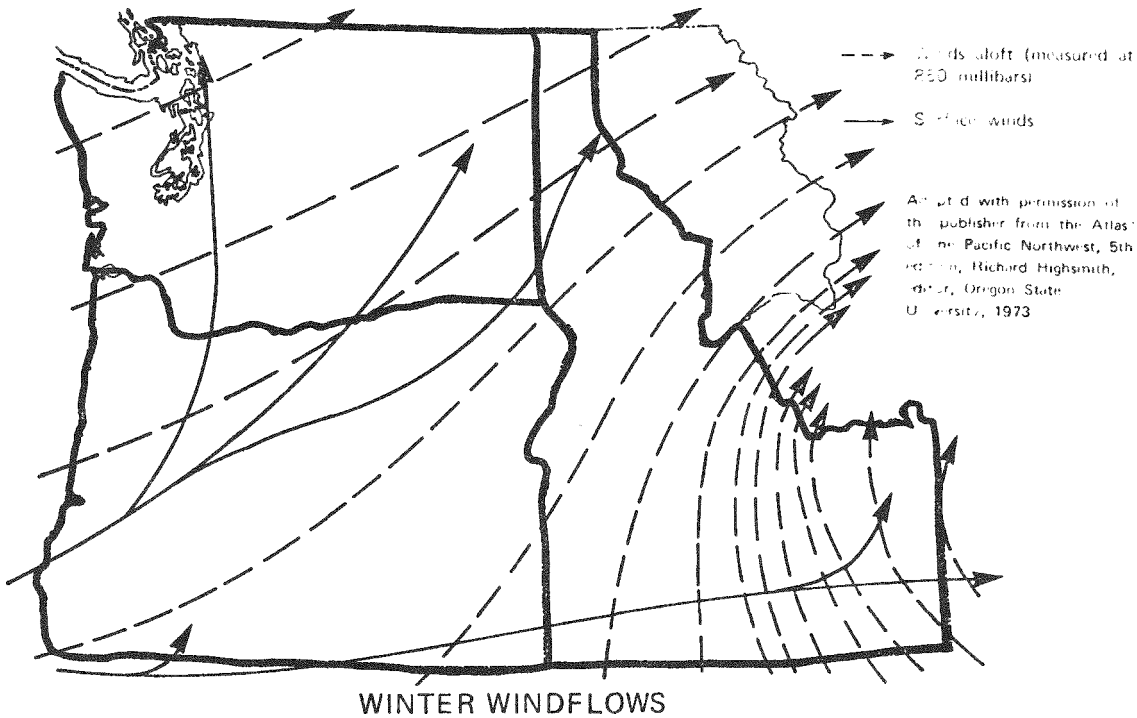


FIGURE II-C-99. Winds by Quarter - October

Data Source: Ref. 13, National Atlas.



SUMMER WINDFLOWS



WINTER WINDFLOWS

FIGURE II-C-100. Summer and Winter Windflows

Data Source: Ref. 20, BPA Role EIS, p. III-12.

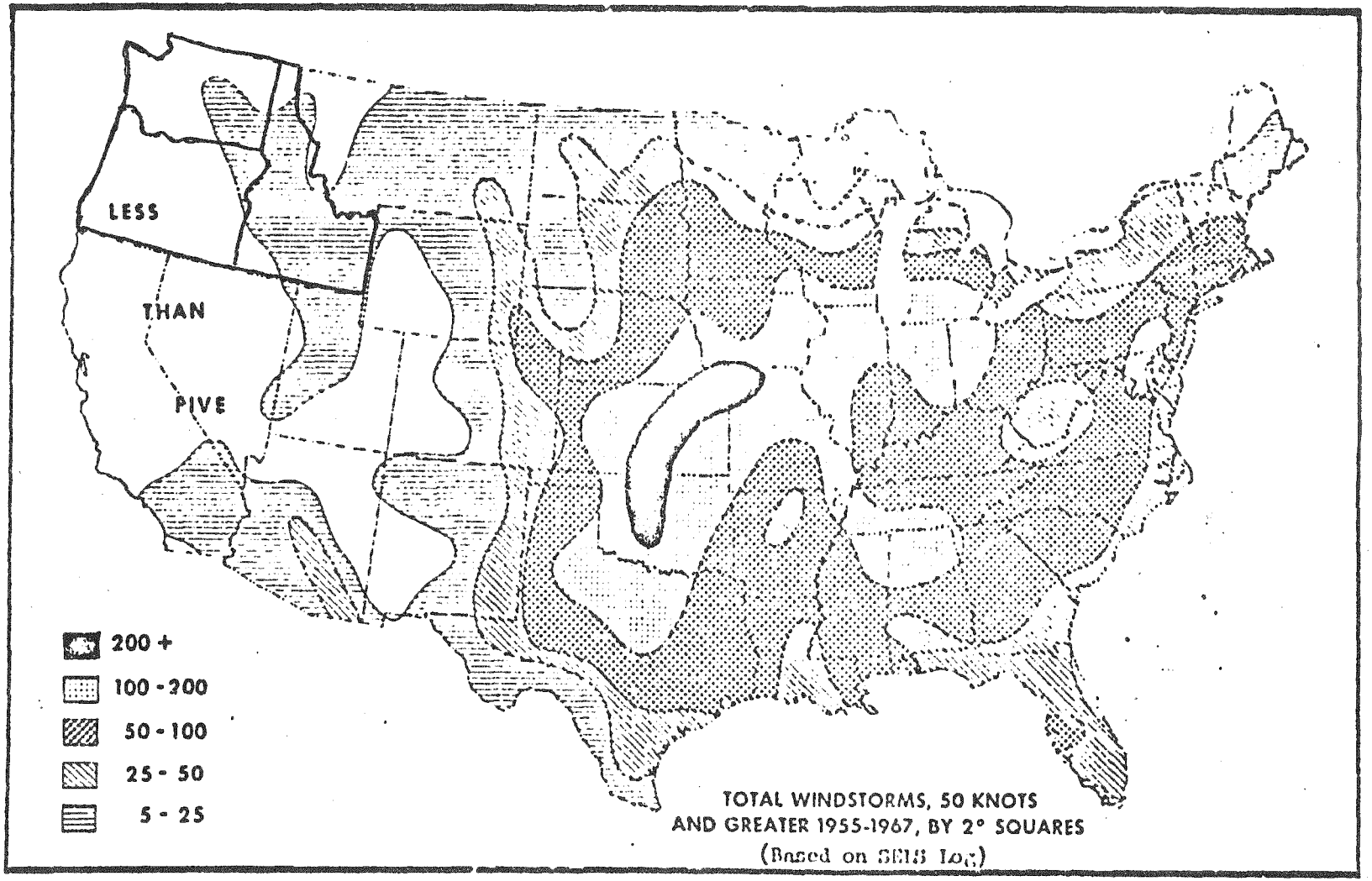


FIGURE II-C-101. Total Windstorms

Data Source: Ref. 30, Local Storm Occurrences, p. 77.

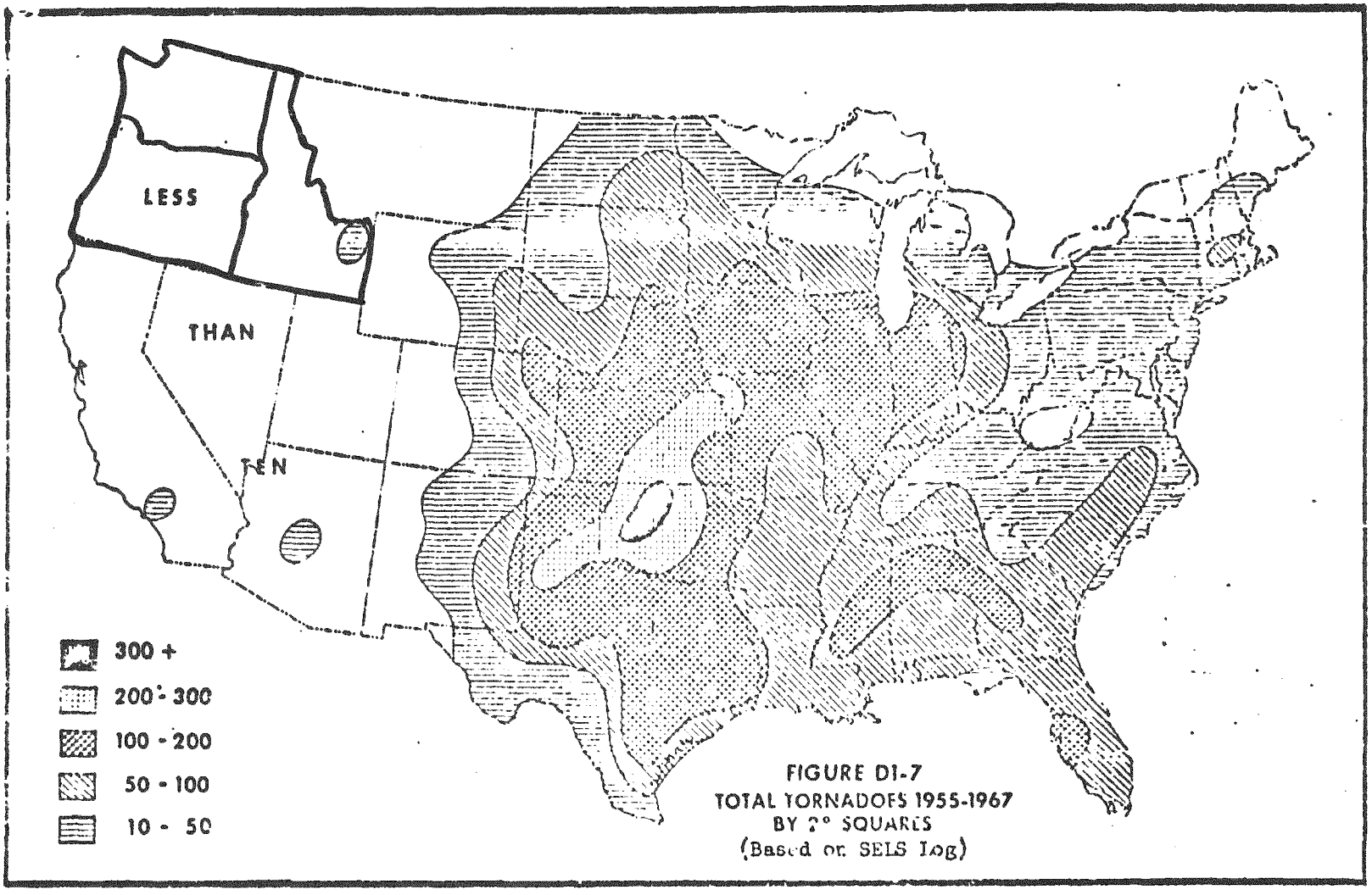


FIGURE II-B-102. Total Tornadoes, 1955-1967

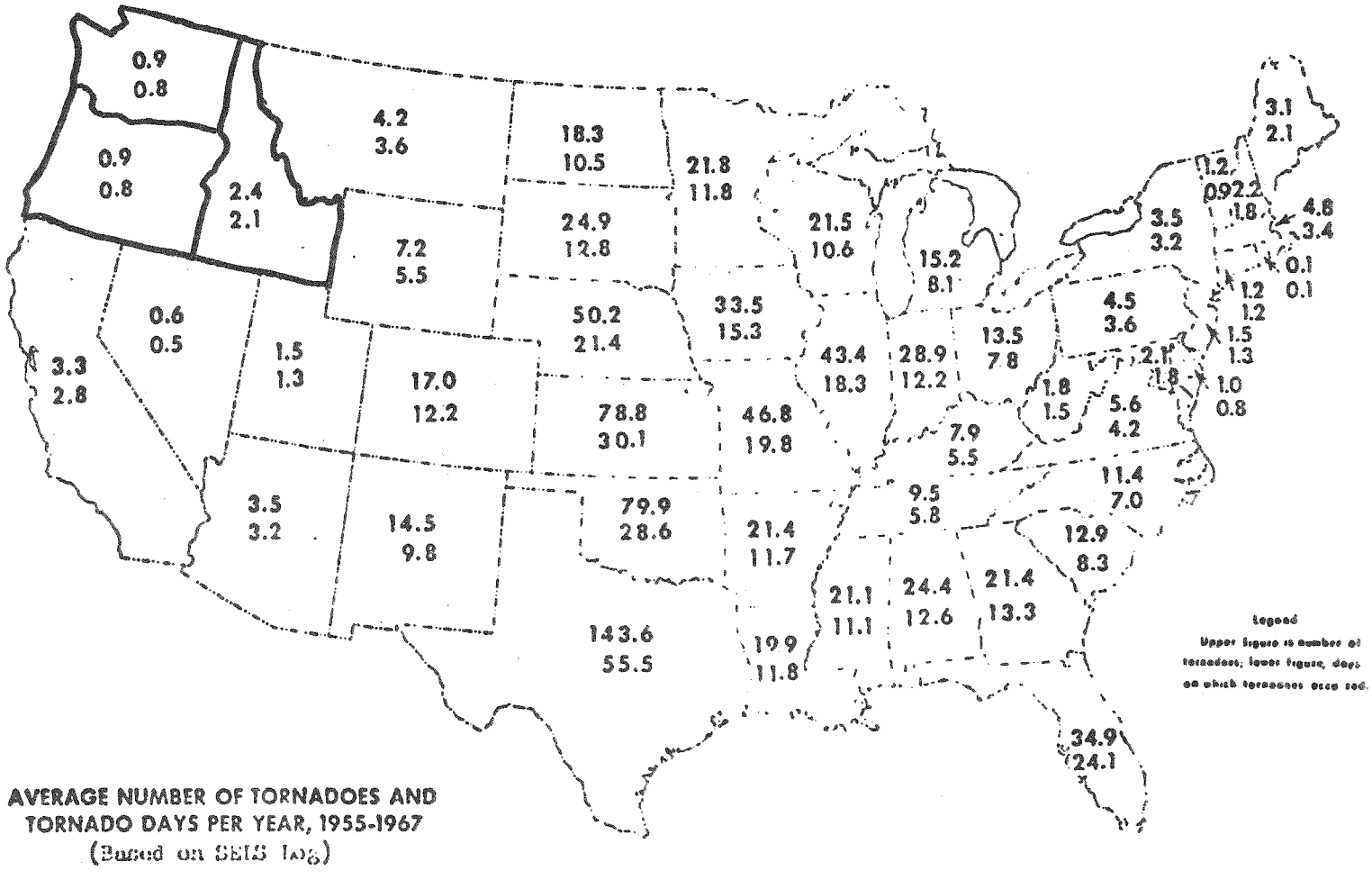
Data Source: Ref. 30, Local Storm Occurrences, p. 70.

TABLE II-C-31

MONTHLY FREQUENCY OF TORNADOES BY STATES
(BASED ON SELS LOG)

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Al	15	18	64	55	22	28	16	3	10	12	34	37	317
ID	0	0	1	0	3	13	9	2	3	0	0	0	31
OR	0	0	2	2	2	1	0	1	0	2	1	0	11
WA	0	0	1	2	4	1	0	1	1	0	1	0	11
Total	202	327	683	1746	2719	2294	1347	766	623	323	370	208	11608
Mean	15.5	25.1	52.5	134.3	209.1	176.5	103.6	58.9	47.9	24.8	28.4	16.0	893

Data Source: Ref. 31, Severe Local Storm Occurrences, p. 10.



AVERAGE NUMBER OF TORNADOES AND TORNADO DAYS PER YEAR, 1955-1967
(Based on SEIS Data)

FIGURE II-C-103. Average Number of Tornadoes and Tornado Days Per Year, 1955-1967.

Data Source: Ref. 30, Local Storm Occurrences, p. 65.

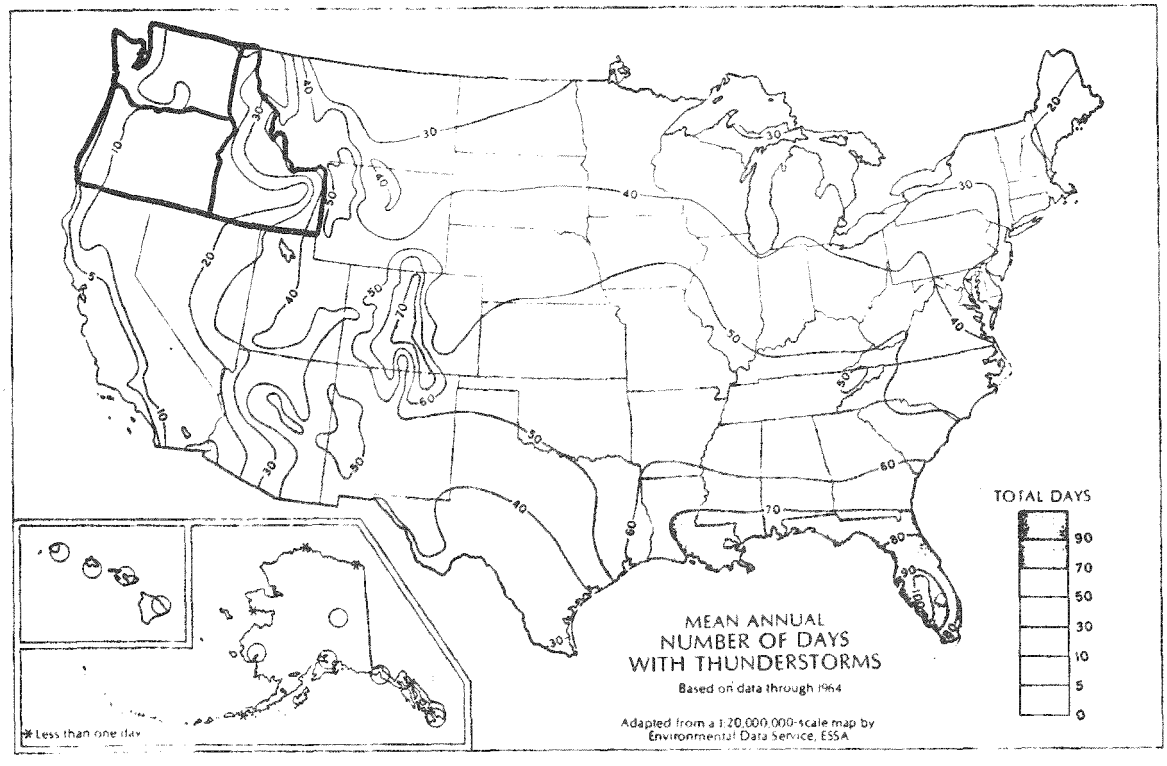


FIGURE II-C-104. Mean Annual Number of Days with Thunderstorms

Data Source: Ref. 13, National Atlas.

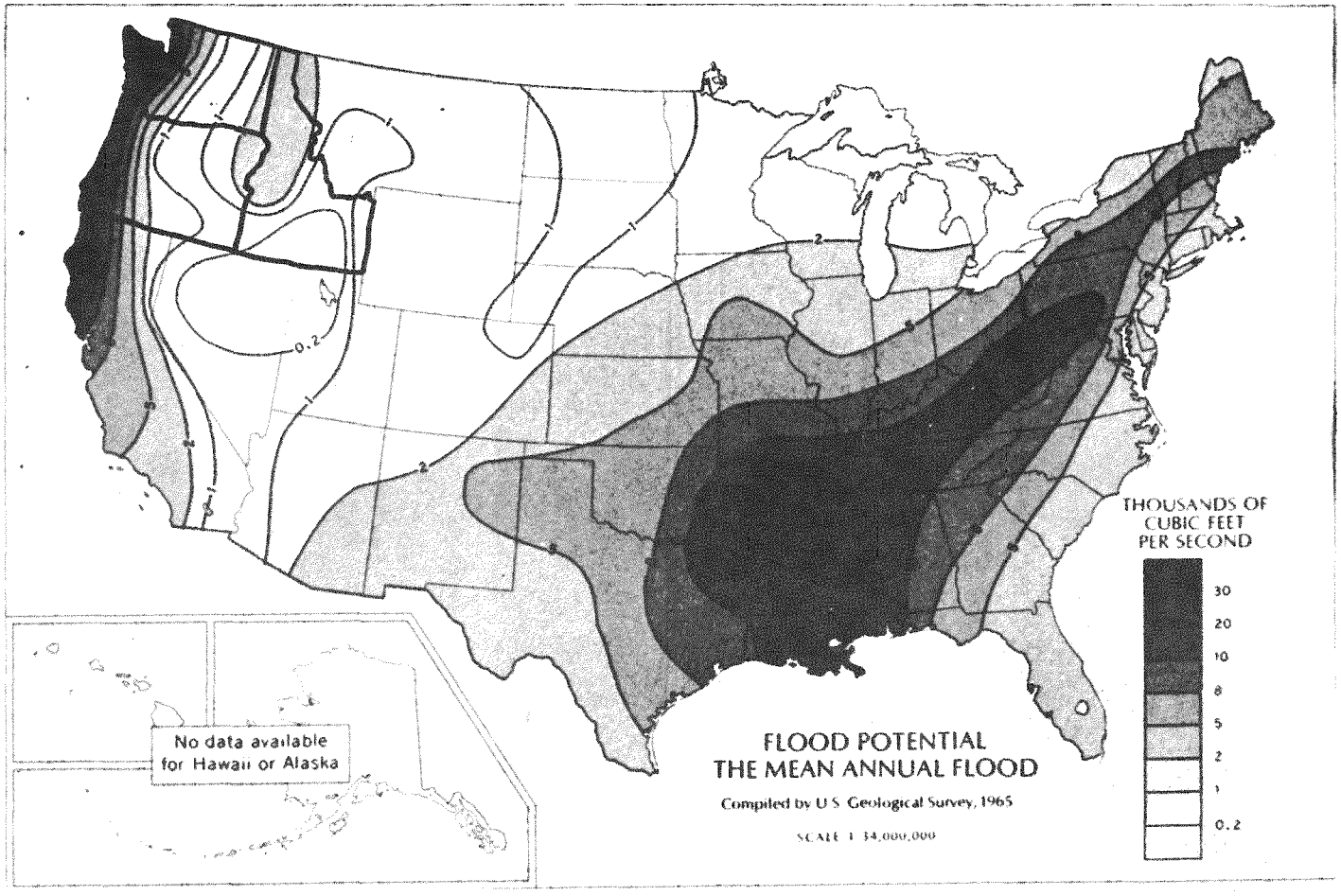


FIGURE II-C-105. Flood Potential - Mean Annual Flood

Data Source: Ref. 13, National Atlas.

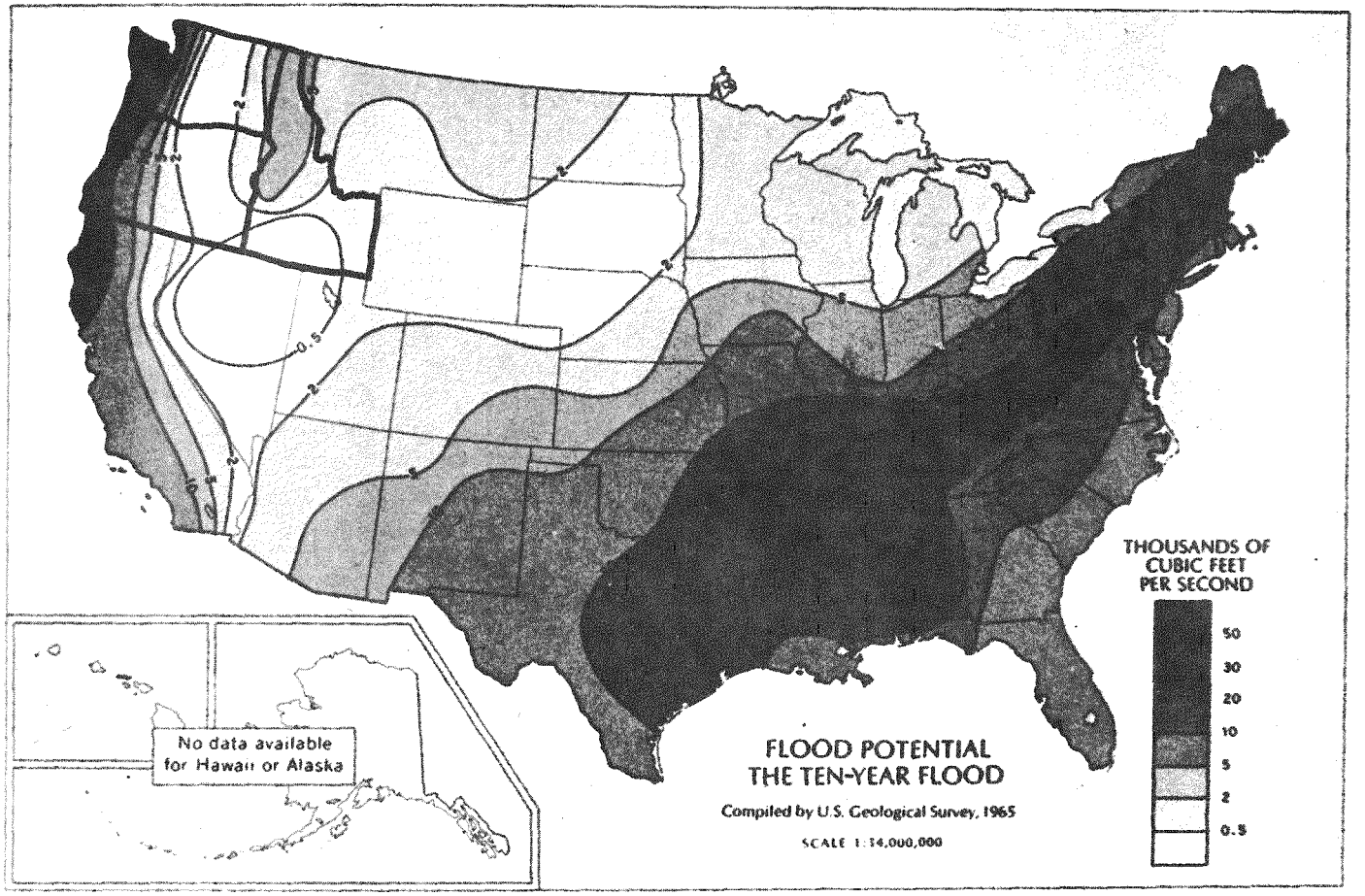


FIGURE II-C-106. Flood Potential - Ten-year Flood

Data Source: Ref. 13, National Atlas.

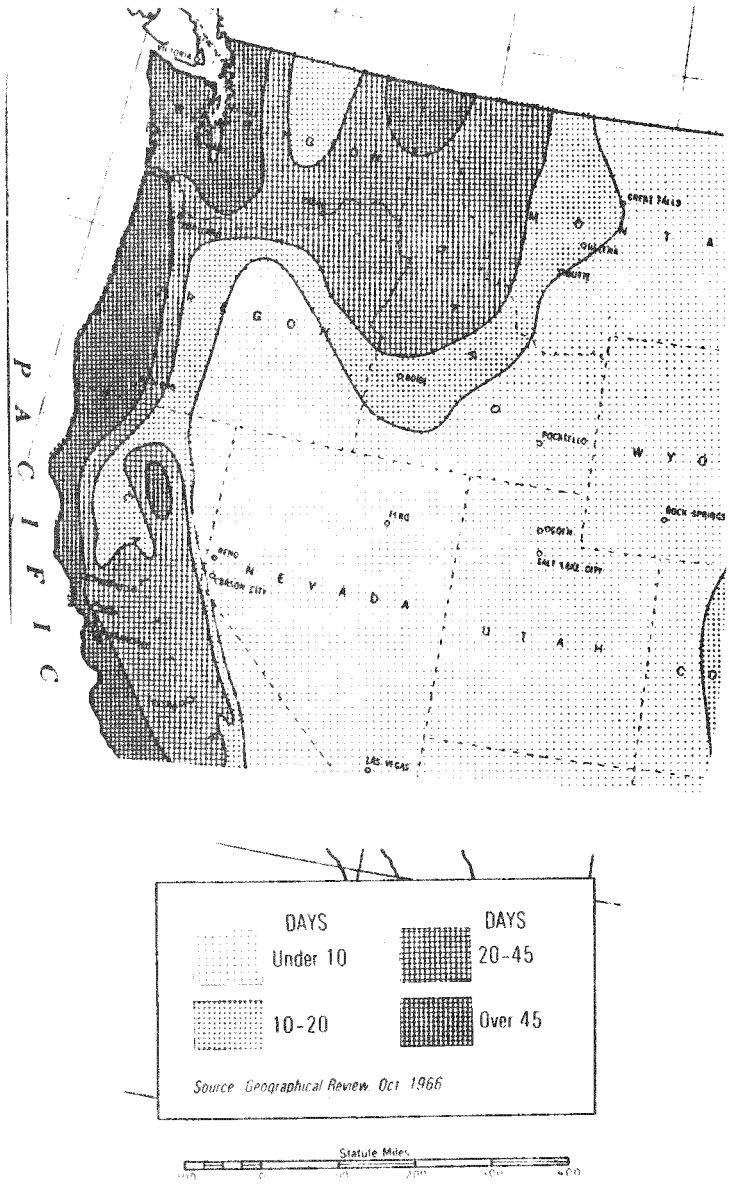


FIGURE II-C-107. Number of Days with Fog (Average Annual)

Data Source: Ref. 9, Water Atlas.

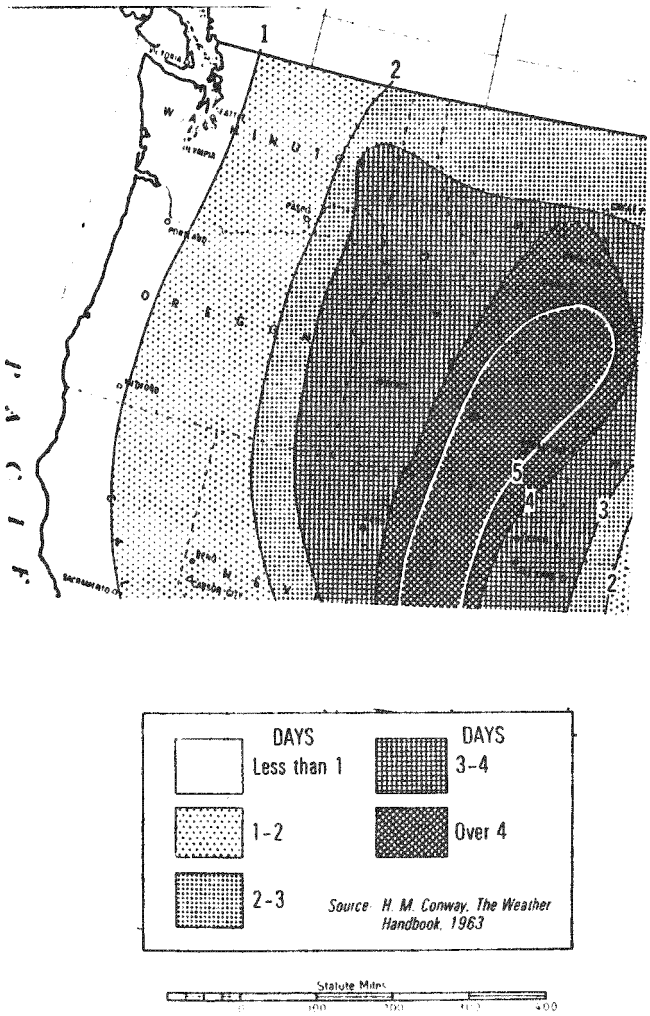


FIGURE II-C-108. Number of Days with Hail (Average Annual)

Data Source: Ref. 9, Water Atlas.

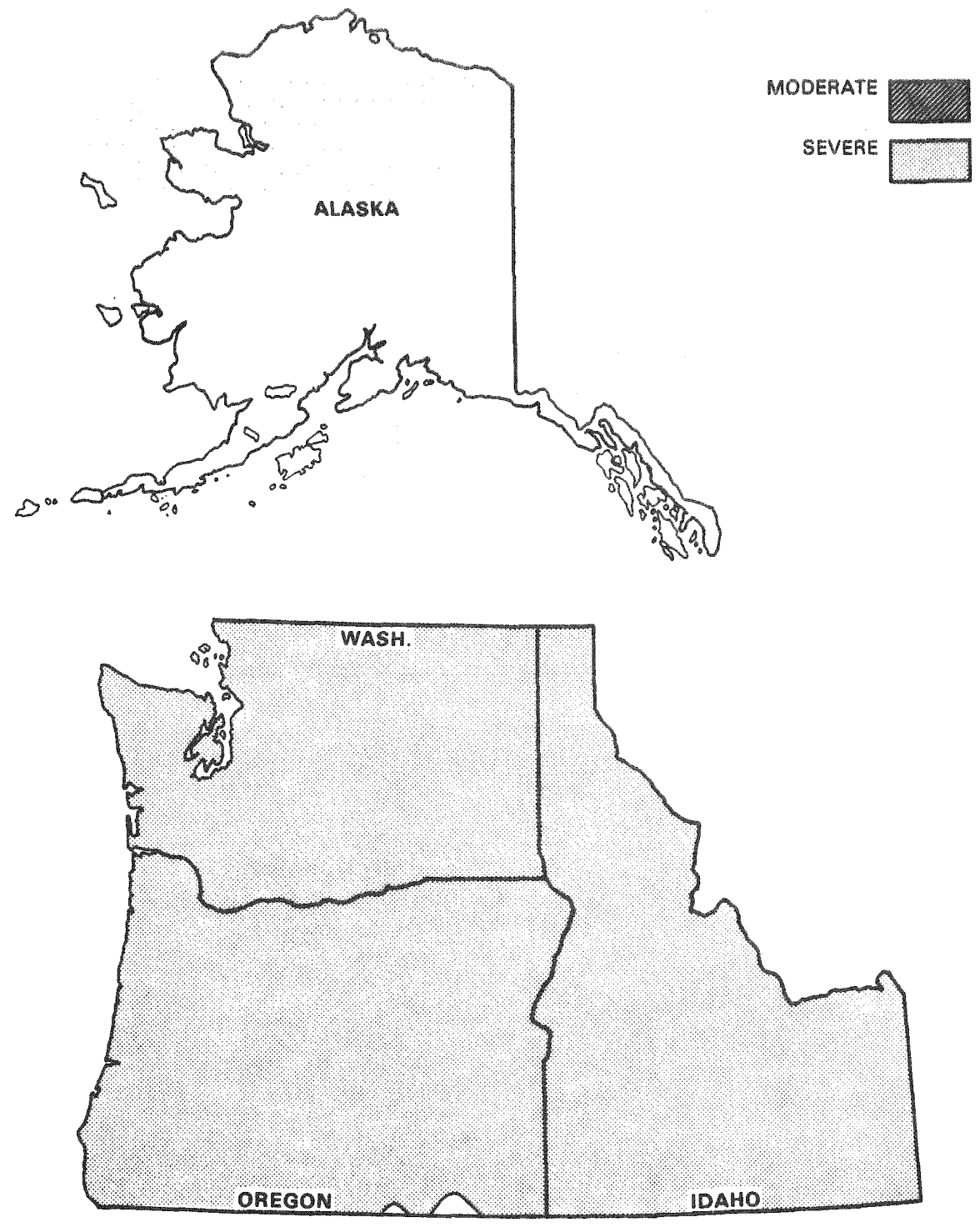


FIGURE II-C-109. Areas Vulnerable to Drought

Data Source: Ref. 13, National Atlas, p. 118.

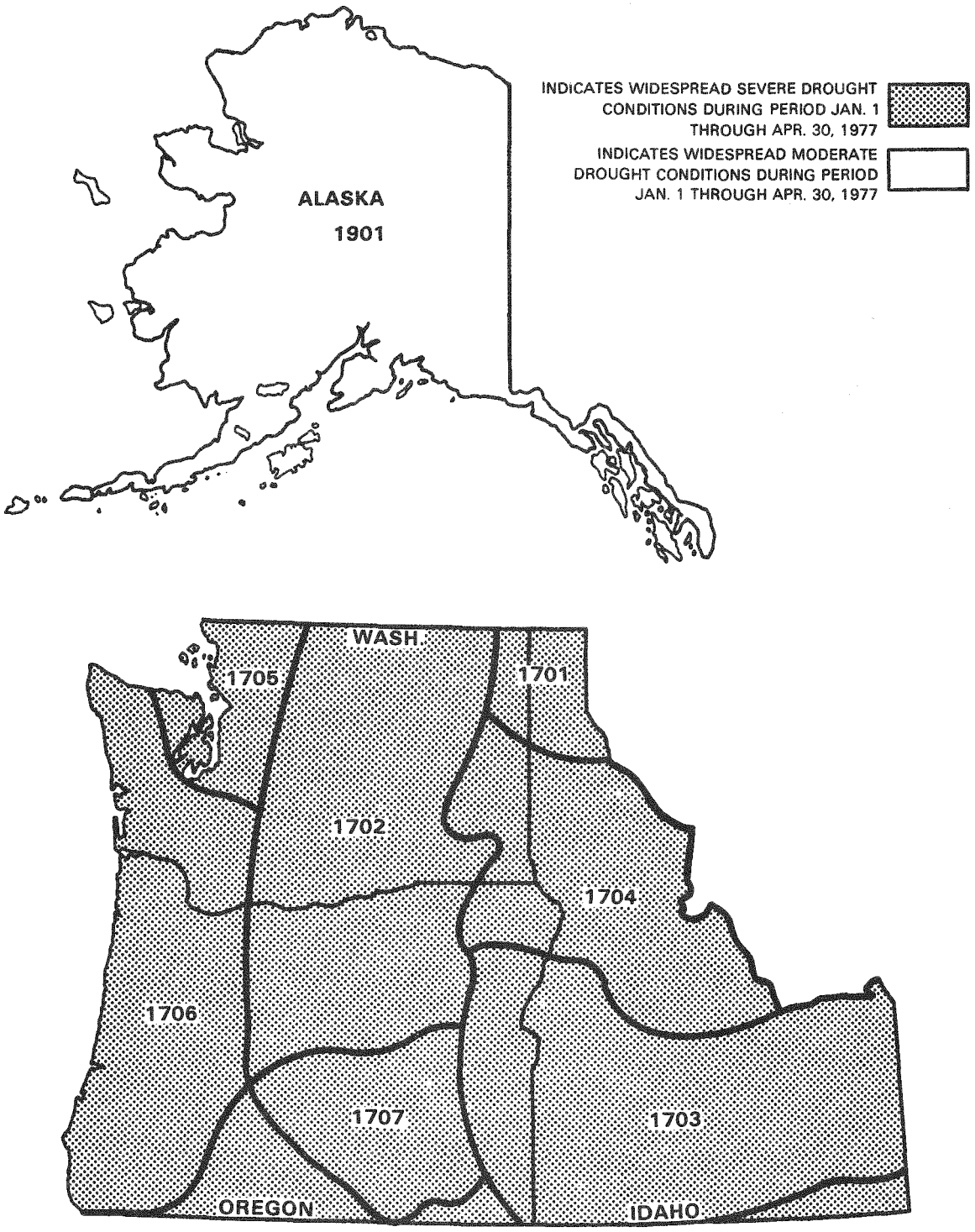


FIGURE II-C-110. Water Shortage During the 1977 Drought

Data Source: Ref. 15, Preliminary Water Resources Problem Statement.

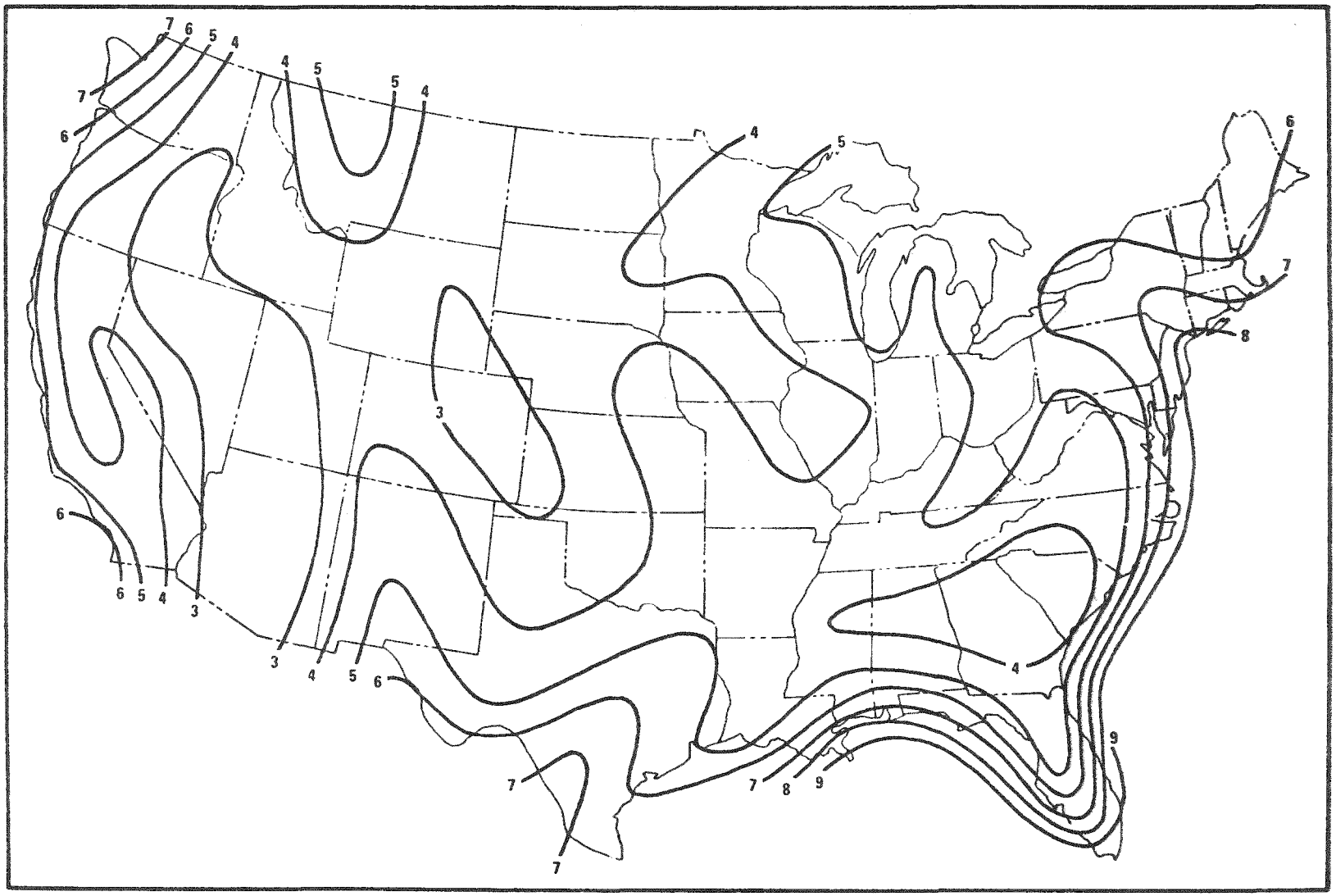


FIGURE II-C-111. Isopleths (m x 10^2) of Mean Annual Morning Mixing Heights

Data Source: Ref. 32, Mixing Heights, Wind Speeds, and Urban Air Pollution Potential.

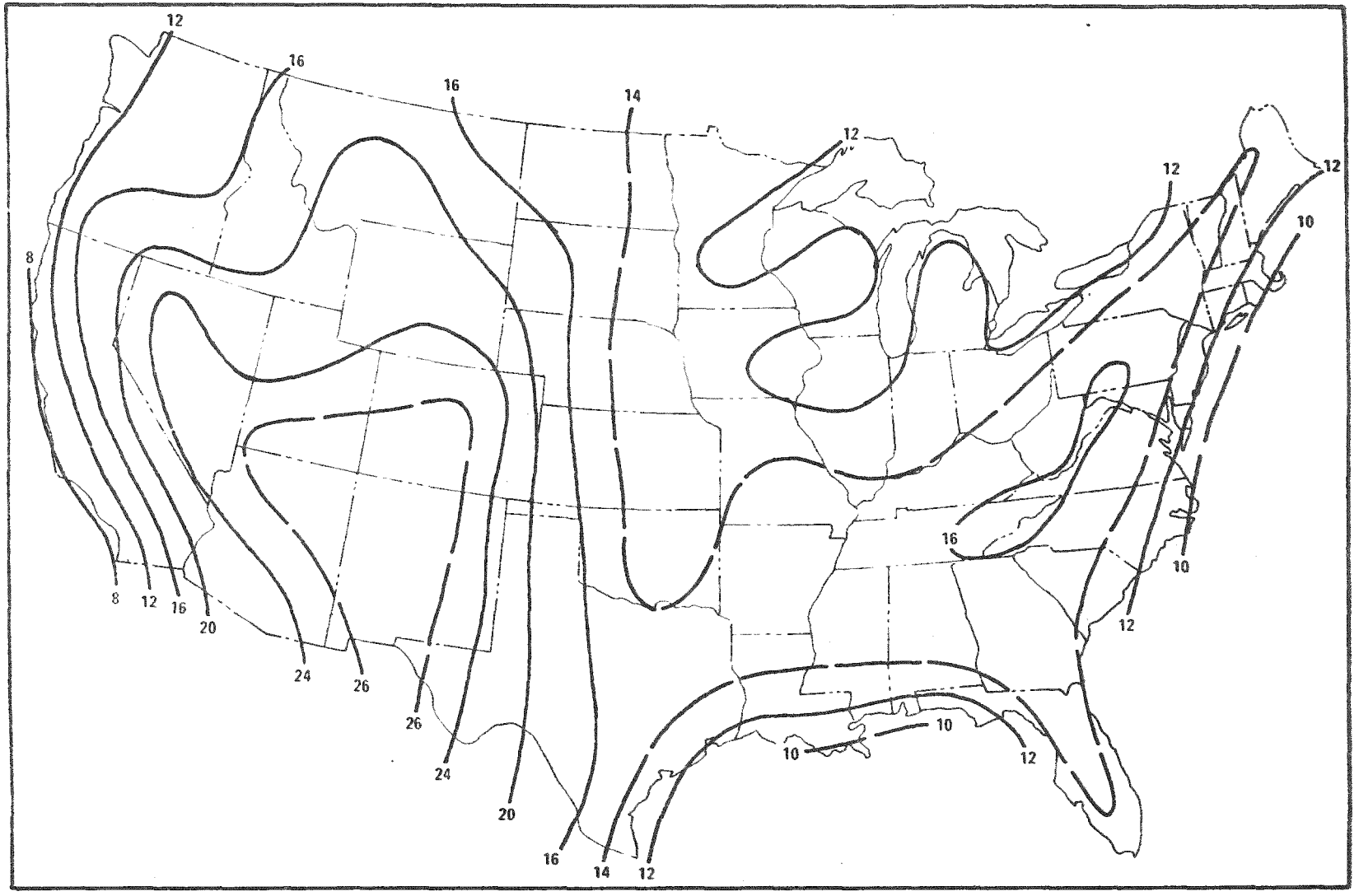


FIGURE II-C-112. Isopleths (m x 10^2) of Mean Annual Afternoon Mixing Heights

Data Source: Ref. 32, Mixing Heights, Wind Speeds and Urban Air Pollution Potential.

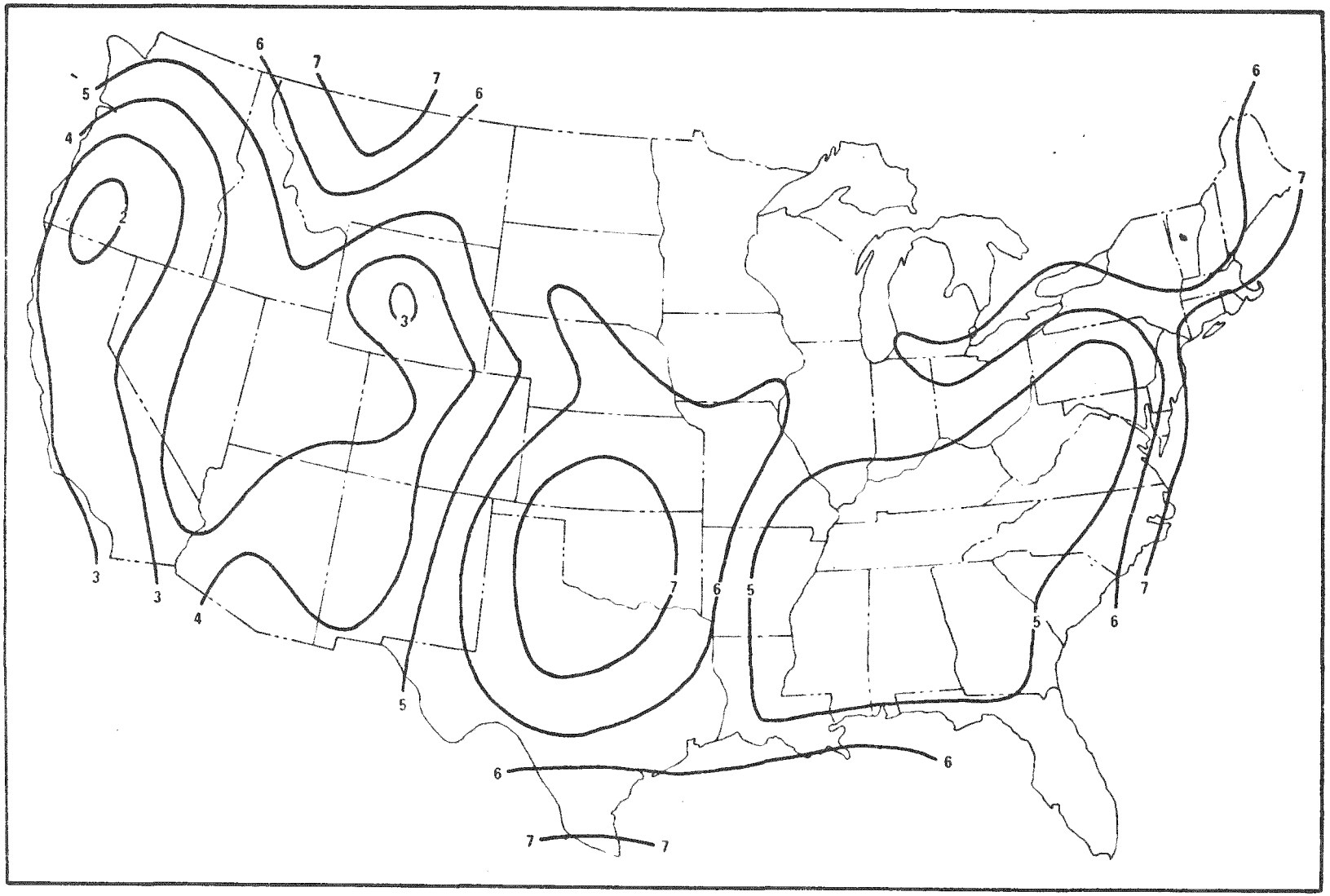


FIGURE II-C-113. Isopleths (m sec^{-1}) of Mean Annual Wind Speed Averaged Through the Morning Mixing Layer

Data Source: Ref. 32, Mixing Heights, Wind Speeds, and Urban Air Pollution Potential.

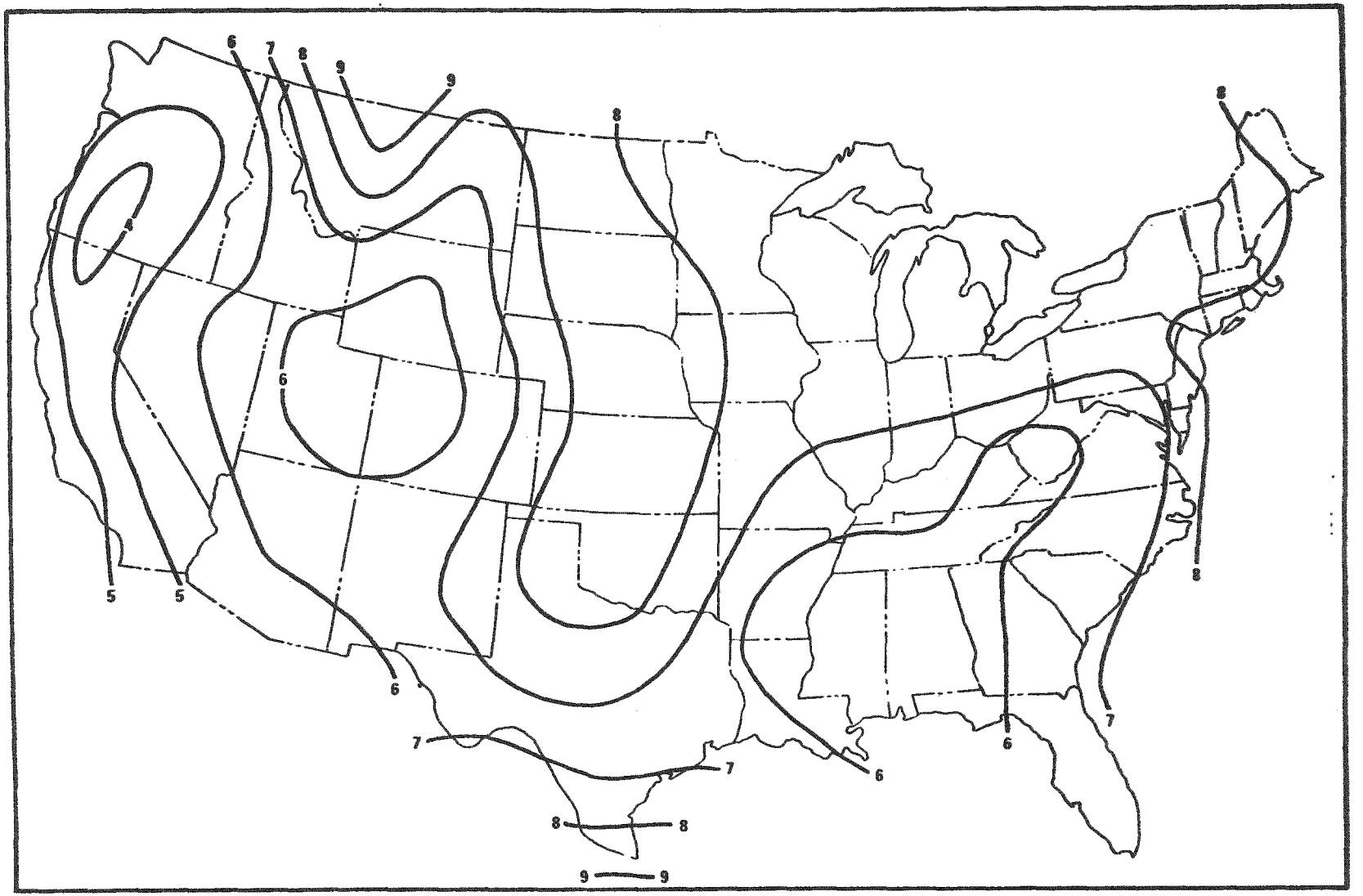
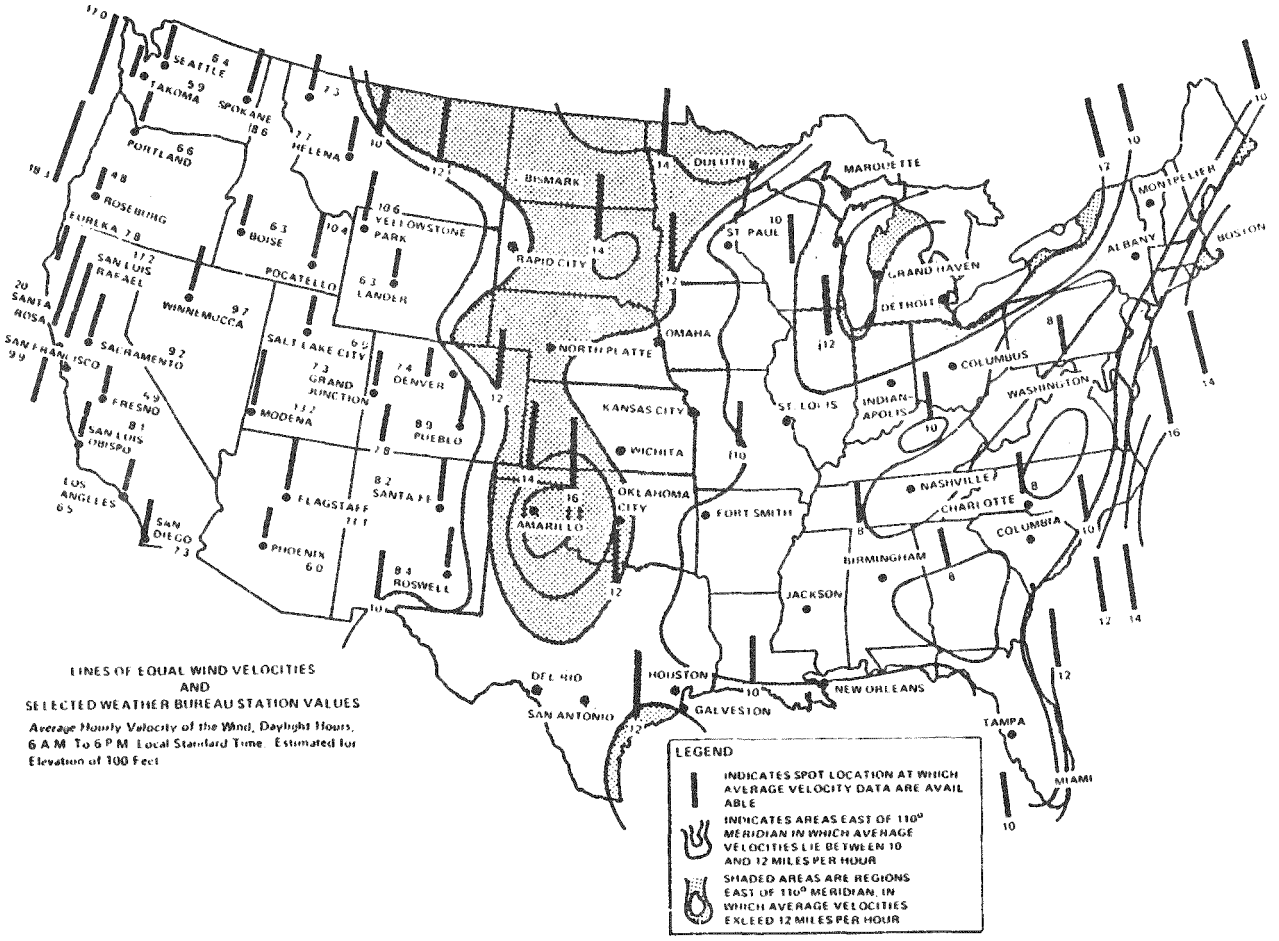


FIGURE II-C-114. Isopleths (m sec^{-1}) of Mean Annual Wind Speed Averaged Through the Afternoon Mixing Layer

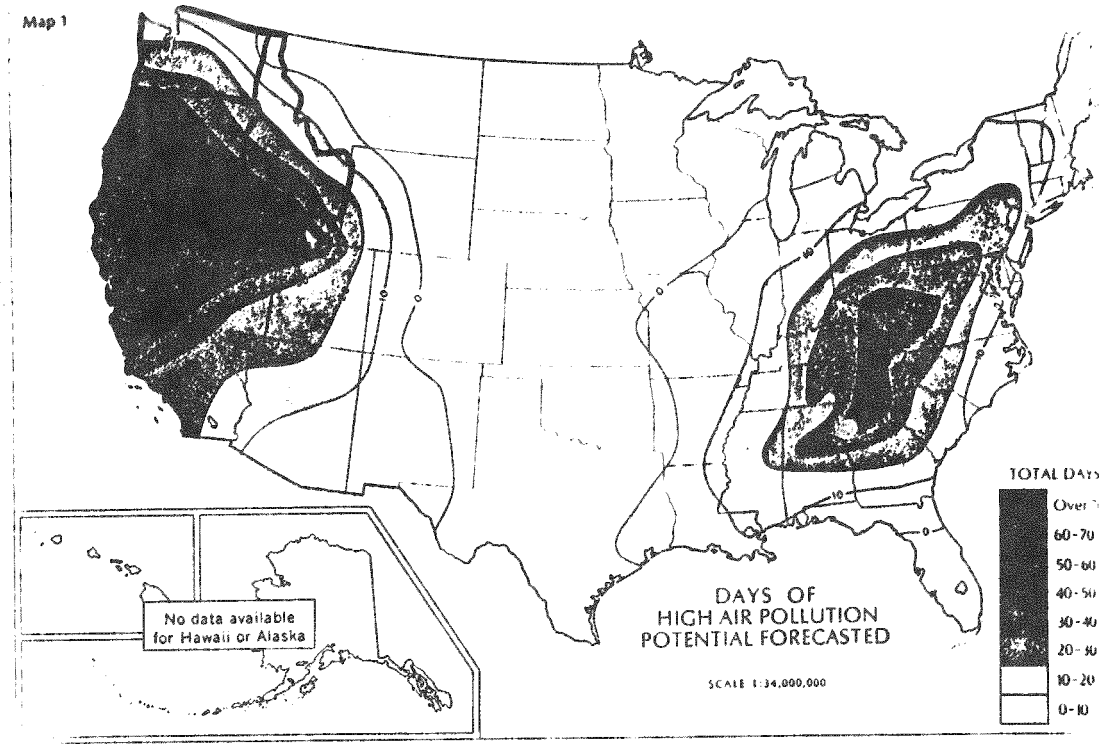
Data Source: Ref. 32, Mixing Heights, Wind Speeds and Urban Air Pollution Potential.



AVERAGE WIND VELOCITIES IN THE UNITED STATES

FIGURE II-C-115. Average Wind Velocities in the United States

Data Source: Ref. 33, The Energy Source Book.



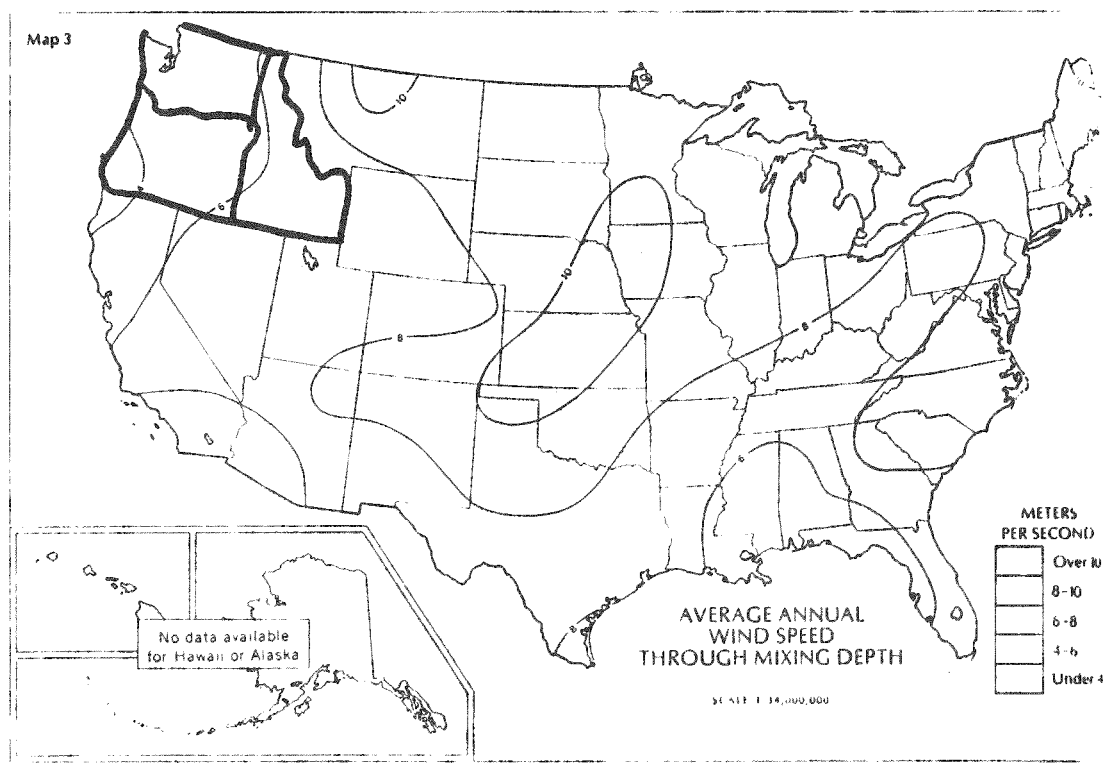


FIGURE II-B-116. Potential Air Pollution and Mixing Depths

Data Source: Ref. 13, National Atlas.

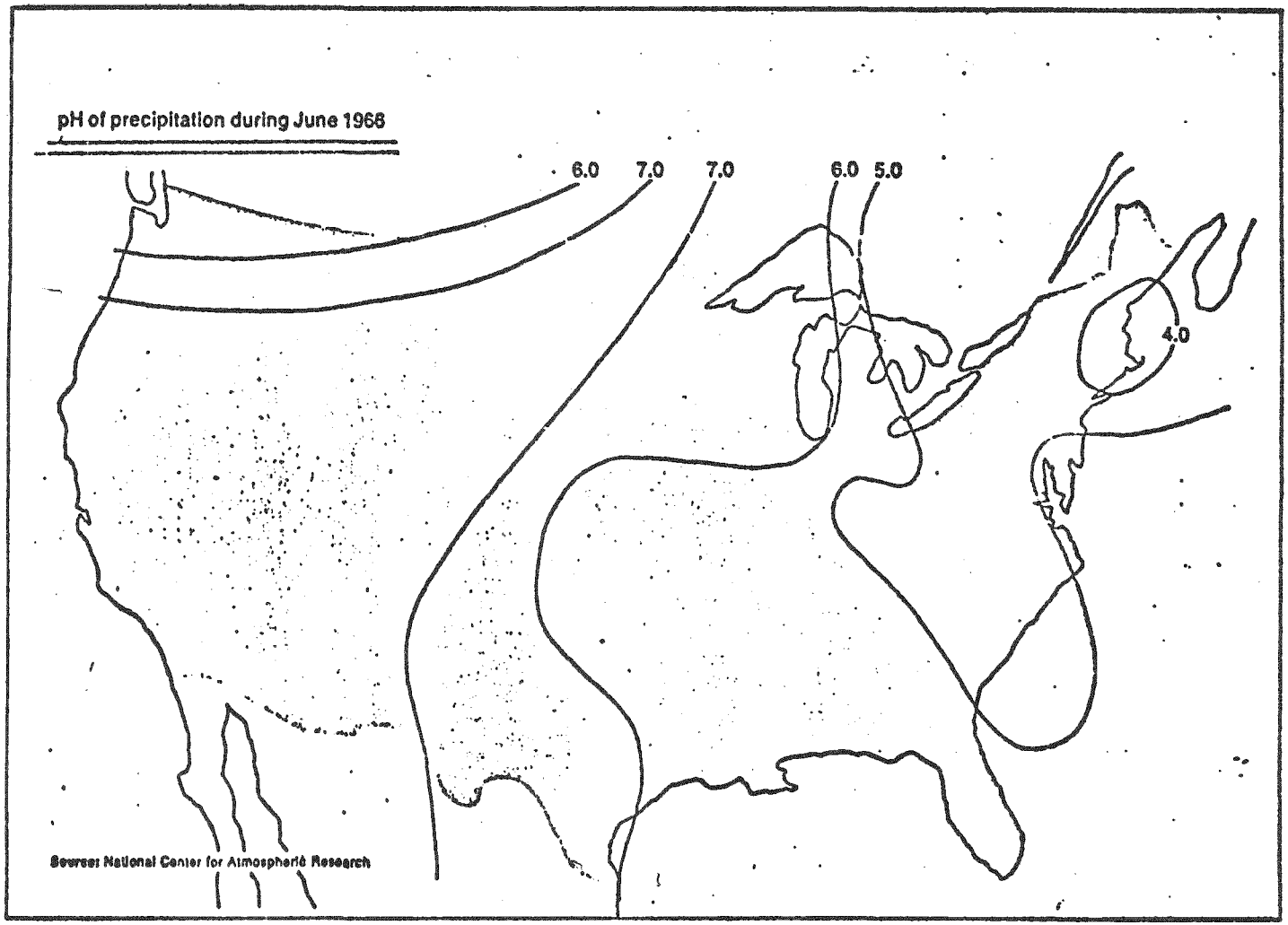


FIGURE II-C-117. Acid Rain

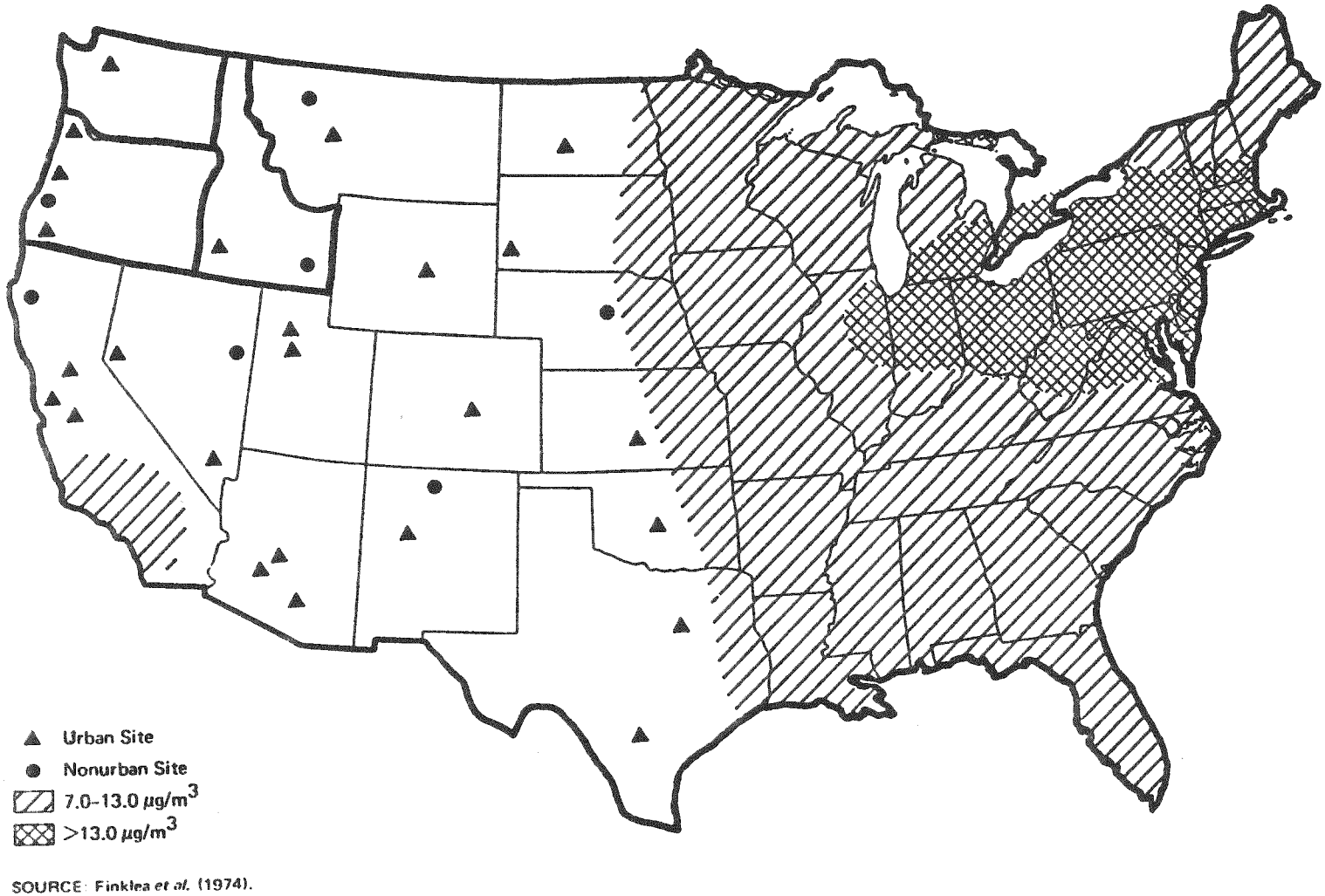
Data Source: Ref. 34, Acid Precipitation.

FIGURE II-C-118. Regions in North America Containing Lakes that Are Sensitive to Acidification by Acid Precipitation

Data Source: Ref. 35, The Effects of Precipitation on Aquatic and Terrestrial Ecosystems.

FIGURE II-C-119. Acidity of Rainfall in the U.S.

Data Source: Ref. 36, Mineral Resources and the Environment.



SOURCE: Finklea *et al.* (1974).

FIGURE II-C-120. 1970 Sulfate Concentrations, Urban

Note: Within Approximately the Eastern half of the Continentl United States, levels of sulfate were higher at urban sampling sites than at non-urban sites.

Data Source: Ref. 36, Mineral Resources and the Environment.

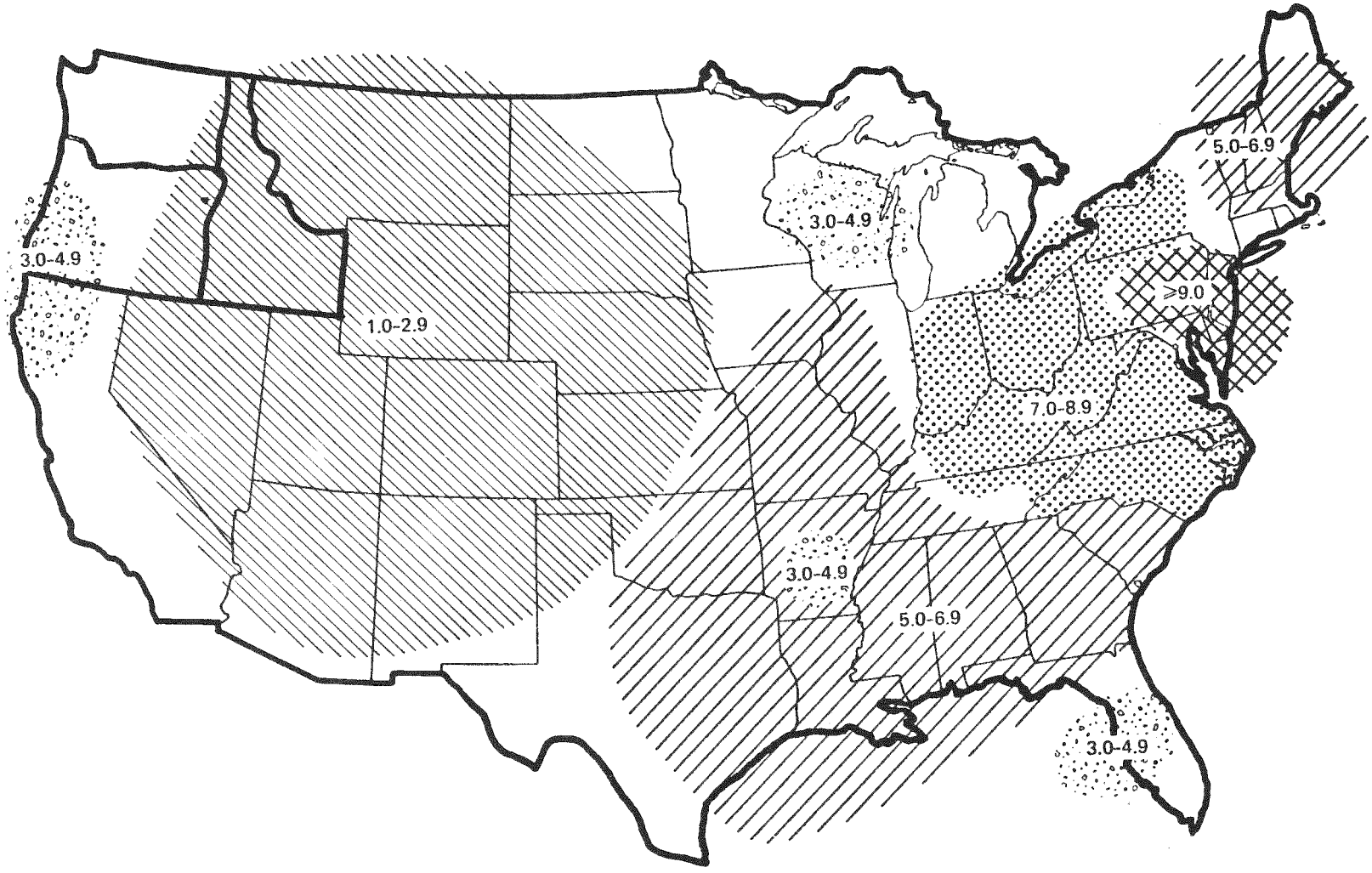


FIGURE II-C-121. Non-urban Average Sulfate Concentration

Data Source: Ref. 36, Mineral Resources and the Environment.

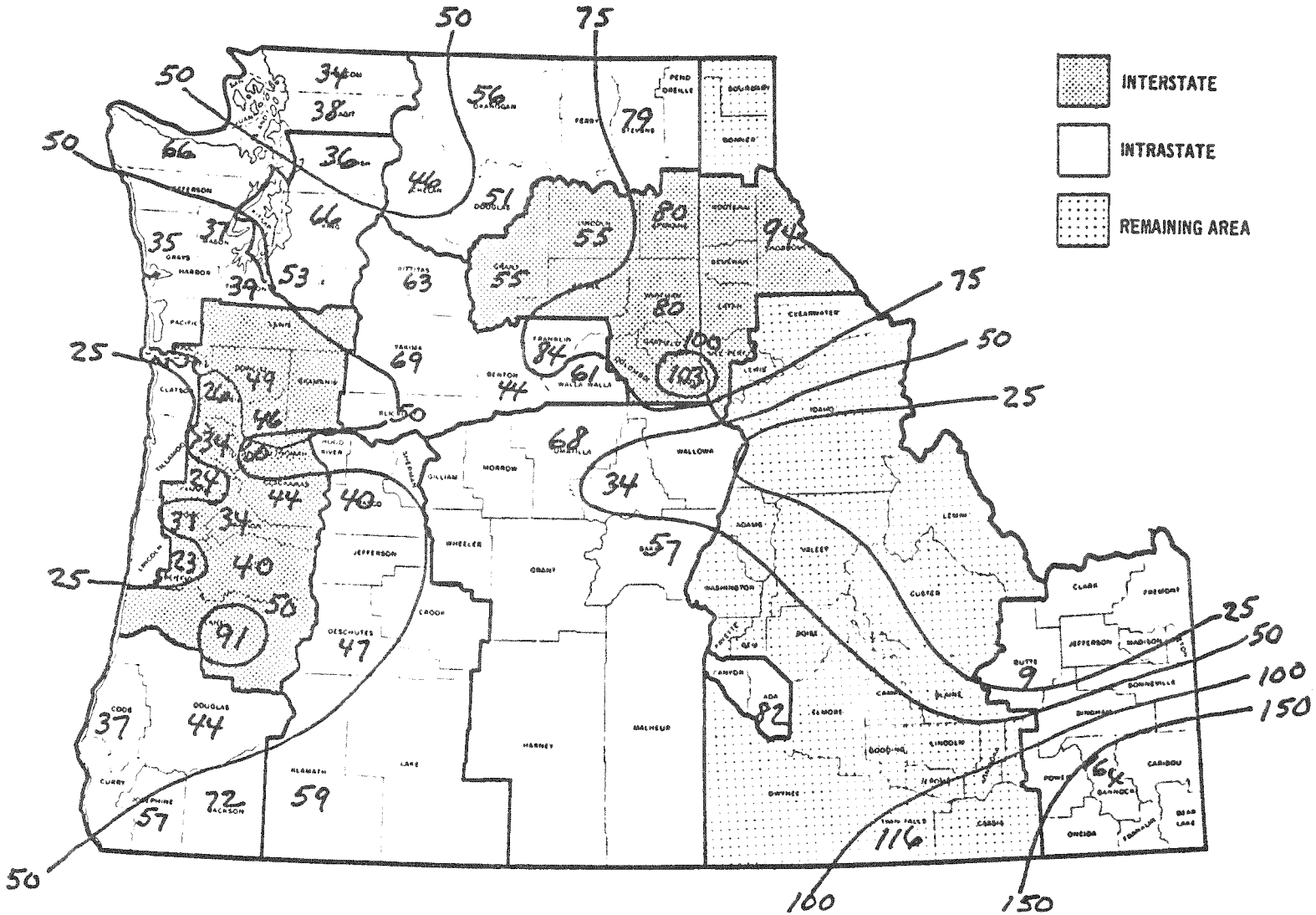


FIGURE II-C-122. Annual Average Particulate Concentrations ($\mu g/m^3$)

Data Source: Ref. 37, Air Quality Data, 1975.

TABLE II-C-32

POWER PLANT EMISSIONS DATA BY AIR QUALITY CONTROL REGION[a]

Particulate Emissions from Power Plants (tons/yr)

State	Air Quality Control Region	Existing in 1975
OR/WA	35	12,328
OR	201	3,130
ID	49	0

TABLE II-C-33

EMISSIONS OF SO_2 AND PARTICULATE MATTER IN THE PACIFIC NORTHWEST[b]

State	SO_2 (tonnes/year)		Particulate Matter (tonnes/yr)	
	Point Sources	Area Sources	Point Sources	Area Sources
Washington	240,770	26,610	132,910	29,370
Oregon	22,810	22,060	124,420	45,390
Idaho	44,180	6,920	32,830	22,780

(a) Data Source: Ref. 22, An Approach to Valuing Visual Pollution from Western Electricity Production, BNWL-2103, p. C-2.

(b) Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21, p. C.3.

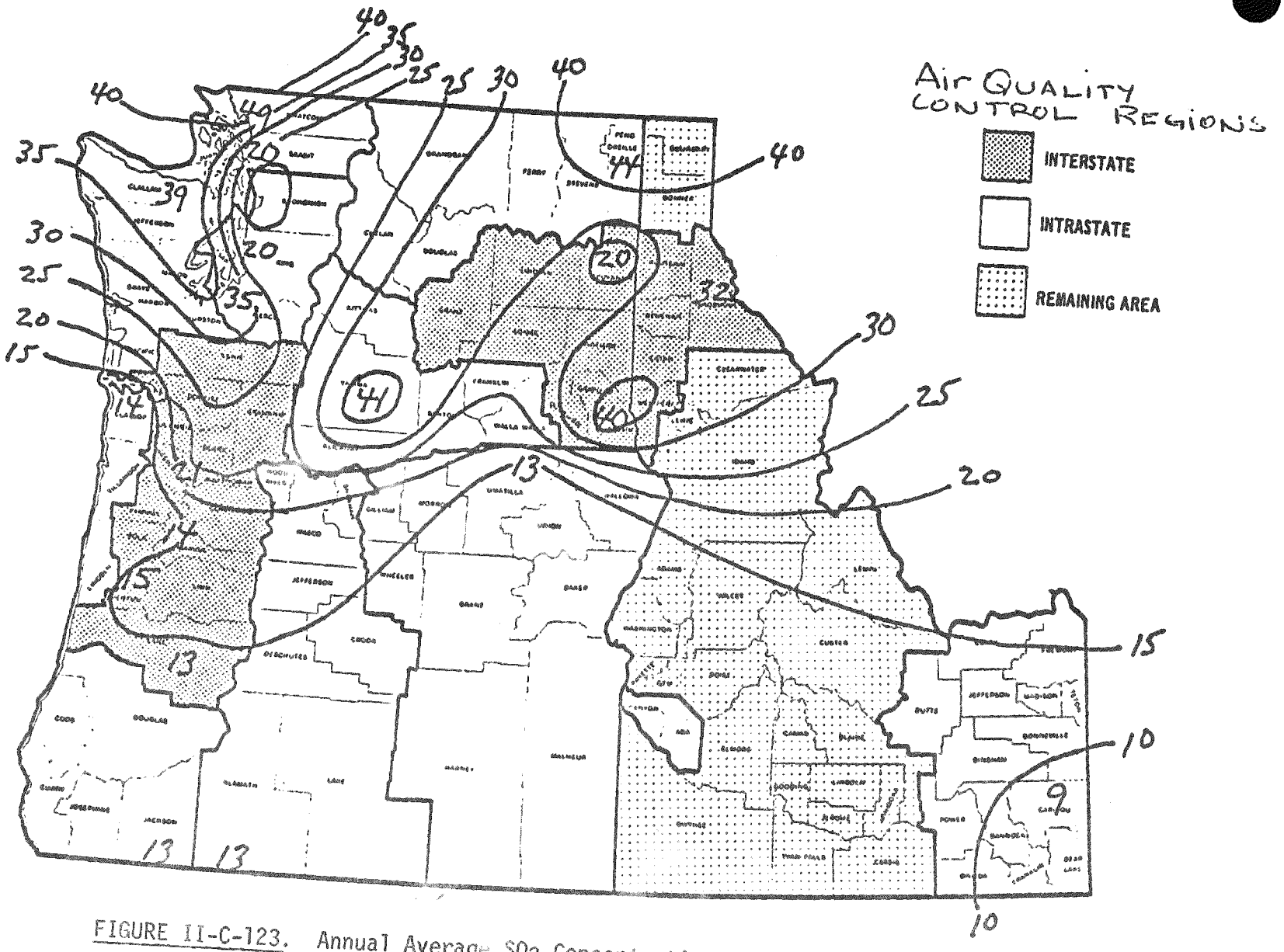


FIGURE II-C-123. Annual Average SO_2 Concentrations in Micrograms/cubic meter (Based on 1975 Data)

Data Source: Ref. 37. Air Quality Data, 1975.

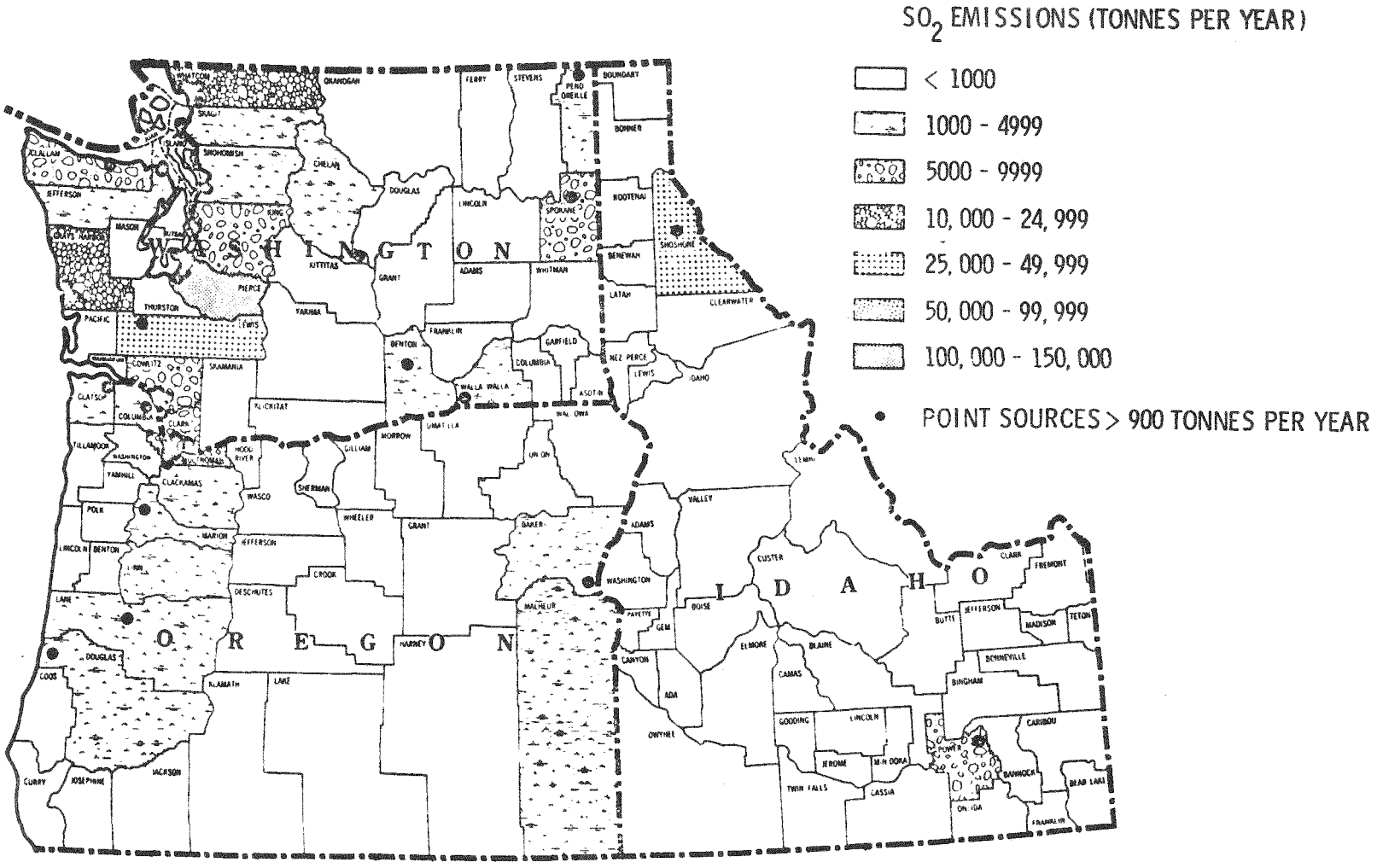


FIGURE II-C-124. Total Point Source Emissions of SO_2 in the Pacific Northwest, 1975

Data Source: Ref. 1, The Impact of Increased Coal Consumption, p. C.2.

TABLE II-C-34

STATE LAND USE NOISE REGULATIONS

Criteria State	Land Usage	Effective Date	Maximum Continuous Noise Ld	Maximum Continuous Noise Ln	Max. Noise Level L max	Max. Impulse Noise	Comment
Oregon	All private property	74	7am/10pm 60	10pm/7am 55			Includes operation of all motor vehicles
WA	All property	77	Cl.A55 Cl.B57 Cl.C60	56 57 60			
	Vehicles				80 dBa		

SUMMARY OF LOCAL JURISDICTIONS WITH NOISE REGULATIONS

Community	dBa	Octave Band	Other	Notes
Bellevue, WA	X			
Mason Co., WA			X	Maximum levels in dB
Richland, WA		X		Old octave band frequencies
Silvertone, OR		X		Old octave band frequencies
Seattle, WA	X		X	Maximum levels in dB
Portland, OR	X	X		

Note: To date only 5 states have land use noise regulations.

Data Source: Ref. 38, "Noise Regulation in State and Local Noise Ordinance."

SOLID WASTE

This section will identify the use of wastes for the production of energy. Urban, agricultural and forest wastes will of course be available for conversion to energy as long as wastes are generated. Agricultural and forest waste conversion is discussed in Chapter 1 under Biomass. Urban waste potential will be discussed in this section.

Most metal and glass in urban refuse can be recovered and recycled, leaving the organic portion of the waste for energy conversion. And aside from providing needed energy, the use of refuse for energy production would also help to solve some of the environmental problems surrounding solid waste disposal. On a per capita basis, urban refuse in the United States was estimated at 7 lb/day in 1967. An increase to 10 lb/day is experienced when industrial waste is included.(1)

The harnessing of "trash power" has been confined to refuse-fired steam-generating systems and pilot plants that use shredded paper and light plastics. Shredded material is either fired as a 10% to 20% heat value supplement to coal, or is converted by pyrolysis to gas or oil.

During 1974, Eugene Water and Electric Board (EWEB), Eugene, Oregon, burned air-classified garbage in their Waterville steam plant in a series of tests. A feasibility analysis by the University of Oregon's Bureau of Government Research and Service concluded that with power revenues realized from energy generated at the plant helping to defray part of the costs, this type of system is economically competitive with other environmentally acceptable solid waste disposal methods.

A Lane County proposal calls for a plant with a capacity of two billion pounds of steam for heating and processing uses in its first year of operation in 1977. The power-and-steam facilities would produce about 725 million kWh of electrical energy the first year. The energy supplied by the waste-fired system is more than one-fourth the 1977 estimated EWEB electrical requirement. Total initial cost for the facilities is estimated at $54.9 million, based on 1973 price levels. Refuse disposal in the plant is estimated to cost

(1) Information Source: Ref. 20, BPA Role EIS, pp. V-138, V-139.

$4.40 per ton less than by landfill. Ash and residue from the plant would amount to only about 3% of the original wood and refuse landfill requirement.

The powerplant would use three large wood waste-fired boiler units of 460,000 lb/hr capacity and two separate solid waste-fired boiler units. The plant would have the capability of using 4,000 tons/day of wastes. Municipal waste in the Eugene-Springfield area for 1975 is projected at 700 tons/day, increasing to about 1,000 tons/day by 1990. Wood wastes would supply the remainder.

A study prepared for Richland, Washington, concluded that the use of solid wastes to supplement coal as fuel in a $400 million power plant would save the equivalent of 45,000 tons of coal annually. The study was conducted in response to an inquiry from the Exxon Nuclear Company on whether the city would be able to furnish the huge supplies of electric power required for a nuclear fuel centrifuge plant proposed for operation in 1981-82. The study estimated that a 500-MW plant would use 1.7 million tons of coal, plus 59,500 tons of garbage annually.

Information Source: Ref. 20, BPA Role EIS, pp. V-138, V-139.

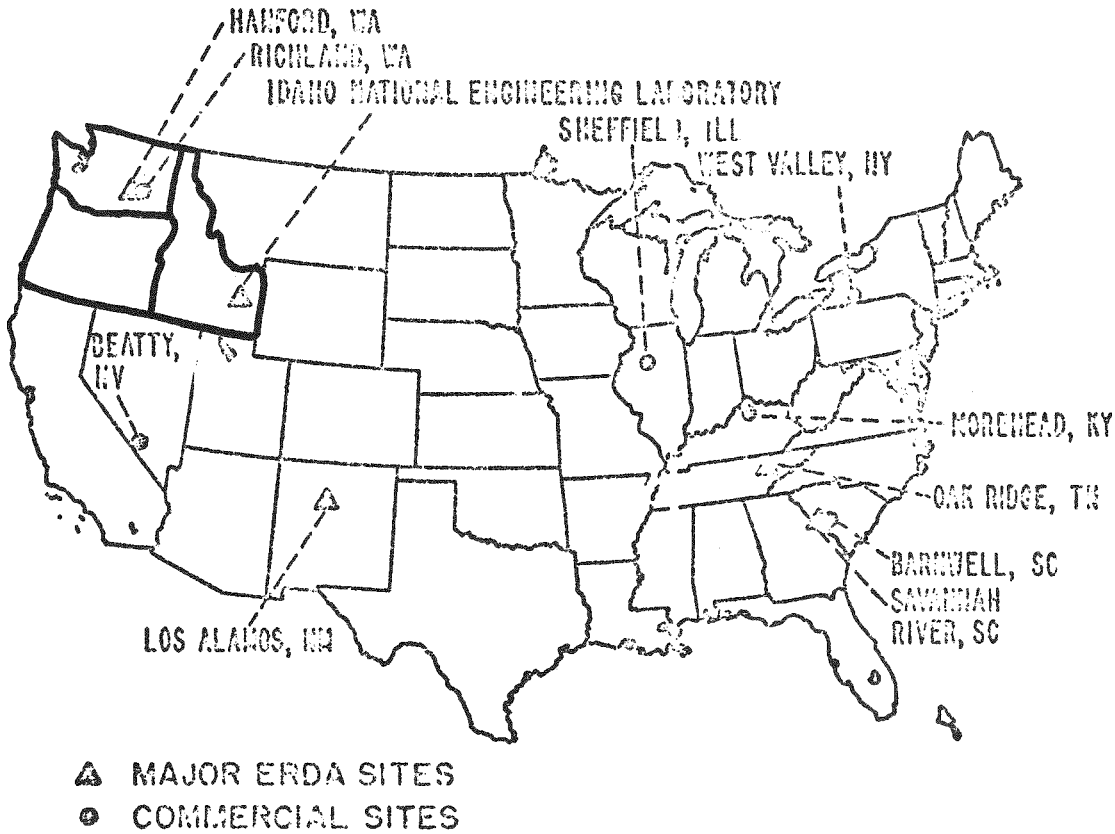


FIGURE II-D-125. Radioactive Waste Burial Site Locations

Data Source: Ref. 39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-35. Licensing Commercial Sites

Activity	Site: Richland, WA
Site Operator	NECO
Site Ownership	Federal, leased to state, leased to NECO
Agreement State	Yes
Activities licensed directly by NRC	Handling and burial of SNM
Activities licensed by State	All other
Burial of plutonium >10 nCi/gm	Pending restrictions
Sample Media	
Water	Three onsite wells, quarterly; offsite surface water, semiannually
Soil	Offsite, quarterly
Vegetation	Offsite, quarterly
Air	None
Other	None

Data Source: Ref. 39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-36.

ENVIRONMENTAL MONITORING RESULTS AT

COMMERCIAL DISPOSAL SITES

Monitoring Activity	Site: Richland, WA
Extent of tritium migration observed	None[a] Possible vapor diffusion in soil
Extent of other radionuclide migration observed	None observed
Transport media	None indicated
Potential causes for future problems	Drastic climate change
Solutions or preventions	Natural conditions sufficient

(a) Environmental surveillance program may be insufficient for detection of all modes of migration.

Data Source: Ref. 39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-37. Burial Ground-Specific Environmental Surveillance Programs at ERDA Sites

Monitoring Activity	Site: Richland, WA
Soil	None specific to burial grounds. Special studies planned.
Vegetation	No routine sampling; samples are taken if surface radiation survey indicates possible activity uptake
Air	None specific to burial grounds (occasional operational sampling)
Other	Earth surface radiation survey; semiannually
Extent of tritium migration observed	None from solid waste burial ground
Extent of other radionuclide migration	Uptake by deep rooted plants (tumbleweed)
Transport mechanisms	Tumbling tumbleweeds
Potential causes for future problems	Uncontrolled plant growth
Solutions or precautions	Plant species control

Data Source: Ref.39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-38. Hanford Commercial Site Waste Inventory

Waste	Units	Richland Site
Waste By-product Material	Curies, non-decayed	190,000
Special Nuclear Material	Grams	1,700
Source Material	Kg	5,000
Total Waste Volume	$Meters^3$	15,550

Waste Buries at Hanford

Waste	Units	Richland Site Amount
Ci		810,000
TRU	g	365,000
U	Kg	600,000
Volume	$Meters^3$	199,000

Data Source: Ref.39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-39. Commerical Burial Site Characteristics

Site Characteristics	Site: Richland, WA
Mean annual precipitation (mm)	200
Surficial material type	Clay, sand and gravel
Thickness (meters)	Over 150
Interstitial permeability to water (cm/day)(a)	Variable
Bedrock material type	Volcanic
Structure	Flat-lying
Ground water depth to shallowest saturated zone (meters)	100
Depth of continuous groundwater zone (meters)	100
Depth to regional aquifer (meters)	100
Surface water proximity	10 km
Flow characteristics	Large, perennial (Columbia River)
Absorptive or ion exchange capacity of material surrounding burial(a)	Moderate
Principal flow paths away from burial	Unsaturated flow in pores

(a) Interstitial permeability and absorptive capacity can be bypassed by flow along fractures or other high permeability zones.

Data Source: Ref.39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-39. (contd)

Operation	Site: Richland, WA
Burial Trench Size (meters)	90 x 8 x 6 deep
Provisions for Water Collection and Containment	None required
Waste Disposal Procedures	Entire trench filled to 0.6 m of surface
Waste Covering Frequency	When trench is filled
Type of Final Cover	Excavated earth fill; no compacting
Depth of Final Cover	Minimum 2 m total; mounded 1 m above grade
Other	

ERDA Waste Burial Ground Operations

Operation	Site: Richland, WA
Burial trench/pit size	1.5-5 wide (bottom width) x 4-8 deep x variable length
Provisions for water collection and containment	None
Waste disposal procedures	Trench filled from one end
Waste covering frequency	Daily after deliveries
Type of final cover	Excavated fill to surface; mounding as necessary
Depth of final cover	Minimum 2.5 m total, or that needed to reduce dose to <1 mR/hr at surface
Other	

ERDA: Alternatives for Managing Wastes from Reactors

Data Source: Ref.39, Alternatives for Waste Isolation and Disposal.

TABLE II-D-40.

EXISTING COMMERCIAL LOW-LEVEL WASTE (LLW)

(AS OF 1/1/77)

Site[a]	Status	Millions of Cubic Feet Buried[b]
Hanford, WA	Open	0.51

(a) Another site near Cimarron, New Mexico, is under consideration by the state

(b) Includes commercial TRU waste buried

Site	Millions of Cubic Feet Buried[a]
Hanford, WA	6.40
Idaho Falls, ID	5.27

(a) Includes previously buried TRU waste

Data Source: Ref. 40, Reports of Task Force for Review of Nuclear Waste Management, p. 119.

TABLE II-D-41.

HAZARDOUS WASTE MANAGEMENT INDUSTRIES'
ESTIMATED PROCESS CAPACITY, 1974

Region	Thousands of Gallons per 24-hour Day				
	Chemical Treatment	Incinera-tion	Secure Landfill	Deep Well Injection	Resource Recovery
Region X					
Washington	28		125		405
Idaho			200		

Data Source: Ref. 12, Environmental Quality Annual.

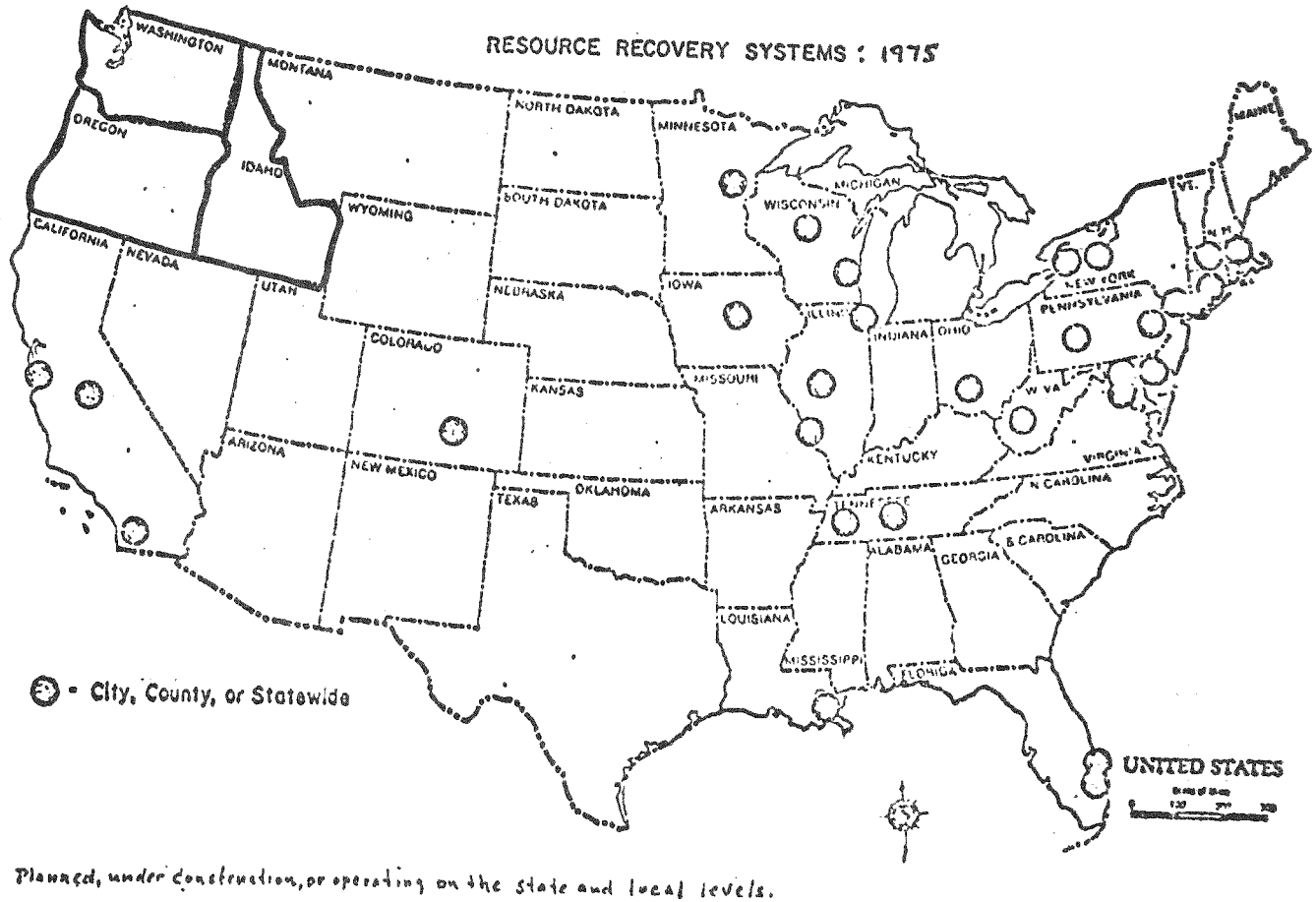


FIGURE II-D-126. Resource Recovery Systems: 1975

Data Source: Ref. 41, Waste Control Act of 1975.

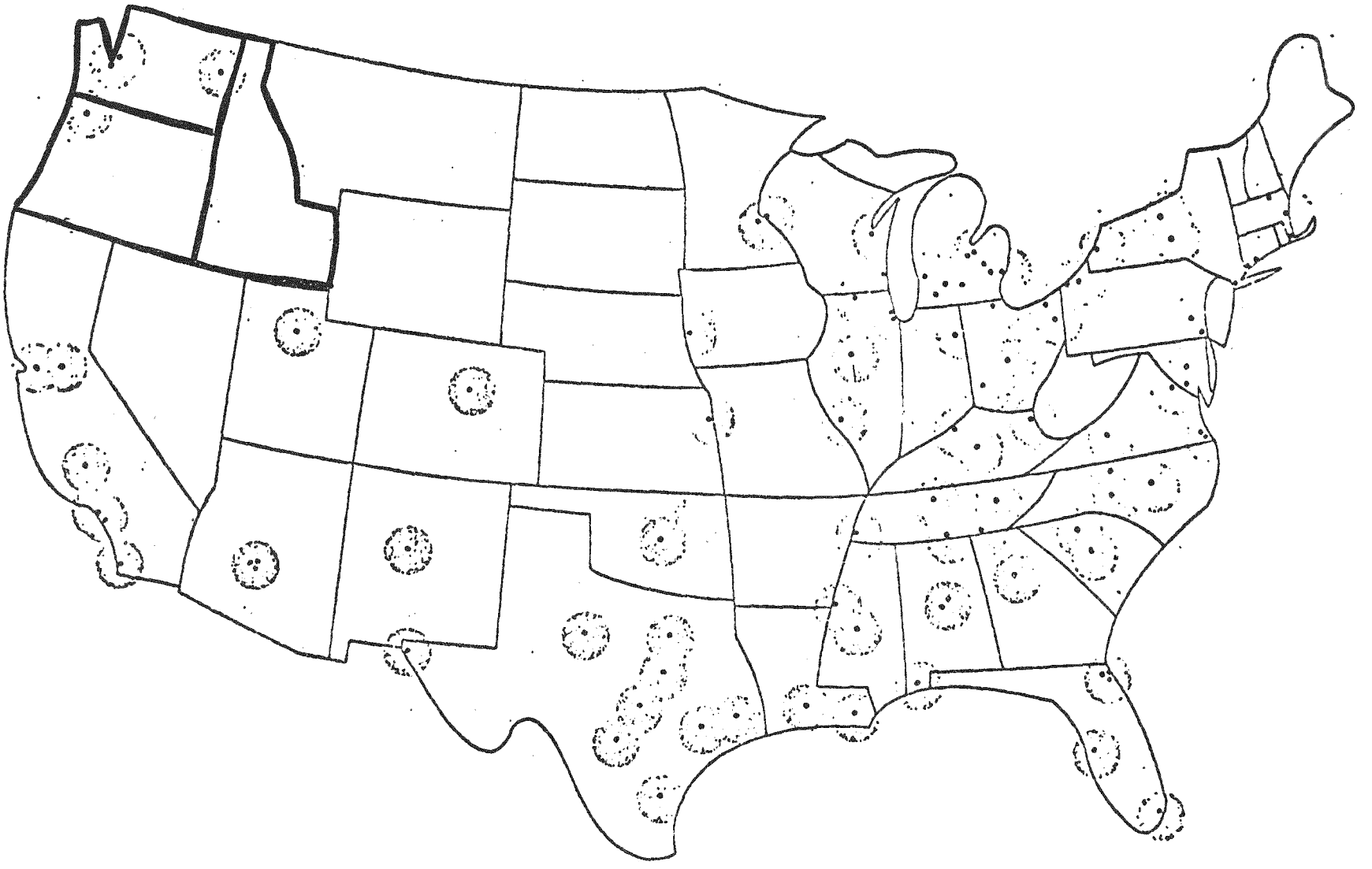
TABLE II-D-42.

MSW ENERGY RECOVERY SYSTEMS

Location	Key Participants	Process	Capacity (ton/day)	Description
Existing Facilities				
None in the NW				
Facilities Planned				
Seattle, WA	City of Seattle	Pyrolysis	1500	Gas produced with possible methanol or ammonia production; 30 MW equivalent power
Projects Under Study				
Eugene, OR	Lane County	Undetermined	1000	24 MW equivalent power Solid waste as fuel; feasibility study completed to use waste as supplemental fuel in a Eugene municipal steam power plant that currently burns wood waste; additional waste fuel is required because wood wastes are becoming scarce.

Facility Feature	Location	Owner or Designer
Recycle	Oregon	Resource Recovery By-products
Recycle	Portland, OR	City
Shredder-Recycle	Tacoma, WA	Pierce Tacoma Resource Recovery
Shredder-Recycle	Cowlitz County, WA	Cowlitz County
Recycle-Incinerator	Whatcom County, WA	County

Data Source: Ref. 41, Waste Control Act of 1975.



Dots represent locations of shredders. Shaded areas represent locations within 150 miles of a shredder.

FIGURE II-D-127. Solid Waste Recovery: Automobile Shredders 1974

Data Source: Ref. 42, Resource Recovery and Source Reduction.

TABLE II-D-43.

SOLID WASTE DISPOSAL

	Estimated Dumps in 1968	Dumps Closed or Converted
U.S. Total	15,616	5,581
Alaska	127	17
Idaho	45	59
Oregon	203	43
Washington	382	93

Data Source: Reference 43, Hearings Before the Subcommittee on Envir. Pollution of the Comm. on Public Works.

TABLE II-D-44.

PROGRESS IN STATE SOLID WASTE MANAGEMENT PLANS — 1974

Area	Inventory Stage	Plan Draft Stage	Plan Completed	Plan Approved
U.S. Total (by States)	1	4	45	44
Alaska		X		
Idaho			X	X
Oregon			X	X
Washington			X	X

Data Source: Reference 43, Hearings Before the Subcommittee on Envir. Pollution of the Comm. on Public Works.

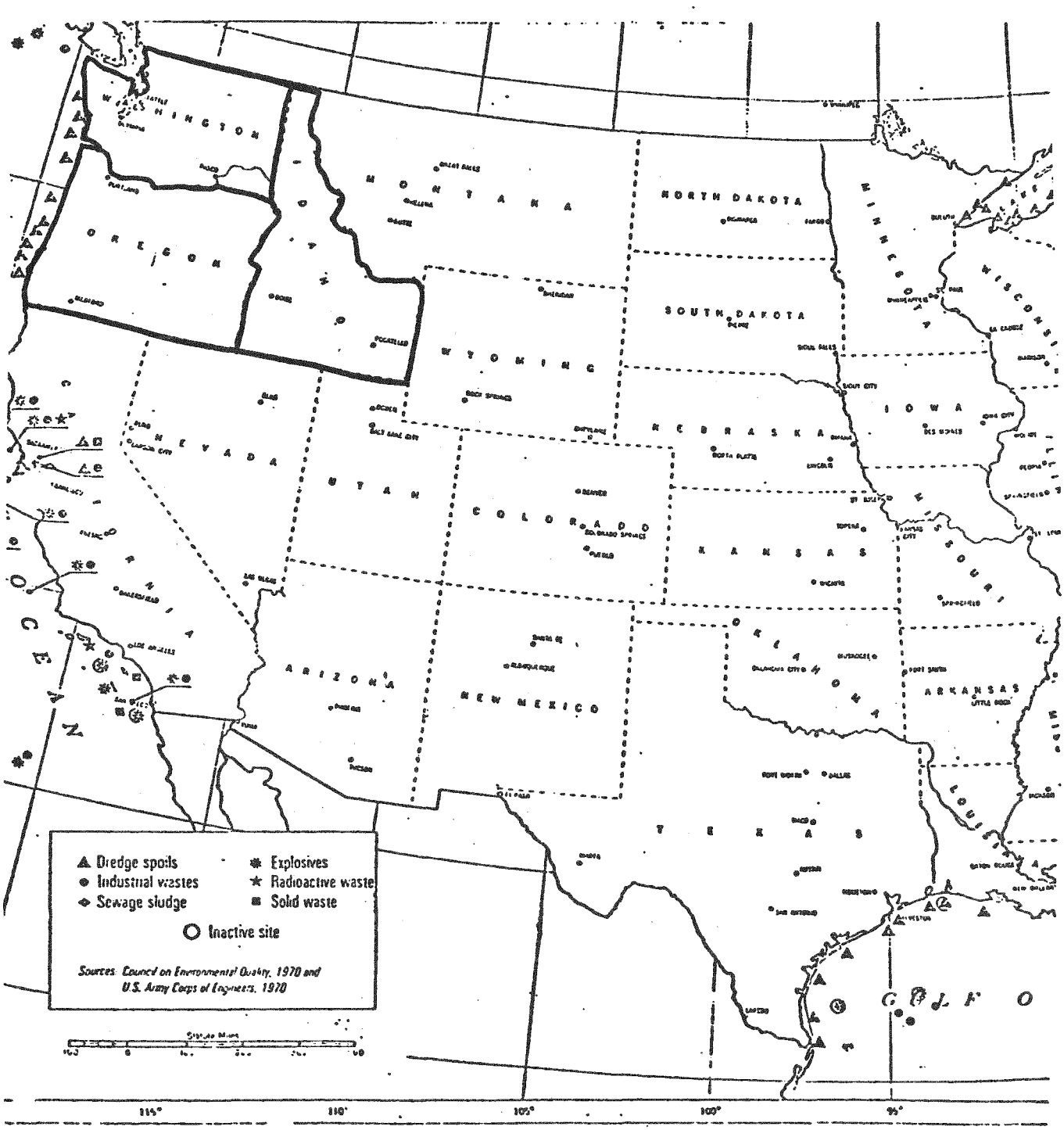
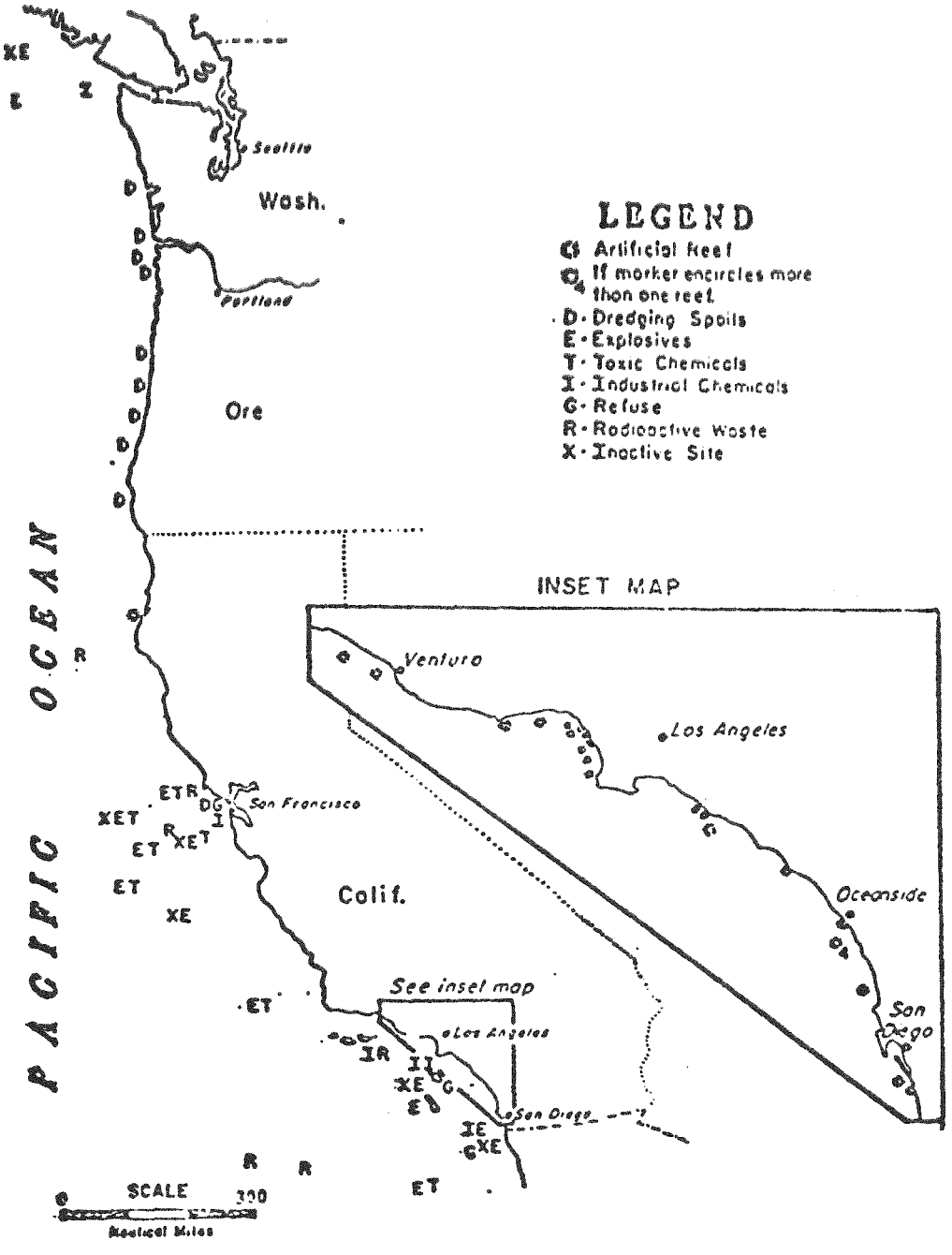


FIGURE II-D-128. Offshore Disposal of Waste: Western United States

Data Source: Ref. 9, Water Atlas.



Pacific Coast Disposal Areas and Artificial Reefs[a]

FIGURE II-D-129. Marine Waste Disposal

Data Source: Ref. 44, Handbook of Environmental Control.

TABLE II-D-45.

MARINE WASTE DISPOSAL
ESTIMATED POLLUTED DREDGE SPOILS

Area	Total Spoils, tons	Estimated Percent of Total Polluted Spoils	Total Polluted Spoils, tons
Atlantic	30,880,000	45	13,896,000
Gulf	13,000,000	31	4,030,000
Pacific	8,320,000	19	1,580,800
Totals	52,200,000	34	19,506,800

Data Source: Reference 44, Handbook of Environmental Control

TABLE II-D-46.

TOTAL U.S. SEA DISPOSAL OF RADIOACTIVE WASTES
1946 THROUGH 1967

Disposal Area	Number of Containers	Byproduct Material, curies	Source Material, lb
Pacific Ocean	52,538	14,708	1,895
Atlantic Ocean	33,998	79,484	Unknown
Gulf of Mexico	1	10	Unknown
Totals	86,537	94,202	--

Data Source: Reference 44, Handbook of Environmental Control

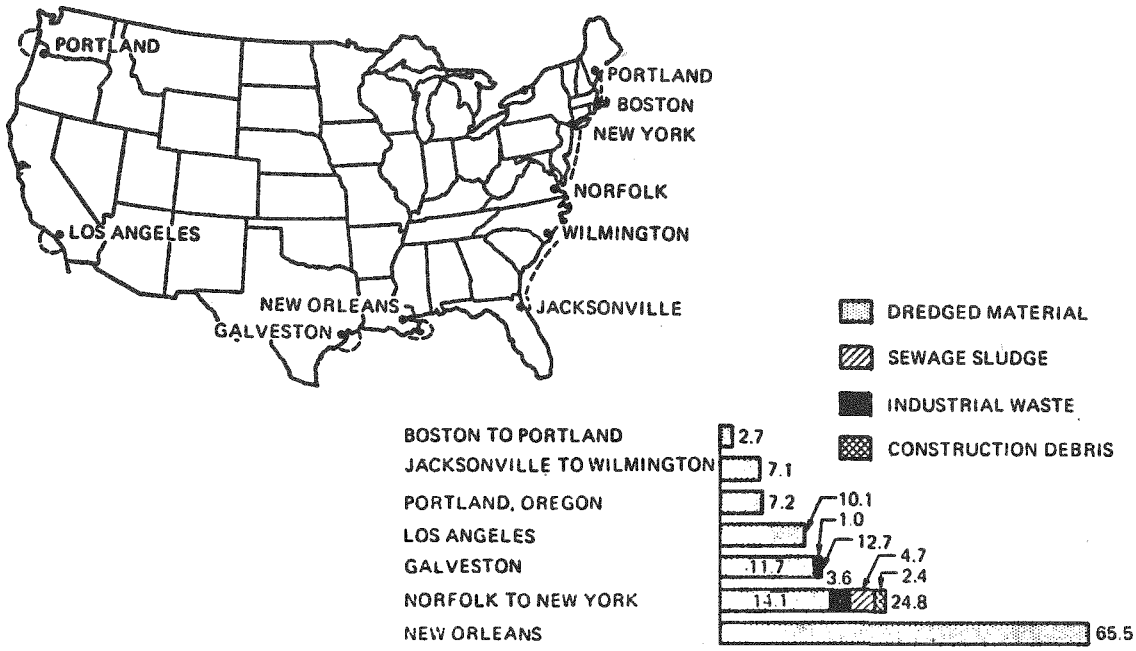


FIGURE II-D-130. Ocean Waste Disposal (in millions of tons) by Category: 1974 (Source: U.S. Department of Commerce)

TABLE II-D-47. Ocean Disposal of Dredged Material (Source: U.S. Army Corps of Engineers)

Army Corps of Engineers Division	1973		1974			1975		
	Millions of cubic yards	Millions of tons	Millions of cubic yards	Millions of tons	Percent of change	Millions of cubic yards	Millions of tons	Percent of change
North Pacific	7.586	7.017	5.982	5.534	−21	7.609	7.038	+21
Total	44.208	40.892	98.164	91.266	−55	87.826	81.239	−10

[a] Data rounded for clarity.

TABLE II-D-48. Types and Amounts (thousands of tons) of Vessels-Discharged Oceans Disposal (Source: U.S. Environmental Protection Agency)

Waste type	Pacific			Total		
	1973	1974	1975	1973	1974	1975
Industrial waste	0	0	0	5.059	4.592	3,446
Sewage sludge	0	0	0	4.899	5.010	5,040
Construction and demolition debris	0	0	0	974	770	396
Solid waste	0.2	0.2	0	0.2	0.2	0
Explosives	0	0	0	0	0	0
Subtotal	0.2	0.2	0	10,924	10,373	8,882
Dredged materials				44,208	98,665	87,826
Total				55,132	109,038	96,708
Change over past year, %					+96	−11

[a] Data may not add to total because of rounding.

Data Source: Ref. 12, Environmental Quality Annual.

TABLE II-D-49. Resource Recovery/Energy Conversions Practices

	Alaska	Idaho	Oregon	Washington
1 Communities Practicing Resource Recovery For Municipal Waste	0	0	277	16
2 Communities Listed in #1 Which Have Investments Of Over $500,000	-	0	4	6
3 Communities Practicing Volutary Separation or Sorting	-	0	275	16
4 Major Separation Of Waste For Resource Recovery Tons/Per/Day	-	0	50	Unknown
5 Processed As Fuel--State Total Tons/Per/Day	-	0	17	Unknown
6 Incentives Required to Stimulate Resource Recovery				
B	2	3	1	3
C				
D	1	1		
E	3	2	2	1
F			3	2
G				
H				
I				
7 No. of Municipal Incinerators as of Oct. 1, 1976	0	0	0	1

Data Source: Ref. 45, Waste Age, March 1977.

TABLE II-D-50. Hazardous Waste Control Practices

	Alaska	Idaho	Oregon	Washington
1 Haulers Of Sludge/Liquid-- Industrial Wastes:				
Licensed/Other		Yes	Yes	Yes
Number	50	67	65	150
2 Special Collection For Hazardous Wastes:				
By State				
Required?	Yes	No	Yes	Yes
Rules & Regs.?	Yes		Yes	Yes
3 Special Processing or Disposal of Hazardous Waste:				
By State				
Required?	Yes	Yes	Yes	Yes
Rules & Regs.?	Yes	Yes	Yes	Yes
4 Control of Liquids/Semi-Solids, Pastes/Sludges Regulated:				
By Current Legislation?	Yes	Yes	Yes	Yes
Effective Date	1973	June 1973	July 1971	Nov. 1972
5 No. of Waste Disposal Facilities Or Sites Able To Handle Hazardous Or Liquid Wastes:				
Permitted Sites	0	7	1	0
Known Sites	0			0
Estimated or Unknown				3

*Column 6
B Technical evaluations of successful operation by experts.
C Citizen support for new concepts
D Better and more stable markets for energy and/or recovered materials.
E Stronger enforcement of existing Legislation
F Better recognization of local government
G More interest on the part of local financiers
H More interest on the part of local secondary materials industry
I More interest on the part of local managers of solid waste systems

Data Source: Ref. 46, Waste Age, April 1977.

TABLE II-D-51. Collection Practices

		Alaska	Idaho	Oregon	Washington
1	Refuse Storage Practices Enforced By:	Municipality Borough	Municipality	State County, Municipality	County
2	State Requirements Allow Collection By:				
	A	x	x	x	x
	B	x	x	x	x
	C	x	x	x	x
	D	x	x	x	x
	E*				
3	Contract Procedures With Private Companies	None	Competitive Bid Only	Competitive Bid Only	Competitive Bid/Negotiations
4	State Attitude On Collection Service				
	A	x	x	x	x
	B				
	C	x	x		x
	D				x
5	Licenses For Solid Waste Collectors By:	State Public Utilities Commission	None	None	State 150
6	Collection Vehicle Specifications Controlled By:	None	Local/State	None	Local/State
7	Proportion Of Refuse Collection Activity By:				
	% Public	50	13	3	5
	% Private	50	87	97	95
8	No. of Transfer Stations Planned In the Next Two Years With:				
	Stationary Compaction	Two	0	0	0
	Top Load Trailers	Unspecific	5	10	10
9	No. of Transfer Stations Operated With:				
	Stationary Compaction	0	1	1	0
	Top Load Trailers	1	3	1	15
10	Licenses For Sludge/Liquid Waste Haulers		yes	yes -- Sewage Sludge Only	Yes
11	No. of Licensed Sludge/ Liquid Waste Haulers	50	67	65	150

Data Source: Ref. 47, Waste Age, February 1977.

TABLE II-D-52. Disposal Practices

	Alaska	Idaho	Oregon	Washington	TOTAL STATES
(1) State Population Provisional(1975)	352,000	820,000	2,238,000	3,544,000	212,408,000
(2) Metropolitan Population Provisional(1974)	143,800	131,500	1,366,700	2,495,500	154,241,000
(3) Revision State Solid Waste Legislation Since 1974?	Yes	no	yes	yes	
(4) State Solid Waste Budget $ 1976	312,000	184,000	387,953	550,000	19,257,511
(5) No. os State Solid Waste Employees(1976)	5.5	7	15	19	651.5
(6) No. of Sites With Impermeable Linings(1974)	0	0	0	0	21
(7) No. of Landfill Impermeable Linings Installed Since (1974)	0	0	1	0	82
(8) No. of Leachate Treatment Facilities Installed in Landfills Since (1974)	1	1	8	6	184
(9) Applications of Daily Cover Over Milled Refuse	Cs. Def.	Req.	Cs. Def.	Cs. Def.	
(10) No. of Known Land Disposal Sites(1976)	400	120	167	410	15,821
(11) No. of Sites Licensed, Permitted Or Otherwise Recognized As Sanitary Landfill In Compliance With State Regulations	84	40	157	50	5,740
(12) No. of Authorized Landfills(1976)	300	47	167	320	9,993
(13) Publicly Owned and Operated(1976)	5	5	94	40	3,681
(14) Privately Owned and Operated(1976)	40	1	47	5	1,696
(15) No. of Landfill Closures Since 1974	6	30	36	90	2,371

Data Source: Ref. 48, Waste Age, January 1977.

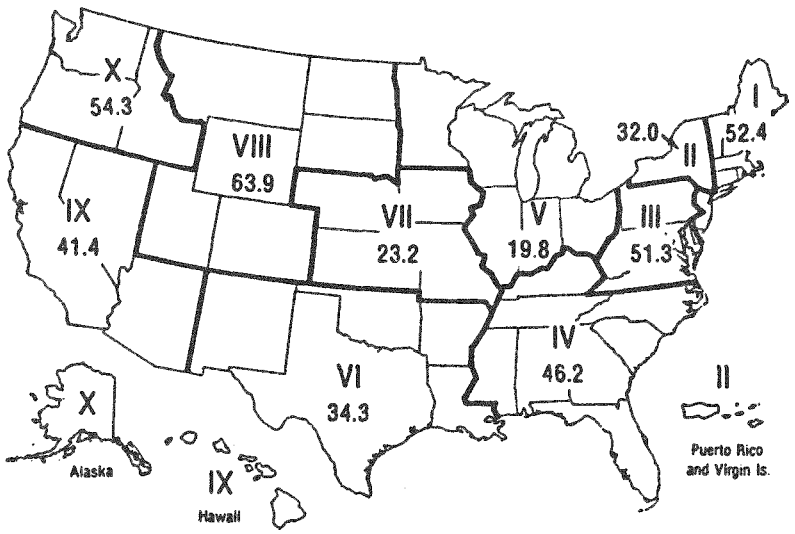


FIGURE II-D-131. Estimated Percent of Population with Secondary Treatment, July 1, 1977

Data Source: Ref. 12, Environmental Quality Annual.

LAND

The Northwest Region's high-quality natural environment is indispensible for maintaining the Regional "quality of life" goal. Both everyday living and outdoor recreation activities are enhanced by the Region's spectacular scenery and natural wonders. Mountains dominate or provide the background for every landscape.(1)

The lower states in the Region are underlain by lava flows, pyroclastics, or sedimentary rocks composed of volcanic materials. Other rock types include granitic, metamorphic, and consolidated sedimentary rocks; these are largely confined to the southern Coast Range, the northern Cascade Range, and ranges of the Rocky Mountain system.(2)

NATURAL LANDSCAPE

Physiographic Provinces for Idaho, Oregon and Washington

Physiographic provinces can be identified because of environmental similarities. The divisions are well documented; however, their names and numbers vary among various publications.

Rocky Mountains--Northern and Middle Rocky Mountains

The Northern Rocky Mountains' province includes parts of northeastern Washington, northern and central Idaho, and western Montana. It is characterized by high mountain ridges and deep intermontane valleys eroded from rocks of moderately complex structure. The mountains of central Idaho, developed by erosion of massive granite rocks, are irregular and resist exploration and settlement. Most of the province drains into the Columbia River.(3)

The Northern Rocky Mountains consist of several mountain ranges formed by erosion of a broad uplifted area of consolidated sedimentary rocks, granitic intrusive rocks, and metamorphic rocks including quartzite, argillite,

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(1) Information Source: Ref. 5. Water Today and Tomorrow.
(2) Information Source: Ref. 4. Columbia-North Pacific Region Comprehensive Framework Study.
(3) Information Source: Ref. 3. Atlas of the Pacific Northwest.

limestone, and dolomite. All of these rocks, except for a few areas of Tertiary intrusive and volcanic rocks, are of pre-Tertiary age. The mountain ranges are separated by broad valleys and basins in which Tertiary volcanic and sedimentary rocks crop out into benches and high terraces and underlie the valley and basin floors beneath surficial deposits of glacial drift, outwash, and alluvium.

The eastern part of the Idaho panhandle is composed mostly of metamorphosed sedimentary rocks of the Belt Series. Mountains in the western part of the Idaho panhandle, in northeastern Washington, and in central Idaho consist chiefly of granitic intrusive rocks, with smaller areas of volcanic and sedimentary rocks. Mountain ranges in Montana south of Missoula, in southeastern Idaho, and in western Wyoming consist chiefly of sedimentary rocks of Paleozoic and Mesozoic age.

Soils developed on the metamorphic rocks are medium-textured, quite permeable, and moderately fertile. Soils formed on the granitic rocks are generally coarse-textured and of low fertility. Although highly permeable, their moisture-holding capacity is low. Wind-deposited, fine-textured soils of good fertility mantle some plateau segments and benches that are underlain by Tertiary basalt or sedimentary rocks. Soils developed on the glacial deposits and alluvium range from coarse sterile sands to deep fertile loams.

Most of the consolidated rocks have low porosity and permeability, and store and yield only small quantities of water. However, a fairly thick zone of soil and subsoil has developed through weathering of the parent rock, and this zone is moderately porous. The water table usually is in this zone, and the aquifer stores and yields a large amount of water that maintains the base flow of streams during fair weather and at times in the winter when the precipitation is held as snow. Peak stream flows generally occur in the spring from precipitation and snowmelt. Minimum flows generally occur in the fall or early winter when ground water discharge is least. The alluvial and outwash deposits in the valleys are porous and permeable. They store and yield large volumes of ground water. Recharge to these deposits consists chiefly of influent seepage

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Information Source: Ref. 4. Columbia-North Pacific Region Comprehensive Framework Study

from streams entering the valleys, and seepage from irrigation. The trunk streams receive large quantities of effluent seepage in their lower courses within the valley.

A part of the Middle Rocky Mountains province extends into southeastern Idaho, where northerly to northwesterly trending mountain ridges and valleys have eroded from folded, thrust-faulted, or tilted rocks. The valleys are about 6000 ft above sea level, and the ridges 2000 to 4000 ft higher. Block-faulting, characteristic of the Basin and Range Province, extends into this area also; therefore, the boundary is somewhat arbitrary.

The northern part of the area lies in the Snake River drainage basin, whereas Bear River on the south, following a circuitous route, eventually drains into Great Salt Lake, as does Malad Valley.

The flattish ridge tops indicate former peneplanation. Subsequent cycles of stream erosion have superimposed many streams in watergaps and have almost completely dissected the land. Travel is fairly easy along the valleys and connecting watergaps.(1)

Central, northern, and eastern Idaho, western Montana, and western Wyoming are covered with numerous ranges which make up this province. About half of these ranges, principally in the northern and eastern parts, have a north-south orientation. Between them are long, narrow valleys through which the major streams flow. The rest of the mountain masses are in blocks rather than linear ranges, and are dissected by steep-walled valleys running in various directions. Elevations rise from 2000 ft in the lowest valleys up to over 12,000 ft on some of the peaks. This group of closely placed mountains makes up the largest physiographic province. The southern part is drained by the Snake River and its principal tributaries, the Salmon and Clearwater Rivers, while the northern part drains to the Columbia in Canada through the Kootenai and Pend Oreille Rivers. Between these two systems, the Spokane River drains a considerable area of northern Idaho westward to the Columbia.(2)

(1) Information Source: Ref. 3. Atlas of the Pacific Northwest
(2) Information Source: Ref, 4, Columbia-North Pacific Region Comprehensive Framework Study.

The Rocky Mountain subregion is the largest. Much of the economy of the area is based upon use of its natural resources, including forestry, mining, and recreation. Livestock production and associated hay forming is predominantly practiced in the broad valleys of western Montana, east-central Idaho, and eastern Oregon. Lumber production in this subregion is not as significant as in the Coastal-Cascade subregion because of climatic extremes.

Population is concentrated along transportation routes in narrow mountain valleys where farmland or mineral deposits provide the principal means of livelihood. The most highly populated area lies along the north-south Rocky Mountain Trench, which supports two-thirds of the western Montana population. The valley bottoms of the Okanogan, Pend Oreille, Flathead, Little Bitterroot, Bitterroot, Clark Fork, and Salmon Rivers support various forms of agriculture.

The largest single landowner in the Rocky Mountain subregion is the federal government, which manages about 75% of the subregion, principally through the Forest Service.(1)

Columbia Intermontane - Columbia River Plateau

The Columbia Intermontane Province includes the Columbia Basin, Central Mountains, Harney High Lava Plains, Malheur-Owyhee Upland, and Snake River Lava Plain. The term Columbia Plateau is inadequate.

The Columbia Basin is an irregular structural and topographic basin underlain by middle Tertiary basalt flows that have been depressed below sea level in the Pasco area and up-warped on the flanks of the surrounding mountains. Fluvial lacustrine, eolian, and glacial sediments overlie much of the basalt, and locally form terraces or other subordinate physiographic features.

The portion in north central Oregon is partly a plateau incised by canyons and partly a low plain of sand and gravel. The portion in south central Washington comprises a series of anticlinal ridges (partly faulted) and synclinal valleys. The outstanding features include Horse Heaven Hills, Yakima Valley, Saddle Mountain, Kittitas Valley, and the Wenatchee Mountains (Frenchman Hills). The Columbia and Yakima Rivers cross several of these ridges in watergaps. Most

(1) Information Source: Ref. 20, BPA Role EIS

of the remainder is a plateau in varying but generally youthful stages of dissection. Noteworth are the Waterville Plateau, Quincy Basin (alluviated), Palouse Hills (silt-covered), and Tri-State Upland (on the southeast). Of the scabland channels, Grand Coulee is chief. The northern edge of the plateau was glaciated.(1)

The Columbia River Plateau is a vast agricultural area. Livestock grazing and farming form the primary economic base of the subregion. Wheat and small grains are grown using dryland farming practices. Over 60 different crops are grown on the irrigated lands, including major crops of sugar beets, alfalfa, wheat, corn, beans, and apples.

By 1973 irrigation water service was available to 526,628 acres in Washington. The Bureau of Reclamation is currently studying the feasibility of irrigating an additional 568,000 acres. Water impoundments provide numerous resting and feeding areas for waterfowl using the Pacific Flyway. These waters are, therefore, also important in sustaining the recreational pursuits of hunters and fishermen. Upland game birds have increased dramatically on the Plateau as a result of grain farming. However, from 1952 to about the mid-1960s they have declined to the present populations. For example, the increase in pheasant population resulted from an increase in habitat caused by irrigation; its decline has been due to increased farming efficiency.

Population is concentrated in Spokane, the main agricultural and financial center, and in the Wenatchee, Kittitas, and Yakima Valleys. One-third of the Plateau's population lives and works in the Yakima Valley. Corporations and private individuals own most of the land in this subregion. The Columbia Basin Irrigation Project has been largely responsible for the rapid rise in population in this arid subregion.(2)

Straddling the Washington-Oregon line, the Columbia Plateau is the central province east of the Cascades. From elevations of nearly 4000 ft around the edges, the plateau slopes gently down to about 350 ft along the gorges of the Columbia and the lower Snake Rivers. At a distance, the plateau appears flat

(1) Information Source: Ref. 3. Atlas of the Pacific Northwest
(2) Information Source: Ref. 20. BPA Role EIS

or gently rolling, but it is dissected by present-day streams, and in the northern part by deep, vertical-walled coulees which were formed as temporary flood water channels during the time the course of the Columbia River was blocked by an ice sheet. Many small rivers drain the area, which extends south from the upper curve of the Columbia to the Blue Mountains, west to the foothills of the Cascades, and east above the Snake just east of the Washington-Idaho line.

Throughout most of the Columbia Plateau the volcanic rocks are overlain by varying thicknesses of surface materials. Almost everywhere upland surfaces are mantled with anywhere between a few and more than 100 feet of loess or windblown sand. North of the Columbia River, glacial outwash, sand and gravel, and lacustrine silt fill basins and channels in the basalt. Soils on the outwash range from sandy loams to silt loams and generally gravelly in the profile. Soils on lake beds are compacted stratified silts. The loess and other windblown deposits range from sand to silt loams. These soils are deep and fertile, and are easily eroded.

The Columbia River Group, the glacial outwash,, and the younger alluvium along present streams yield large quantities of water at many places. The alluvium, glacial outwash, and windblown deposits have a high porosity and store large volumes of water where saturated. However, in many places those deposits are above the water table, which is in the underlying basalt, having low average porosity. Much of the area is semi-arid to arid. Annual recharge probably does not exceed 3 in., and in some places may be equivalent to less than 1 in. of water over the area.

In the western and southern parts of the Columbia Plateau, most of the discharge of streams is generated in the Cascade Range and in the Blue and Ochoco Mountains. A considerable part of the eastern Columbia Plateau has little or no external drainage.(1)

The Central Mountains comprise a complex group of folded and faulted uplifts, including the Seven Devils, Wallowa, Elkhorn, Greenhorn, Aldrich, and

(1) Information Source: Ref. 4. Columbia-North Pacific Region Comprehensive Framework Study.

Ochoco Mountains. They rise 200-5000 ft above their surroundings, and reach elevations of 6000-10,000 ft. They include various rocks of differing erosion resistance. Because of orographic rainfall, the mountains are dissected to about the stage of maturity. The higher portions, especially the Wallowa Mountains, were glaciated. Alluviated fault troughs occur within the mountains, as at La Grande, Oregon.

The Harney High Lava Plains are situated between the Central Mountains, the Basin and Range area, the Cascade Mountains, and the Malheur-Owyhee Upland. They are mainly a flattish, youthful tract of late Cenozoic lavas, ranging in elevation generally from about 4000-5000 ft. The surface is lower near the Deschutes River canyon, the only major stream in the area. Volcanoes are abundant in the western portion. Chief among them is Newberry Volcano (Paulina Mountain), with its breached caldera.

The Malheur-Owyhee Upland occupies parts of southeastern Oregon and southwestern Idaho. It is a partly dissected, warped plateau, mostly 4000-8000 ft high and underlain mainly by Cenozoic lava flows, tuffs and lake beds. Most of the area is unmapped and essentially unstudied. The Owyhee River and its tributaries drain much of the area in deeply incised canyons.

The Snake River Lava Plain is an arcuate down-warp 30 to 60 miles wide and about400 miles long. It descends gently from an elevation of about 6000 ft above sea level at its east end to about 2200 ft on the west. The eastern part is a more or less silt-covered, youthful lava plain, almost featureless except for low laval domes and occasional cinder cones. Very young lavas occur at Craters of the Moon, Hell's Half-Acre, and elsewhere. The western part of the plain is underlain by lake beds and alluvium, as well as by lava, and it is partly dissected by terraces, box canyons, and open valleys. As a result of its open terrain, its soils, waters, and other favorable factors, the Snake River Lava Plain supports a large and growing population.(1)

The Snake River Plateau, like the Columbia Plateau, supports an economy based primarily upon agriculture. This subregion, which also is extensively irrigated, is noted principally for its production of potatoes, beets, beans,

(1) Information Source: Ref. 3, Atlas of the Pacific Northwest

hay and wheat, sheep, and beef cattle. Most of the area is rangeland used for livestock grazing. The largest ranches in the Pacific Northwest are located in this subregion.

Population is concentrated around four main areas: the Boise-Payette district, the Twin Falls-Burley district, Ontario, and the American Falls Reservoir. The federal government is the largest single landowner in this subregion, owning and managing 65% of the land area, which is principally under the control of the Bureau of Land Management.(1)

Basin and Range Province

The northern edge of the Great Basin section of the Basin and Range Province extends into south central Oregon and into southern Idaho. The part in Idaho consists of a series of tilted fault blocks and parallel stream valleys developed in a region of folded rocks. By contrast, the part in Oregon is a youthful high lava plain interrupted by fault block mountains and by fault troughs. Representative of the high-standng blocks are Steens Mountain, Hart Mountain, Albert Rim, and Winter Ridge. Typical fault troughs are Alvord Basin, Warner Valley, and the basins of Abert, Summer, Goose, and Klamath Lakes. Small volcanoes of late Cenozoic age are numerous in the western portion, where a sheet of pumice extending over an area of more than 10,000 square miles greatly modifies the vegetation, surface runoff, and land use. Hundreds of young fault scarps cross the area. A few high rims are dissected. The northern boundary is transitional.(2)

Cascade Mountains

The Cascade Mountains of Oregon and the southern half of Washington are a broad up-warp composed of:

- a basal portion of early Tertiary tuffs, breccias, lavas, and mudflows, exposed in Columbia River Gorge and other deep valleys;
- a thick middle section of middle Tertiary basalts that form the deeply eroded Western Cascades; and

(1) Information Source: Ref. 20, BPA Role EIS
(2) Information Source: Ref. 3, Atlas of the Pacific Northwest

- an upper section of late Tertiary and Quternary andesites and basalts that form the less dissected High Cascades lava platform, which is generally 15-25 miles wide and 4000-6000 ft high along the crest of the range. Crowning the range are a number of well-known, snow-capped volcanic peaks in various stages of dissection--Mt. Rainier, Mt. St. Helens, Mt. Adams, Mt. Hood, Mt. Jefferson, Three Sisters, Mt. McLoughlin, and others. Rough lava fields of postglacial age occur locally, as at Belknap Crater and McKenzie Pass.(1)

North of a line marked approximately by the courses of the Cedar and Yakima Rivers, the Cascade Range consists of a very rugged group of mountains carved from folded, faulted, and uplifted older (pre-Tertiary) igneous and metamorphic rocks such as granite, gneiss, schist, and greenstone. However, the two highest peaks, Mount Baker and Glacier Peak, were formed as volcanic cones built above the general level of the other mountains. South of the Cedar and Yakima Rivers, the Cascade Range is dominantly constructional; that is, formed by outpouring of volcanic flows and pyroclastics in two periods: during the early and middle Tertiary, and in the late Tertiary and Quarternary Periods. The older volcanic terrain has been considerably modified by errosion, but the younger volcanic rocks that form the High Cascade Range have nearly retained their original form intact.

Soils in the northern Cascade Range are residual, and range from light, erodible, sandy loams to heavy clay loams. Soils on the older Tertiary volcanic rocks generally have a deep profile, and range from porous "shot" soils to heavy loams with clay subsoils. Younger volcanic rocks have a shallower soil and some of the youngest materials have little soil development.

The igneous and metamorphic rocks generally have low porosity and permeability; however, a deeply weathered zone of soil and subsoil, which is moderately porous, stores a considerable amount of water that is discharged into streams during periods of low flow. Because this storage is shallow and gradients are steep in the rugged mountains, the ground-water reservoirs are drained rapidly, and the base flow of streams becomes very low during periods

(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.

of prolonged drought. The volcanic rocks range widely in their porosity and permeability. The older rocks in the Cascade Range generally have a moderate-to-moderately-low porosity and permeability, but store a considerable volume of water in the upper part of the saturated zone. Ground-water storage depletes rather rapidly, and streams draining these aquifers have low base flows after prolonged drought. The younger volcanic rocks are porous and highly permeable, at places accepting more than 100 in. of precipitation without any surface run-off. Some streams draining areas underlain by such rocks receive 75% to 95% of their average discharge as ground-water effluent. These streams, as a rule, have relatively strong flows during dry seasons of the year.

The main crest of the Cascade Range lies at about 5000 ft elevation, while several of the volcanic peaks of the range rise above 10,000 ft. Mt. Rainier reaches over 14,000 ft; Mt. Adams above 12,000 ft; and Mt. Baker, Mt. Hood, Mt. Jefferson, and the Three Sisters above 10,000 ft. Except for a narrow gorge where the Columbia River has cut a route through to the ocean, this long mountain range sharply separates the coastal from the interior portions of the region and has a strong influence on the climate of both parts.(1)

Valleys have been carved deeply into the western part of the range because of heavy precipitation. Their steep upper ends were glaciated during the Pleistocene. Terrace remnants occur in their lower reaches.

The northern half of the Cascade Range of Washington is a maturely dissected upland, underlain by ancient sediments that have been folded, metamorphosed, and intruded by granites. The more or less accordant ridges rise to elevations to 6000-8000 ft. Above them rise several monadnocks (e.g., Mt. Stuart) and two volcanic cones (Mt. Baker and Glacier Peak). The northern Cascades were severely glaciated, and the mountains now harbor many small glaciers.(2)

Pacific Border

The Pacific Border Province includes the Klamath-Siskiyou section, Coast Range, Olympic Mountains, and Willamette-Cowlitz-Puget Lowlands.

(1) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study

(2) Information Source: Ref. 3, Atlas of the Pacific Northwest

The Klamath-Siskiyou section is an area of ancient, generally resistant rocks that have been more or less beveled by erosion, uplifted a few thousand feed, and then dissected in two or more later cycles almost to maturity. The Siskiyou summits are essentially monadnocks above the Klamath peneplain.

The Coast Range of Oregon and Washington consists of moderately folded marine tuffaceous sandstones and shales, together with basaltic volcanic rocks and related intrusives. There also have been peneplaned, raised 1000 to 2000 ft or more, and then eroded by streams to a generally submature stage. Resistant igneous rocks account for certain summits and for several capes projecting seaward. Sea terraces, sand dunes, and other shore features occupy narrow strips along the coast. Drowned valleys provide many harbors, and the drowned lower course of the Columbia River offers a route through the Coast Range.(1)

The Klamath Mountains, at the southern end of the Coast Range, consist of a complex of pre-Tertiary sedimentary and volcanic rocks, large areas of which have been metamorphosed to schist, gneiss, and greenstone. Intrusive igneous rocks, ranging from granite to periodotite and serpentinite, crop out in several large areas. The entire complex has been folded, faulted, uplifted, and greatly eroded to form a rugged mountain group with canyons and a few broad, alluvia-floored valleys.

The Coast Range proper extends from about the Rogue River northward to the Chehalis River, and consists of consolidated rocks of Tertiary age. Marine sedimentary strata, including sandstone, siltstone, and shale, with small amounts of limestone, predominate in the southern part of the range in Oregon; basaltic and adesitic flows and interbedded pyroclastics and tuffaceous sediments predominate in the northern part of the range in Oregon and southern Washington. The rocks have been folded and faulted, but not metamorphosed. Uplift and dissection have produced a rugged terrain, with sharp canyons and narrow alluvium-floored valleys.(2)

The Olympic Mountains consist of a mass of folded and metamorphosed rocks eroded into sharp, steep-sided ridges that stand 4000 to 8000 ft above sea

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(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.
(2) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.

level. A broad central core consists of early Tertiary and pre-Tertiary argillite and graywacke partly surrounded by rings of successively younger early-to-middle Tertiary volcanic and sedimentary rocks. Folding and uplift have resulted in a broad, deeply dissected dome-shaped mountain range with radial drainage. The highest peaks bear perpetual snowbanks and several small glaciers. The mountains were severly glaciated during the ice age.

Narrow coastal plains, underlain by unconsolidated to semi-consolidated sand, silt, and gravel at places, extend along the Oregon and Washington coasts. Marine silt and clay, and fluvial sand and gravel (all of early Pleistocene age) form a broad terrace around the southwest flank of the Olympic Mountains.

Practically all the soils in the Coast Range division are formed in colluvium and residuum developed by weathering of the underlying bedrock under humid conditions. Differences in the soils are primarily related to differences in the environment and underlying rocks. Soils on the sedimentary strata are grayish-brown to reddish-brown, sandy loams to clays. Soils on the volcanic rocks are red to brown, lateritic loams to clay loams.

Most of the rocks are older Tertiary, or pre-Tertiary in age, and have been compacted, cemented, and altered so that little of the original porosity remains. Most of the ground water occurs in joints and other rock fractures, and in the weathered zone. Drilled wells obtain water from the fractured rock, and yield small industrial or municipal use. Alluvial deposits in some valleys and in dune and beach sands along the coast yield greater quantities of water.

Because the section is mountainous and maturely dissected, tributary streams are short and have steep gradients. Direct surface runoff is rapid. Considerable ground water is stored in the subsoil and upper part of the bedrock, but the storage is shallow, hydraulic gradients are steep, and groundwater storage depletes rapidly during periods of no recharge. For these reasons, the base flow the the streams becomes small during prolonged drought.

There are few peaks in the Coast Range proper which exceed an elevation of 3000 ft. The mass of the Olympic Mountains at the extreme north rises

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Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.

sharply, and peaks reach nearly 8000 ft. The Klamath Mountains rise abruptly from sea level to elevations of more than 5000 ft. Most of the drainage from these coastal mountains is by small rivers running westward to the Pacific Ocean. There are, however, several larger valleys and estuaries providing gaps in the mountains. Where the Coast Range meets the Klamaths and forms an east-west barrier, the streams flow westerly from the Cascades to the Pacific Ocean.

The Willamette-Puget Sound Trough lies for the most part below 1000 ft elevation and between the Cascade Range to the east and the Coast Range and Olympic Mountains to the west. It is between 30 and 50 miles wide, and about 350 miles long. During the down-warping, subflexures developed so that the trough is interrupted at several places by hills extending along or part way across the trough. Alluvial and lacustrine deposits of late Tertiary age, and alluvial, glaciofluvial, and glacial deposits of Quarternary age underlie the floor of the trough. North of Centralia most of the surface material is of glacial origin, deposited by an ice sheet that extended into the area from Canada. The hills rising above the alluvial floor consist of sedimentary and volcanic rocks identical with those that crop out in parts of the flanking mountain ranges and that underlie the alluvial deposits in the trough.(1)

The Willamette and Cowlitz Lowlands are primarily stream valleys eroded to low elevations in belts of relatively nonresistant tilted or Tertiary rocks. Resistant rocks locally form hills and watergaps. Both valleys contain alluvial terraces. Although they were once mature, an alluvial fill has made their floors young again. The Puget Lowlands, eroded by streams and Pleistocene glaciers, is a partially drowned system of valleys. Hummocky plains of till and fairly smooth sheets of glaciofluvial gravel border Puget Sound.

The Willamette-Cowlitz-Puget Lowlands are especially favorable to the needs of man, and support a large fraction of the total population of the region.(2) Approximately 68% of the region's population lives in the Puget

(1) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study

(2) Information Source: Ref. 3, Atlas of the Pacific Northwest

Sound-Willamette Lowlands subregion. The regional urban centers of Seattle, Tacoma, Portland, and Eugene are the foci of industrial and commercial activity. The rural landscape supports an intensive agricultural base.

An important advantage that this subregion has over other subregions in the Northwest is its easy access to the sea. Puget Sound and the Columbia River provide access to several deep-water ports, including Seattle and Portland, which are the principal import-export outlets for the region.(1)

The present streams have cut down into the basin fill, and a thin veneer of recent alluvium has been deposited along the flood plains. Residual soils have developed on the sedimentary and volcanic rocks. Soils on the sedimentary rocks are commonly gray to brown, sandy loam to clay loam, and those on the volcanic rocks are reddish deep clay loam to heavy clays. Soils on the bench lands north of Centralia have developed on the glacial deposits, and include stony brown to reddish loam and clay loam on the till, and soils ranging from fine sandy loam to coarse gravelly loam, depending upon the character of the underlying glacial outwash. In the valleys, the soils are recent alluvial sediments. In the Cowlitz and Willamette Valleys soils include recent alluvium and gray to brown, sandy to clayey loams developed on older alluvial deposits.

Many wells drilled in coarse sand and gravel in the alluvial and glacial deposits have moderately large to very large yields. Because of medium-to-heavy precipitation in the section and bordering mountains, recharge is high; generally, much potential recharge is rejected as surface runoff. Large supplies of ground water are available at many places.

Most of the larger streams originate in the flanking mountain ranges; their flows are augmented by ground-water effluent from the alluvial deposits in the basins. The Willamette River in Oregon drains the area south of the Columbia River. In Washington, the Lewis and Cowlitz Rivers serve as tributaries to the Columbia, the Chehalis River drains into the Pacific Ocean, and the Skagit and other smaller rivers emptying into Puget Sound drain the northern part of the Trough.(2)

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(1) Information Source: Ref. 20, BPA Role EIS.
(2) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study

Seismic Activity

The Pacific Northwest is an area of moderate earthquake activity, with written records of seismic events dating back to 1833. The map of Figure II-E-141 shows zones of seismic risk. This figure has been adapted from the Uniform Building Code of 1976.

Earthquakes are measured in terms of either the amount of energy they release (magnitude, expressed on the Richter Scale) or the degree of ground shaking they cause at a particular locality (intensity, expressed on the Mercalli Scale). The magnitude scale is a logarithmic expression of the energy released by an earthquake, and is measured on a seismograph. Each whole unit of magnitude may represent a 50- to 70- fold increase over the preceding magnitude.

Earthquake intensities, on the other hand, are determined by personal observation of the effects of earthquakes on people, on structures like buildings, and on the earth's surface. Table II-E-56 defines 12 measurements of intensity ranked in their increasing order of strength. These intensities apply to the seismic risk zones of Figure II-E-141.

Tsunamis, known as seismic sea waves, could cause significant damage to the Washington and Oregon coasts should severe earthquakes occur in the Pacific Basin. The greatest damage from tsunamis is most likely to occur where waves are funneled into constricted areas such as bays or estuaries.

Oregon's wide continental shelf and generally high and rugged coastline with protruding headlands act to dissipate the speed and impact of tsunami waves. However, the location of most of the populace in low-lying areas and along estuaries makes the potential for tsunami damage high.

The largest recorded tsunami wave to hit the Oregon Coast occurred about midnight on March 27, and early morning of March 28, 1964. This tsunami was generated about 6 hr earlier (5:36 p.m., Alaska Time) by a submarine earthquake in the North Pacific Ocean, 80 miles southeast of Anchorage. The quake (known as the Good Friday Earthquake of Alaska) caused waves to move the length of

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Information Source: Ref. 20, BPA Role EIS, III-8.

the Pacific Coast, doing catastrophic damage to some ports, particularly along the Alaskan Coast and at Crescent City, California.

LAND USE

Land capability is determined by the following physical factors:

- character and kind of soil (water-holding capacity, texture and structure, nutrient level, and existence of minerals);
- associated land features (topography); and
- climate.

Physical characteristics are not subject to the control of man, and thus two considerations must be followed--one being that a certain type of practice must be followed that improves upon a natural state, and secondly, consideration must be given to the type of practice. From the three-state area only about 15% of the land is suitable for irrigation. Of this, 71% is Class III and IV, which should be cultivated with intensive conservation practices. Lands (46%) listed for forestry and grazing are also limited. Land suitability varies with each state. Washington has 27% of its land suitable for agriculture, compared with 10% for Oregon and Idaho.

Recreation

Recreation is one of the Region's most important resources, and a diversity of opportunities exists for enjoyment of leisure time. The recreational amenities of the Region are of very high quality, with alpine meadows, dense rain forests, deserts, and miles of public beach within a few hours' drive of major population centers.(1) The Northwest prvides some of the nation's most valuable developed and undeveloped recreational resources. The combination of proposed lands in Alaska and designated lands in Washington, Oregon and Idaho provides the Northwest with the highest percentage of recreational lands in the nation.

Forest lands, wilderness, rivers and lakes, beaches and dunes, and State and National Parks offer a multitude of opportunities for outdoor activity.

(1) Information Source: Ref. 20, BPA Role EIS.

Maintenance of a quality Regional environment is essential to the enjoyment of the outdoor recreational experience. Figure II-E-155 shows the distribution of important outdoor recreational resources in the Region.

Forest lands provide a significant recreational resource, with over 45,000 square miles of forest under the management of the U.S. Forest Service. The Forest Service maintains 1800 forest camps that provide day and overnight facilities to recreationists. These camps are generally filled to capacity on weekends during peak summer months.

Under multiple-use management concepts, the Forst Service has constructed thousands of miles of trails that provide access to these remote areas. The National Trails System Act provides the means for attaining a national systemp of recreational, scenic, and connecting trails "in order to promote public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas of the Nation." The Pacific Crest Trail in the Northwest was designated as subject to consideration for inclusion as a National Scenic Trail.

Frequency of use is increasing in these fragile alpine environments, causing severe ecological pressures and a deteriorating wilderness experience. Entry into many wilderness areas is being regulated in an effort to control group size and points of entry.

There are five National Parks in the Region: Olympic, Mt. Rainier, and North Cascades in Washington; Crater Lake in Oregon; and Glacier in Montana. The western and northern boundaries of Yellowstone National Park are also in Idaho and Montana. The National Park Service administers 3400 square miles of park land that were visited by approximately 4.5 million people in 1970 (excluding Glacier and Yellowstone). In addition, the National Park Service administers several National Recreation Areas, Monuments, and Historic Sites.

The Bureau of Reclamation, Corps of Engineers, and many private coporations all perform valuable recreation functions, particularly with regard to water-related activities. Reservoirs constructed in conjunction with hydroelectric, flood control and irrigation projects have created several hundred

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Information Source: Ref. 20, BPA Role EIS.

thousand acres of water surface. In 1970 more than 9 million visitors used these reservoirs for boating, fishing, swimming, and water-related recreational activities.

Many thousands of miles of free-flowing rivers and natural lakes also are used extensively for recreation in the Region. Numerous possibilities exist for lake boaters or white water enthusiasts. Several rivers in the Region have been classified under the Wild and Scenic Rivers Act of 1968. Those rivers or portions thereof designated as components of the Wild and Scenic River System include the Rogue and John Day Rivers in Oregon, the Middle Fork of the Salmon and Clearwater Rivers in Idaho, and portions of the Middle Snake River on the Oregon-Idaho border. Numerous study rivers have also been designated for possible inclusions as components of the Wild and Scenic Rivers System.

The Bureau of Land Management (BLM) has in recent years developed recreation facilities in many areas of the Region. As recreation pressures continue to increase on Forest Service lands, many people are finding enjoyment and solitude at rangeland recreation sites developed by BLM. Of particular significance is the Steens Mountain recreation area now being developed in southeastern Oregon. The BLM also has recreation sites in the Coast Range.

In addition to federal recreation developments, there are several hundred state parks scattered through the region; the principal state parks are shown in Figure II-E-155. These are concentrated along the Oregon and Washington coasts, the Columbia Gorge, and on the western flanks of the Cascade Range. Attendance in 1970 totaled more than 40 million visitor-days.

Forests

Forestry and wood products industries are the primary economic activities in the Region, accounting for the major proportion of Regional employment and gross Regional product. The commercial forests of the Region are found principally in the Cascade-Coast Range and Rocky Mountain subregions.

A major portion of the commercial timber harvest occurs west of the Cascade Range, where uniform stands of Douglas fir are predominant and natural

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Information Source: Ref. 20, BPA Role EIS.

productivity is high. These forest have long been recognized as having many diverse and important resource values.(1)

Rapid forest regeneration west of the Cascade Range can be attributed to favorable climate, resulting in near-optimum growing conditions. Other important commercial species in the subregion are western hemlock, western red cedar, sitka spruce, and, on the eastern slopes of the Cascade Range, ponderosa pine.(2) Douglas fir is the predominant species except in areas such as the humid slopes of the Coast Range, where western hemlock and Sitka spruce are important. In the upper slopes of both the Coast and Cascade Ranges, the stands are composed of true firs, western hemlock, mountain hemlock, and lodgepole pine.(3)

The Rocky Mountain subregion, while generally much less productive because of climatic extremes, supports mixed species, with lodgepole pine and Douglas fir of important commercial value. Annual yields drop dramatically from 120 cubic feet per acre (CFA) west of the Cascades to 50 CFA in the forests of central Idaho and western Montana.(4) The true firs, western white pine, larch, and ponderose pine are also important species, of which the latter two are found principally in northern Idaho and western Montana. Western red cedar, western hemlock, and Engelmann spruce are lesser constituents.

Generally speaking, the forest lands of the Columbia-North Pacific Region are in reasonably good condition. Thirty-three percent of all ownerships have a high stocking level of desirable tree species, 34% have a medium level, and 30% are poorly stocked. Only 3% are nonstocked. Within the poorly stocked stands, 40% are publically owned and 60% are privately owned. Although the understocked areas need further improvement, present inventories support current levels of timber harvesting.(5)

Approximately 60% of the forest land in the lower part of the three-state region has been incorporated into the National Forest System and is managed

(1) Information Source: Ref. 20, BPA Role EIS.
(2) Information Source: Ref. 20, Ibid
(3) Information Source: Ref. 4, Columbia-North Pacific Region Comprehensive Framework Study.
(4) Information Source: Ref. 20 BPA Role EIS.
(5) Information Source: Ref. 4, Columbia North Pacific Region Comprehensive Framework Study.

under multiple-use concepts, as the value of the forest extends far beyond that of commercial production. The National Forests are open to private cutting on a sustained-yield basis, under the management and regulation of the U.S. Forest Service.

State- and county-managed forests have largely adopted Forest Service management practices and techniques. More than 30% of the commercial forests in the lower region are held by private interests, principally major timber companies. These companies have adopted silviculture practices and have developed harvest techniques and methods that maintain lands at high levels of productivity.

Forests provide important habitat for big game and other wildlife, and are essential to the protection of watersheds. In addition, forests provide an important recreational resource.

Rangeland

Rangeland in the Pacific Northwest comprises a significant area in the Snake River Plain and Rocky Mountain subregions. Rangeland may be separated into three general types, which are determined by climate, soils, and topography.

In the first rangeland type, areas at highest elevations are characterized by open greassland, in which bunchgrasses are dominant, by perenial open grassland, in which bunchgrasses are dominant, and by perennial forbs and shrubs. These areas occur primarily on side slopes and ridgetops. Groups of trees are interspersed in the ravines and on northern exposures. This kind of range provides important summer forage for sheep, cattle, elk and deer.

In the second rangeland type, open range occurs at intermediate elevations just below the lower fringes of the timbered areas. It is intermingled with, or surrounded by, timbered areas in northern Idaho, western Montana, and at lower elevations in western Oregon and Washington. These grasslands are more extensive than those on the higher elevation range. The forage is of a

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Information Source: Ref. 20, BPA Role EIS.

type that will tolerate drier conditions, and it consists largely of perennial bunchgrasses and forbs. Meadows are quite prevalent along the creeks and rivers. This kind of range furnishes spring, early summer, and fall forage for livestock. It also provides important spring, fall, and winter forage for deer and elk.

In the third rangeland type, a more gently sloping range at the lowest elevations is characterized by bunchgrasses, sagebrush, shrubs, and perennial forbs. This range occurs on plateaus, river bottoms, flats, and benches.

On all the range there are areas where the original desirable vegetation has been replaced largely by undesirable vegetation as a result of long periods of excessive use by both game and livestock, of natural and man-caused fires, of droughts, and of other abusive uses. Noxious and poisonous plants such as goatweed, hologeton, larkspur, medusahead, and wildrye are quite prevalent in certain localities.

Much of the region's rangeland is managed by the BLM. A fundamental problem confronting range management agencies is the control of grazing, or "reconciling growth requirements of forage plants with nutritional requirements of grazing livestock." Improper grazing has in many areas resulted in severe depletion of forage, necessitating closure or restriction of many rangeland areas.

Agricultural Cropland

Agriculture in the region is highly diversified. Grains, fruits, vegetables, livestock, and dairying are important agricultural enterprises. In addition, several specialty crops, including hops, grass seed, peppermint, grapes, potatoes, and nuts are grown.

Agricultural lands are widely distributed throughout the region. The Columbia Plateau is one of the principal dry land wheat growing areas in the United States. Major irrigation projects on the Columbia Plateau have allowed the introduction of row crops including sugar beets, potatoes, corn, and beans. Several thousand additional acres will be placed into cultivation as new irrigation pumping stations and water mainlines are completed.

Information Source: Ref. 20, BPA Role EIS.

The Puget Sound-Willamette Lowlands subregion is important for the cultivation of mixed crops and for dairying and raising livestock. Orchards occupy nearly 10% of the cropland, with apples and pears accounting for much of the acreage. A significant conflict in this subregion is that farms in proximity to urban centers are being subdivided for residential uses. Land conversions have been increasing, with many prime agriculatural acres taken out of producton each year.

A third concentration of agricultural activity occurs on the Snake River Plains in Idaho. Approximately 50% of the row crops in the region are grown in this area. Potatoes, sugar beets, and corn are the principal crops in this subregion. Extensive areas of the Snake River Plains are irrigated.

Agriculture in the Northwest Region has undergone an evolution similar to that in the rest of the country. There has been a steady decline in the numbers of farms and an increase in farm size. This increase has to some degree been precipitataed by participation of large corporations in major agricultural development. This trend is particularly evident in the Columbia Basin.

Information Source: Ref. 20, BPA Role EIS.

LAND OWNERSHIP

The large percentage of public ownership in the Region has had significant bearing upon Regional growth and development, and has provided opportunities for effective land management programs not possible in most other regions of the country. These programs, administered principally through the U.S. Bureau of Land Management, the U.S. Forest Service, and state natural resource departments are responsible for protection and maintenance of valuable forest range areas, and of water quantity and quality through regulation and control of resource use.

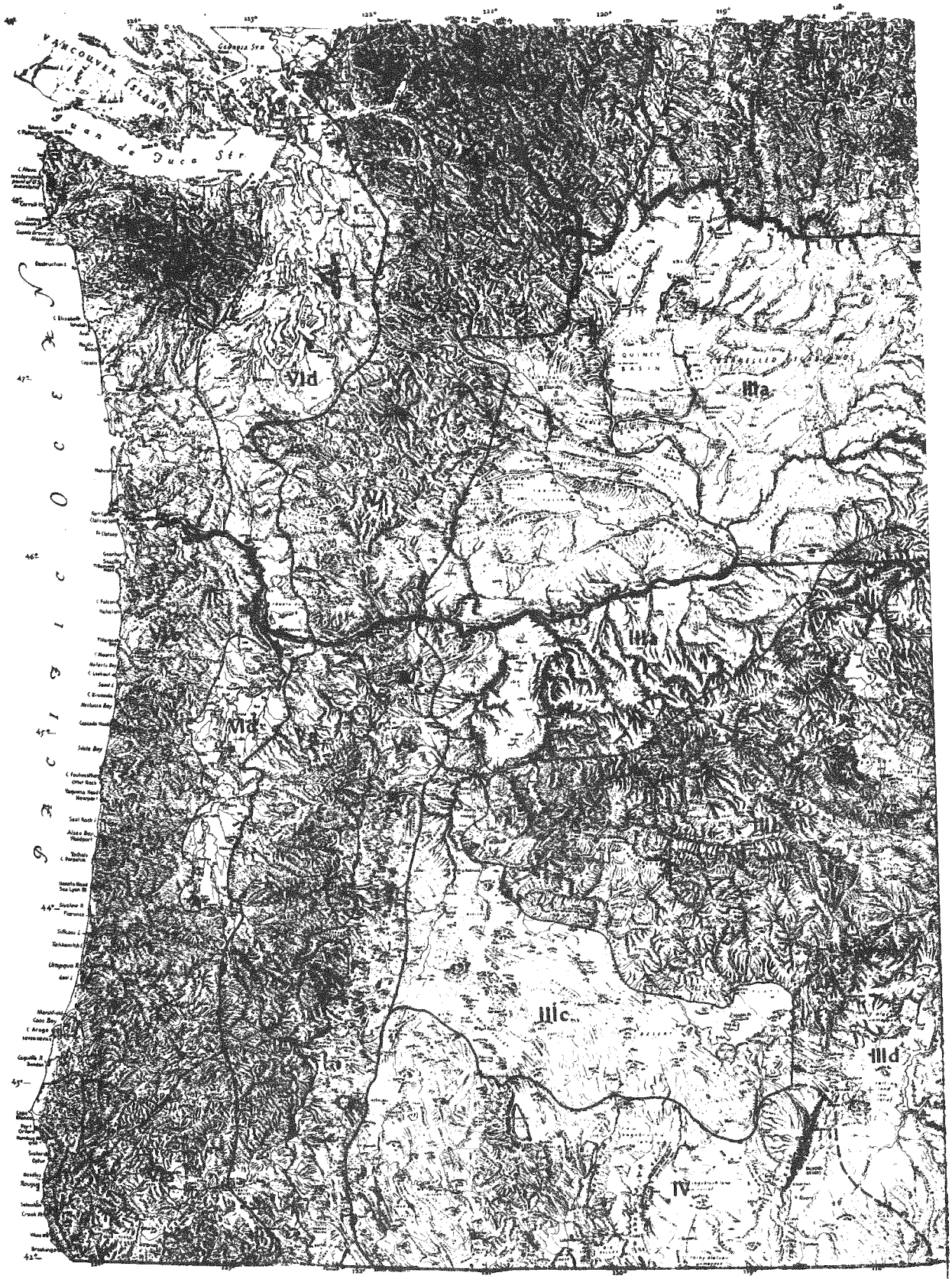
Figure II-E-152 shows the distribution of major ownerships in the Region. Various agencies of the federal government manage approximately 55% in the lower part of the Region, with the Forest Service and BLM controlling over 85,000 square miles, or 90%, of the federal land. The Bureau of Indian Affairs, Bureau of Reclamation, National Park Service, and Fish and Wildlife Service account for the remaining federal ownership.

In the lower part of the Region, state and local governments own approximately 9,500 square miles, the majority of which are managed by state forestry and fish and game departments. Private lands account for 69,000 square miles, with a large proportaion of this area in agricultural and forest lands. Urban land areas total less than 2,600 square miles.

Table II-E-67 summarizes land use and ownership for the Region. Major land uses may be broken down as follows: forest land, 49%; rangeland, 34%; cropland, 12%; urban land, 3%; and other land, 2%. Other lands are generally defined as alpine tundra, rock outcroppings, and areas of continuous rock or sand. Land-use distributions are shown on Figure II-E-146.

Retention of large parcels of land in public ownership has had a significant effect on Regional land use, allowing effective resouce management, and making possible a productive and generally sustained resource base. In addition, these large public holdings have provided an abundance of recreational opportunities.

Information Source: Ref. 20, BPA Role EIS.


VANCOUVER ISLAND
Juan de Fuca Str
Pacific Ocean
VId
IIIa
IIIb
IIIc
IIId
IV

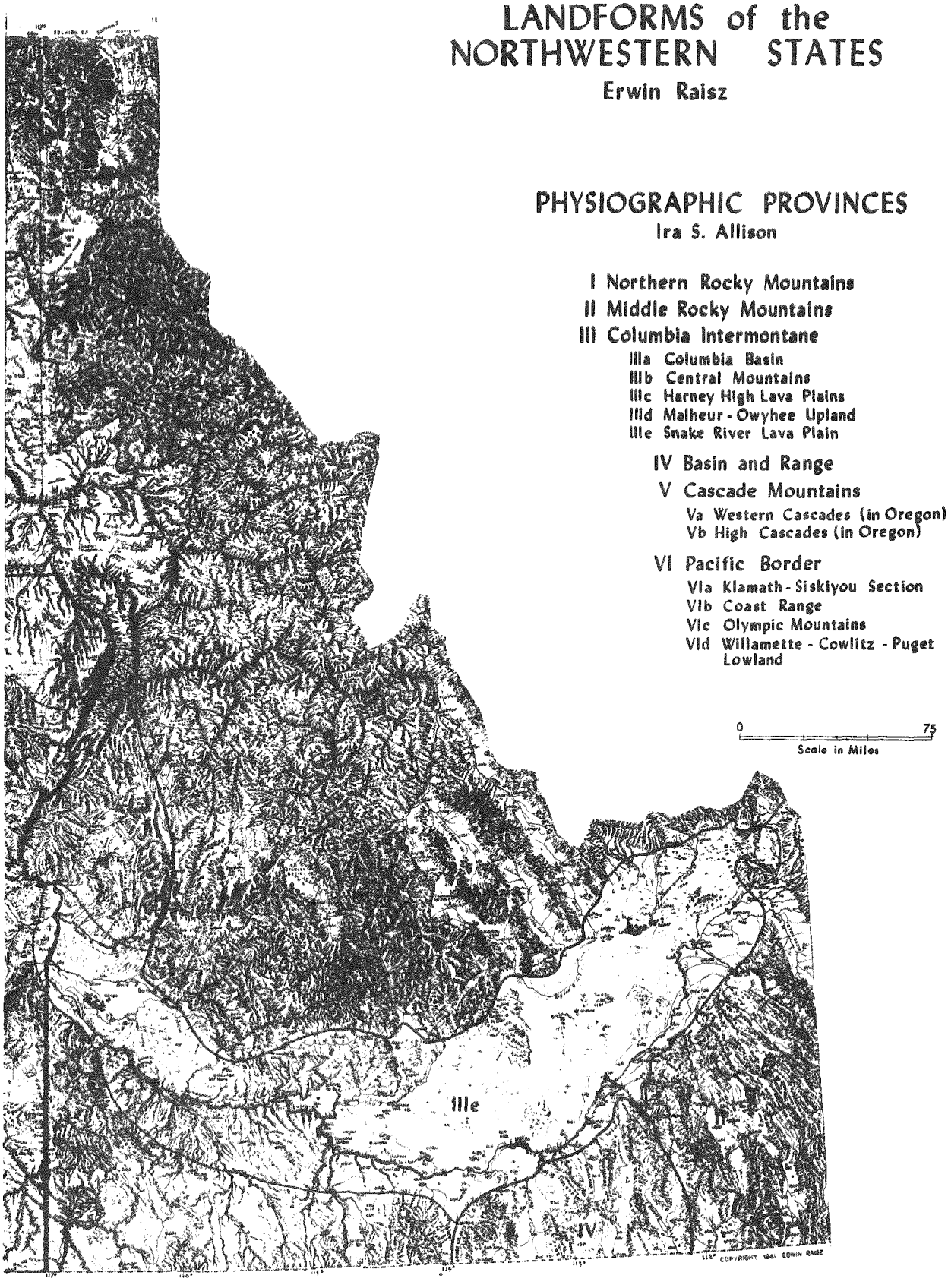
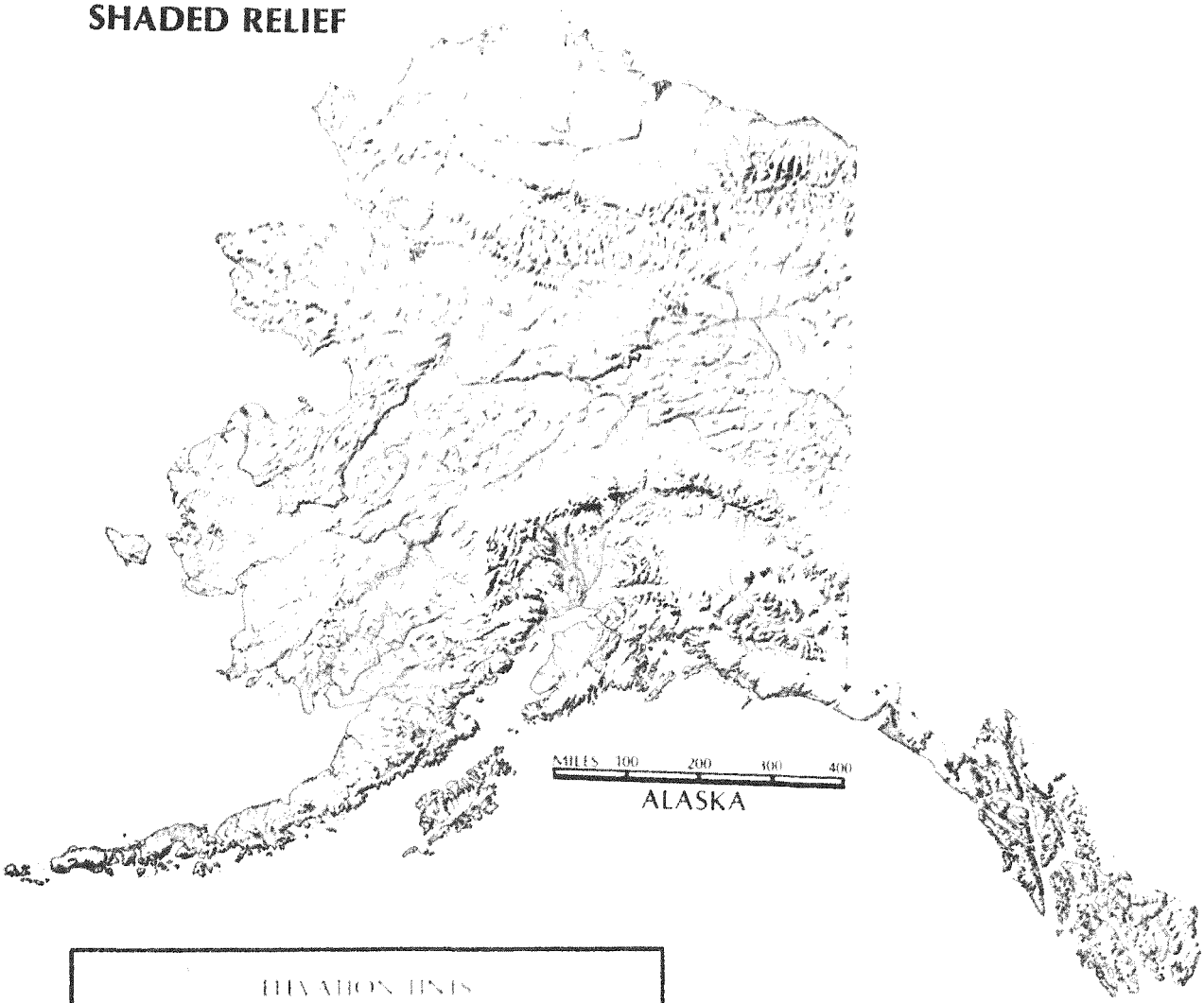


FIGURE II-E-132. Physiographic Provinces

Data Source: Ref. 3, Atlas of the Pacific Northwest, p. 29.



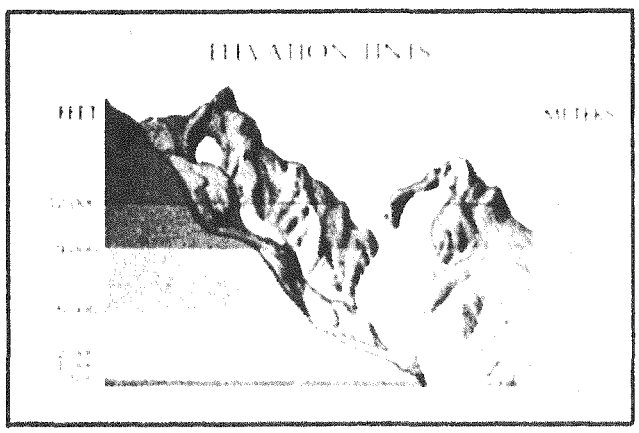


FIGURE II-E-133. Physiographic Features of Alaska

Data Source: Ref. 13, National Atlas, p. 58.

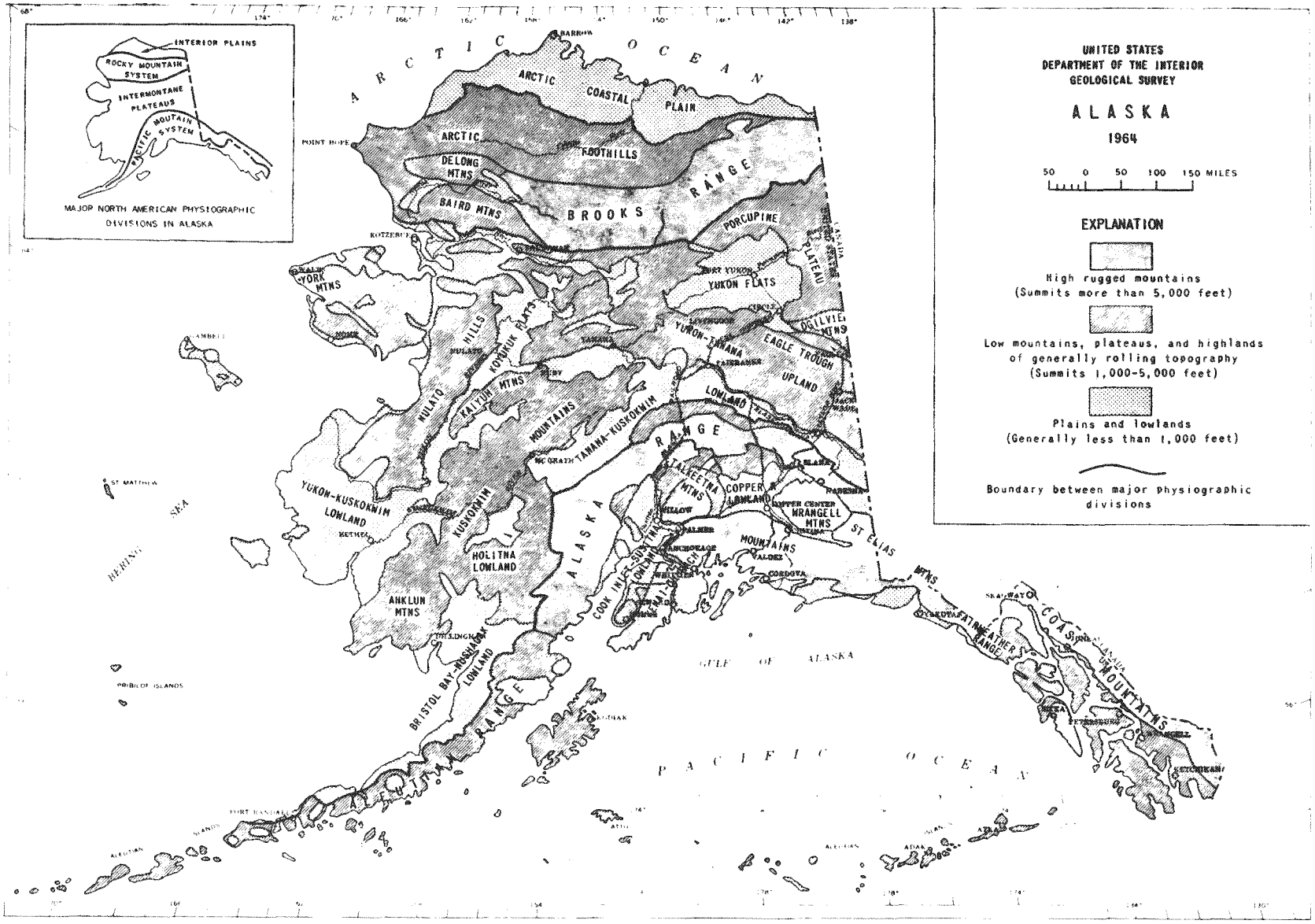
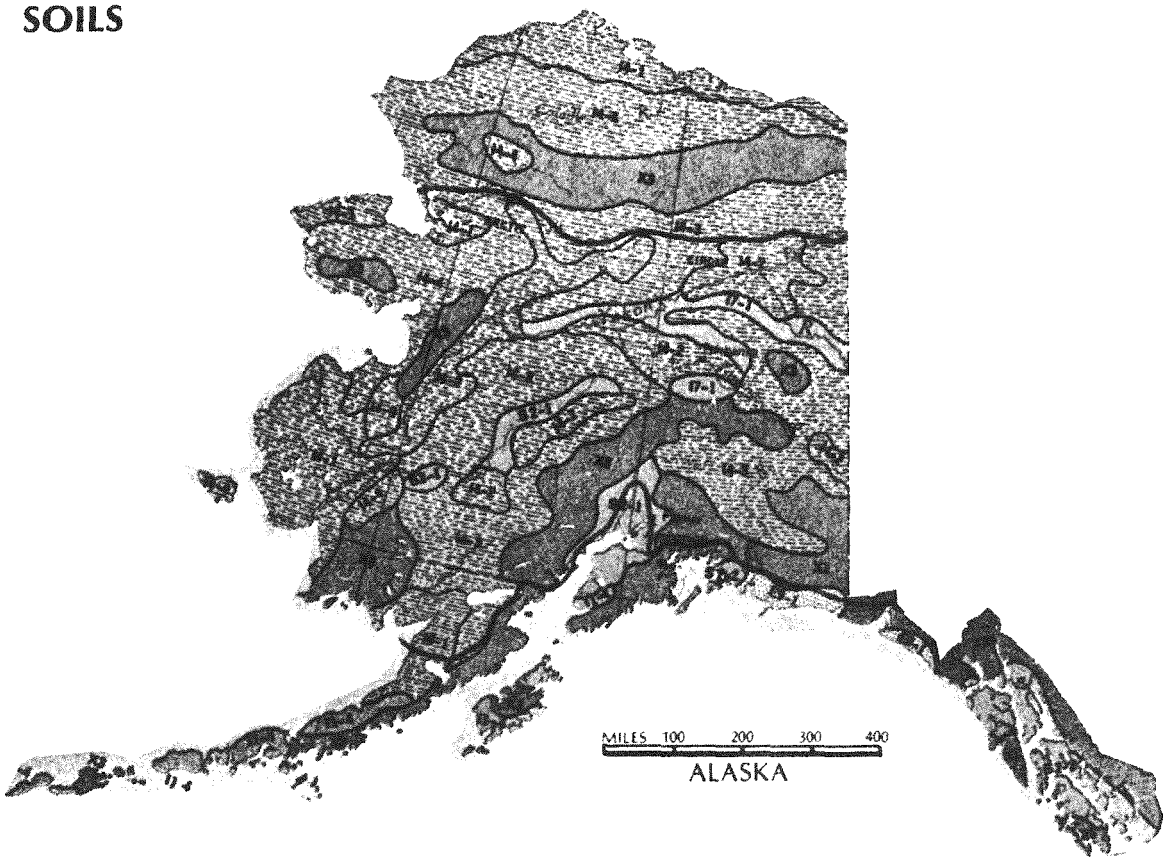


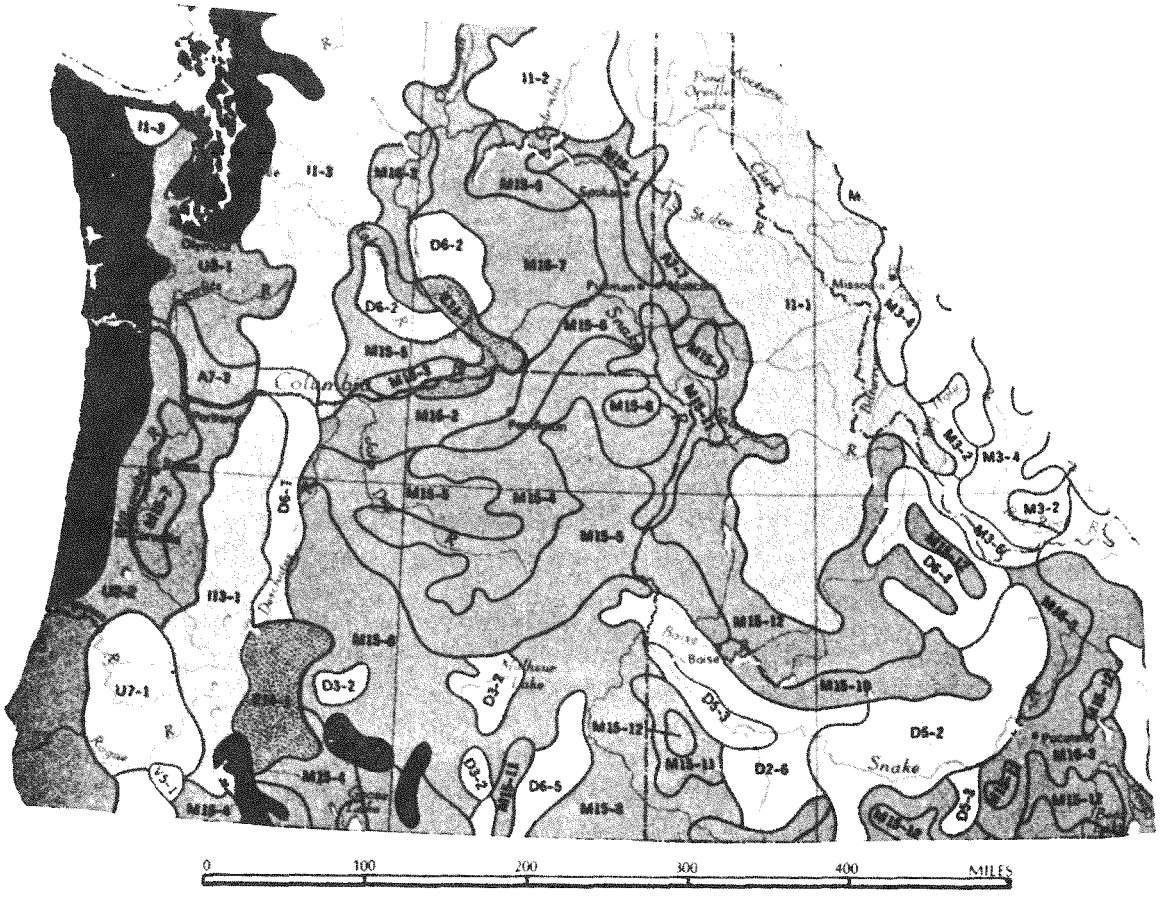
FIGURE II-E-134. Physiographic Provinces of Alaska

Data Source: Ref. 11, Environmental Atlas of Alaska, p. 15.

SOILS



	WARM SOILS Mean annual soil temperature higher than about 47°F			COOL SOILS Mean annual soil temperature lower than about 47°	
	MOIST	WET	DRY	MOIST	WET
INCEPTISOLS	Andepts Dystrandepts I2 Ochrepts Dystrochrepts I8 Eutrochrepts I9 Fragiochrepts I10 Tropepts I12 Umbrepts Haplumbrepts I14	Aquepts Haplaquepts I5 Humaquepts I6	Andepts Eutrandepts I3 Ochrepts Ustochrepts I11	Andepts Cryandepts I1 Ochrepts Cryochrepts I7 Umbrepts Crymbrepts I13	Aquepts Cryaquepts I4
MOLLISOLS	Udolls M6 M7 M8	Aquolls M1 M2[1]	Ustolls M9 M10 M11 M12 M13 M14 Xerolls M15 M16	Borolls M3 M4 M5	
OXISOLS	Orthox O1		Ustox O2		
SPODOSOLS		Aquods S1		Orthods S2 S3 S4[2]	
ULTISOLS	Humults U2 U3 Udults U4 U5 U6	Aquults U1	Xerults U7		
VERTISOLS	Uderts V1 V2		Usterts V3 V4 Xererts V5		



	WARM SOILS (Mean annual soil temperature higher than about 47°)			COOL SOILS (Mean annual soil temperature lower than about 47°)	
	MOIST	WET	DRY	MOIST	WET
ALFISOLS	Udalfs A6[1] A7[1] A8	Aqualfs A1 A2	Ustalfs A9 A10 Xeralfs A11 A12 A13	Boralfs A3 A4 A5	
ARIDISOLS			Argids D1 D2 D3 D4 Orthids D5 D6		
ENTISOLS	Psamments Quartzipsamments E10 Udipsamments E12[1]	Aquents E1	Fluvents E2 Orthents E3 E4 E5 E6 E7 E8 Psamments Torripsamments E11 Ustipsamments E13 Xeropsamments E14	Psamments Cryopsamments E9	
HISTOSOLS		H2			H1

FIGURE II-E-135. Distribution of Principal Kinds of Soils: Orders, Suborders and Great Groups

Data Source: Ref. 13, National Atlas, pp. 86-87.

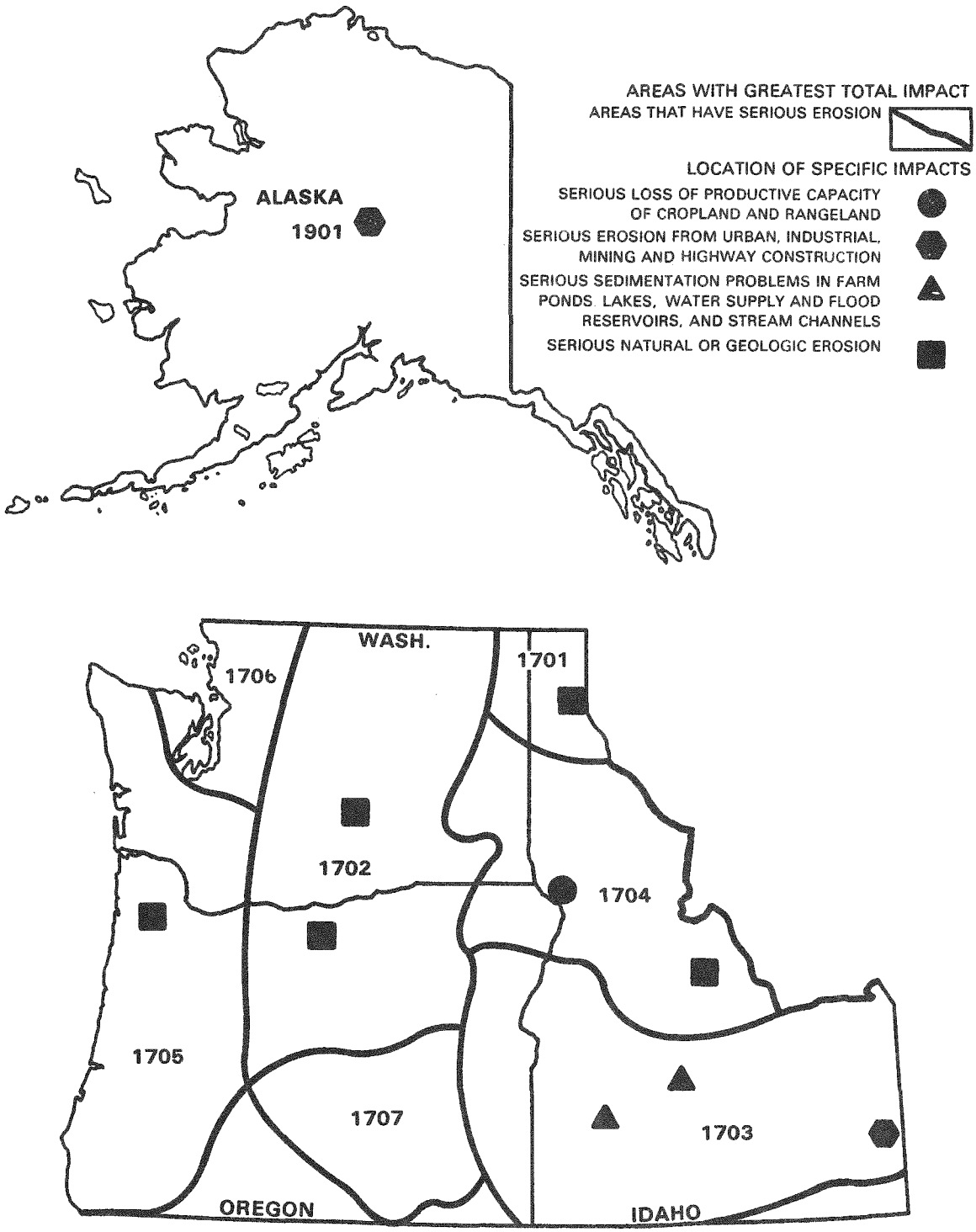


FIGURE II-E-136. Erosion of the Land Resource Base

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

TABLE II-E-53

PRESENT ANNUAL SEDIMENT YIELD RATES BY REGION AND STATE

State	Drainage Area (sq.mi.)	Annual Sediment Yield in Acre-Feet per Sq.Mi.						Annual Sediment	
		>3.0	1.0-3.0	0.5-1.0	0.2-0.5	0.1-0.2	<0.1	Total Acre Feet	Acre-Feet per sq.mi.
Idaho	83,557	82	1,350	5,509	5,390	7,487	63,739	12,460	0.15
Oregon	97,037	-	-	1,413	10,708	38,093	46,823	12,890	0.13
Washington	67,303	425	2,015	2,043	3,591	32,259	26,970	14,700	0.22
Region	247,897	507	3,365	8,965	19,689	77,839	137,532	40,050	0.50

Data Source: Ref. 21, Critical Water Problems Facing the Eleven Western States.

TABLE II-E-54

EXISTING STREAMBANK EROSION IN TERMS OF BANK MILES

State	Total Channel Length Stream Miles	Watersheds < 400 sq. mi. Moderate Erosion Length Bank Miles	Moderate Erosion Soil Loss tons/mile	Serious Erosion Length Bank Miles	Serious Erosion Soil Loss tons/mile	Total Channel Length Stream Miles	Watersheds > 400 sq. mi. Moderate Erosion Length Bank Miles	Moderate Erosion Soil Loss tons/mile	Serious Erosion Length Bank Miles	Serious Erosion Soil Loss tons/mile
Idaho	90,500	4,920	390	567	740	2,763	1,057	820	0	0
Oregon	84,900	11,781	300	2,131	290	3,046	0	0	900	1,000
Washington	62,350	7,195	190	934	480	2,875	477	320	427	750
Region	237,750	23,896	880	3,632	1,510	8,687	1,534	1,140	1,327	1,750

Data Source: Ref. 21, Critical Water Problems Facing the Eleven Western States.

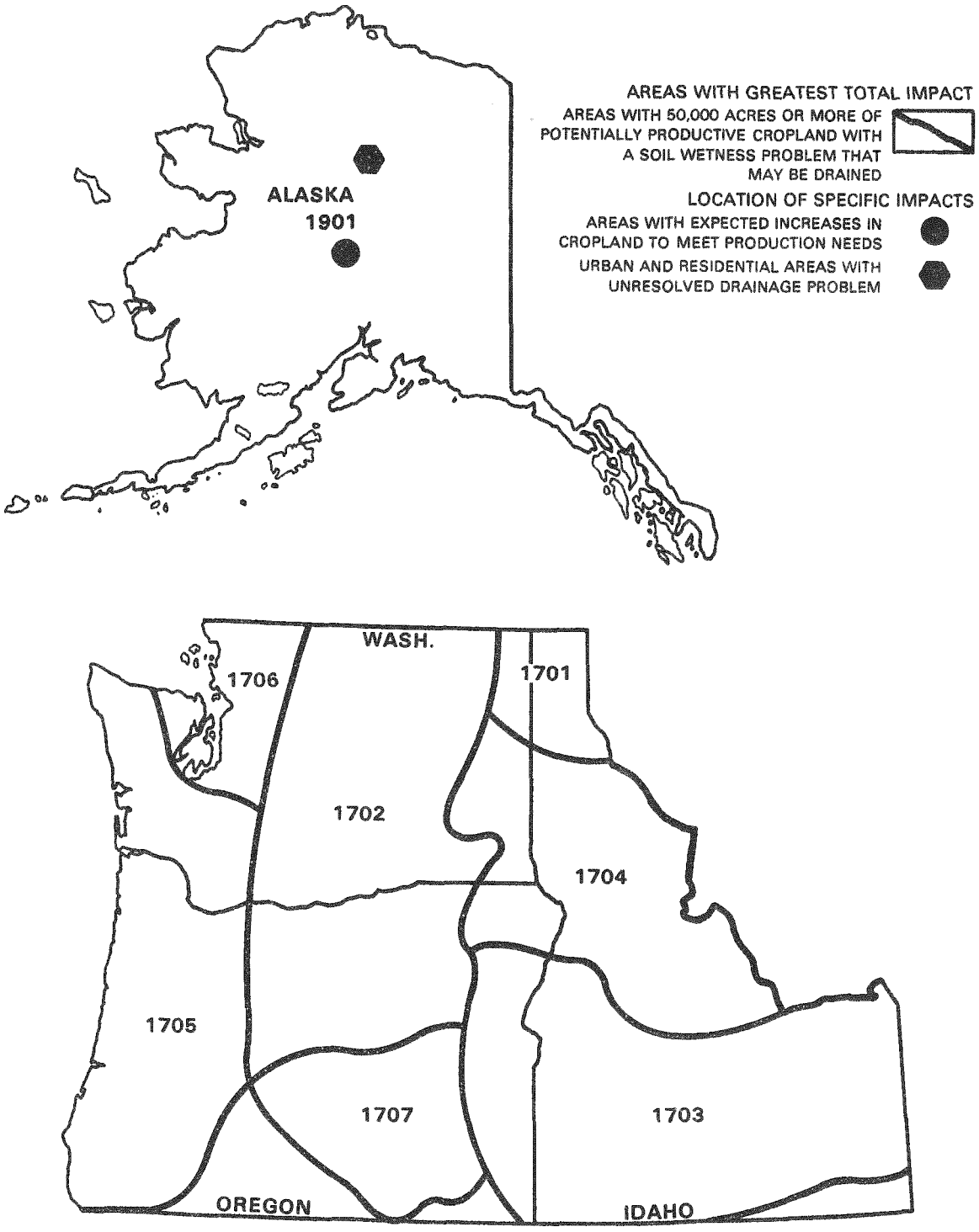
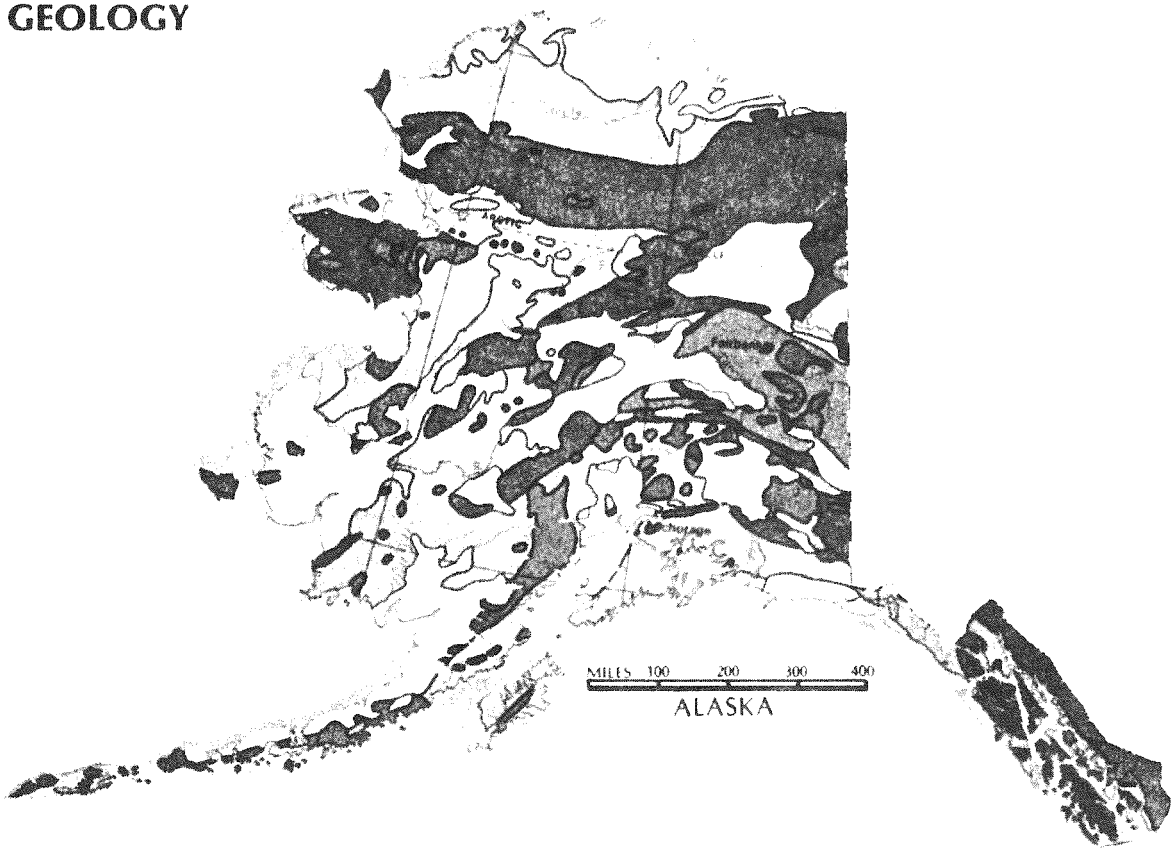


FIGURE II-E-137. Restricted Land Use from Wet Soil

Data Source: Ref. 15, Preliminary Water Resources Problem Statement.

GEOLOGY



SEDIMENTARY ROCKS

CRETACEOUS
In parts of Rocky Mountains and Alaska includes Jurassic and Triassic

JURASSIC AND TRIASSIC

UPPER PALEOZOIC
PERMIAN, PENNSYLVANIAN, AND MISSISSIPPIAN
In parts of Rocky Mountains and Alaska includes middle and lower Paleozoic

MIDDLE PALEOZOIC
DEVONIAN AND SILURIAN

LOWER PALEOZOIC
ORDOVICIAN AND CAMBRIAN
In parts of Missouri, Oklahoma, and Arkansas includes Devonian and Silurian

YOUNGER PRECAMBRIAN
In southeastern United States and Alaska includes metamorphosed Paleozoic

OLDER PRECAMBRIAN
Metamorphic and igneous rocks

INTRUSIVE ROCKS

LOWER TERTIARY, MESOZOIC, AND PALEOZOIC
Chiefly granitic rocks
Lower Tertiary and Mesozoic in Western States and Paleozoic in eastern United States

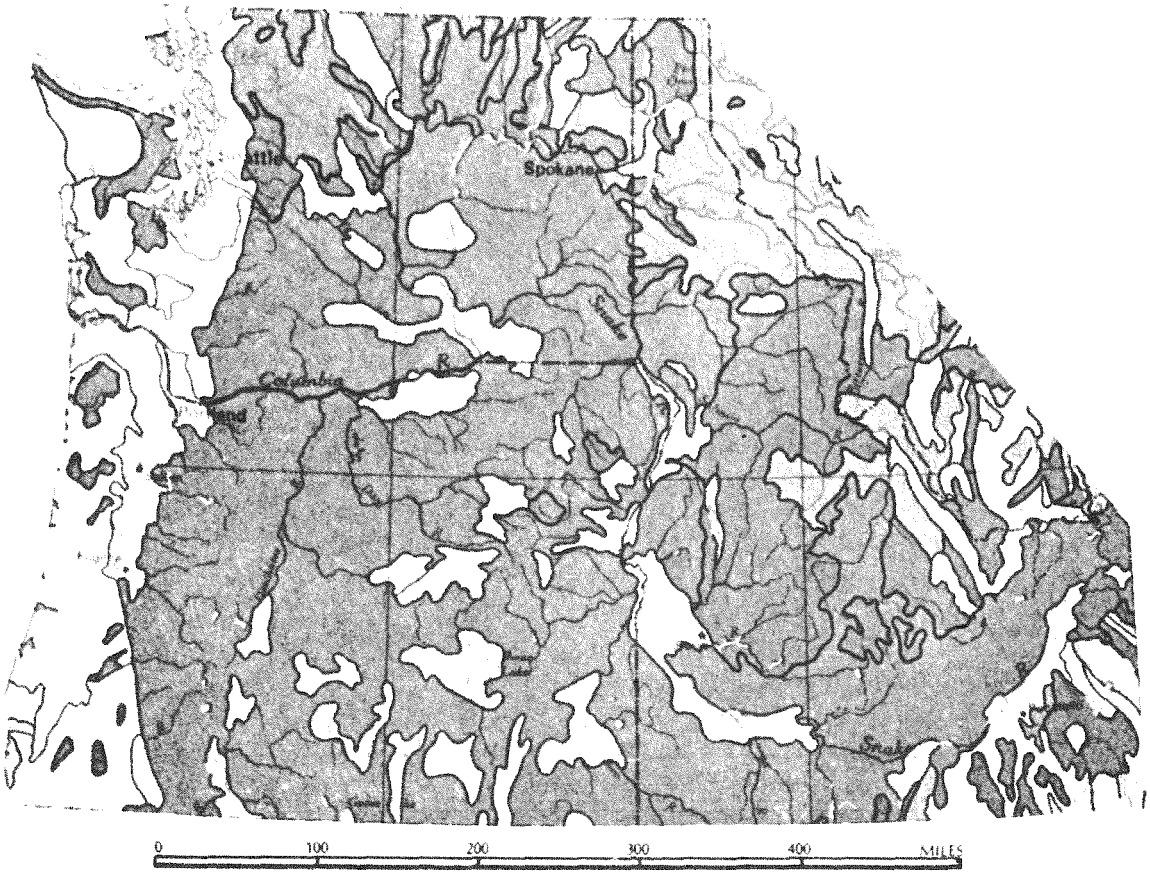


FIGURE II-E-138. Geology

Data Source: Ref. 13, National Atlas, pp. 74-75.

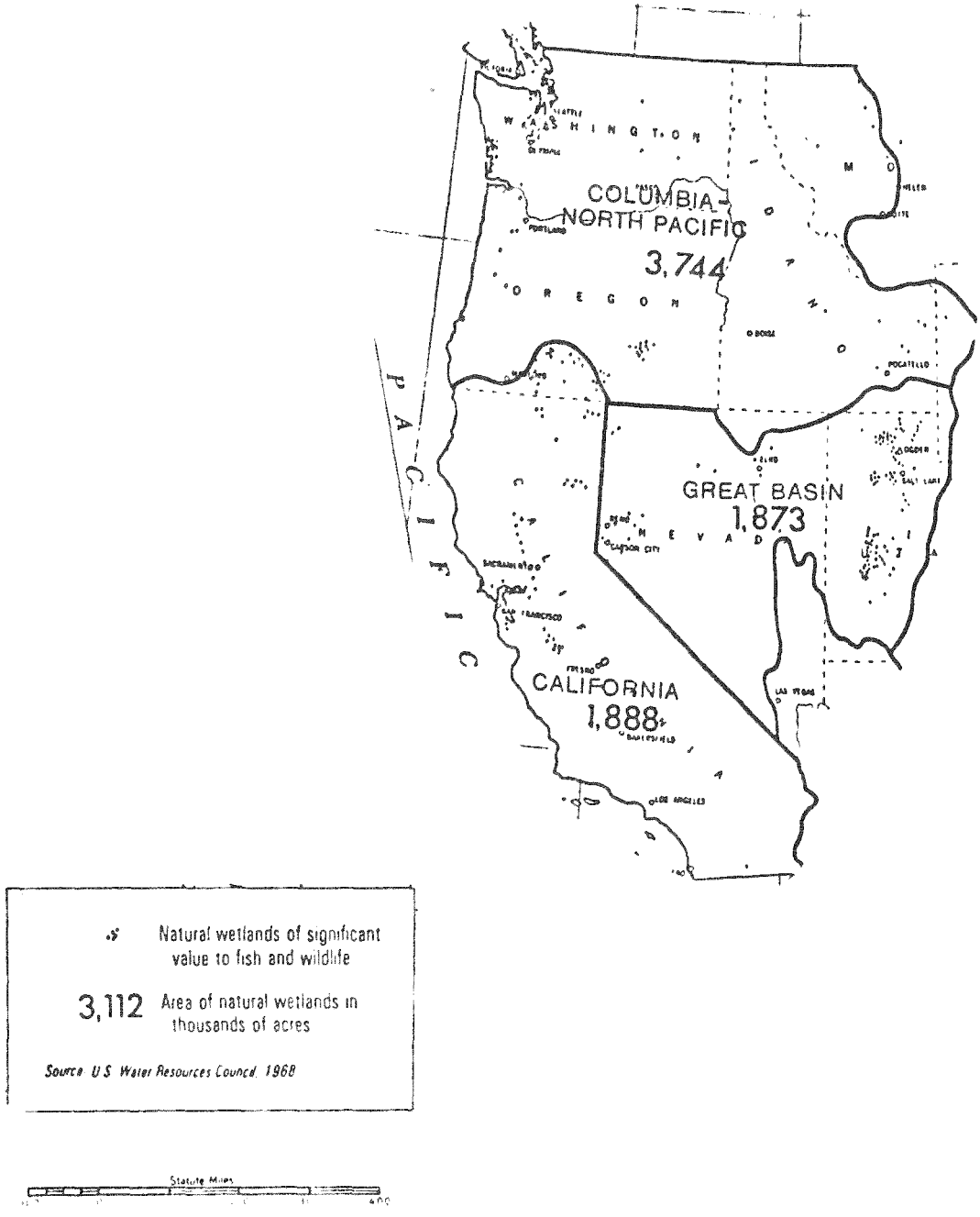


FIGURE II-E-139. Natural Wetlands

Data Source: Ref. 9, Water Atlas.

TABLE II-E-55

TOTAL AREA OF WETLANDS IN THE UNITED STATES IN 1956
(SHAW AND FREDINE 1956)

State	Acres (Total)	Acres (Wetlands)	% Wetlands
Idaho	53,476,480	108,900	0.20
Oregon	62,067,840	472,600	0.76
Washington	43,642,880	223,200	0.53

Data Source: Ref. 49, "Wetlands of the United States".

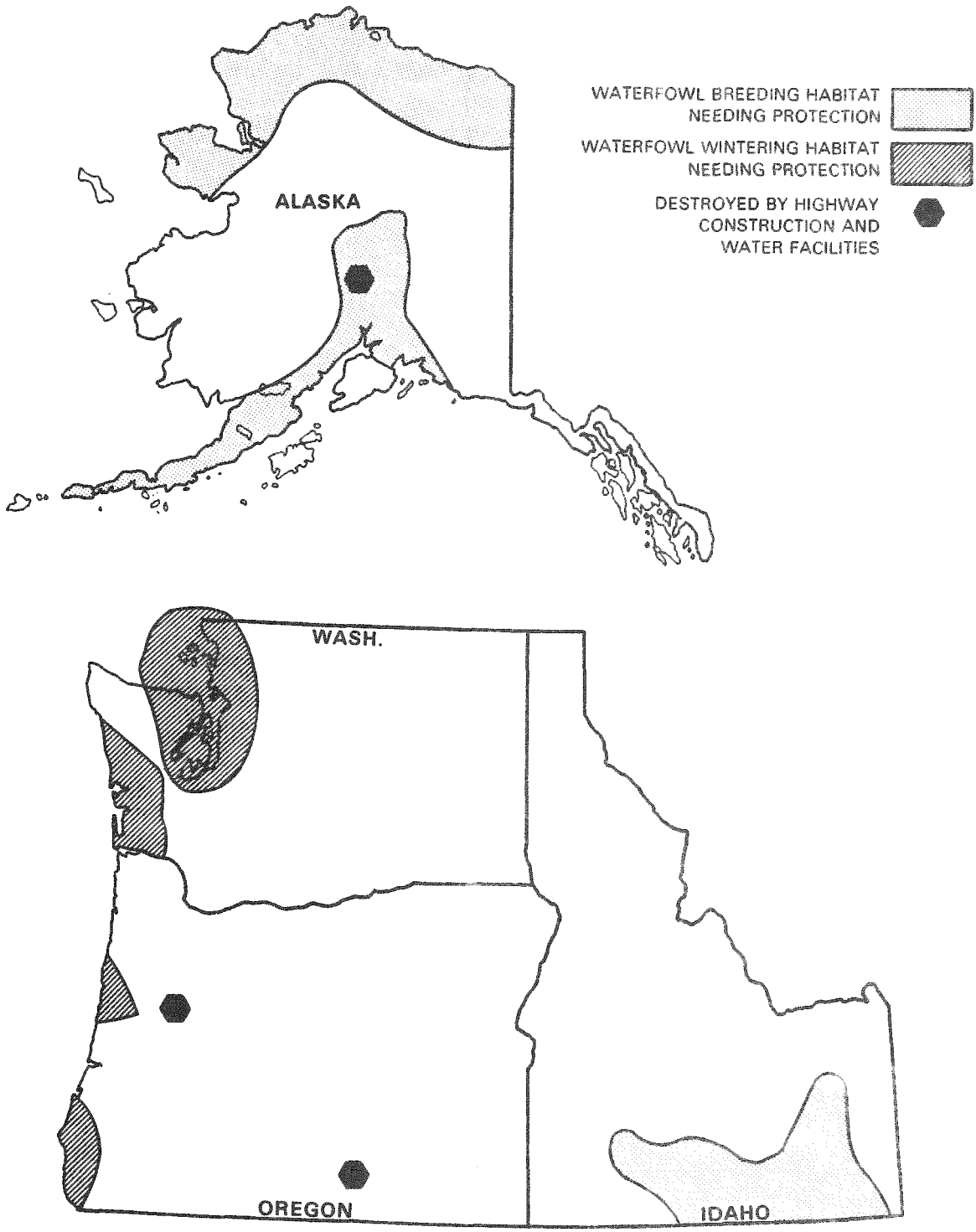
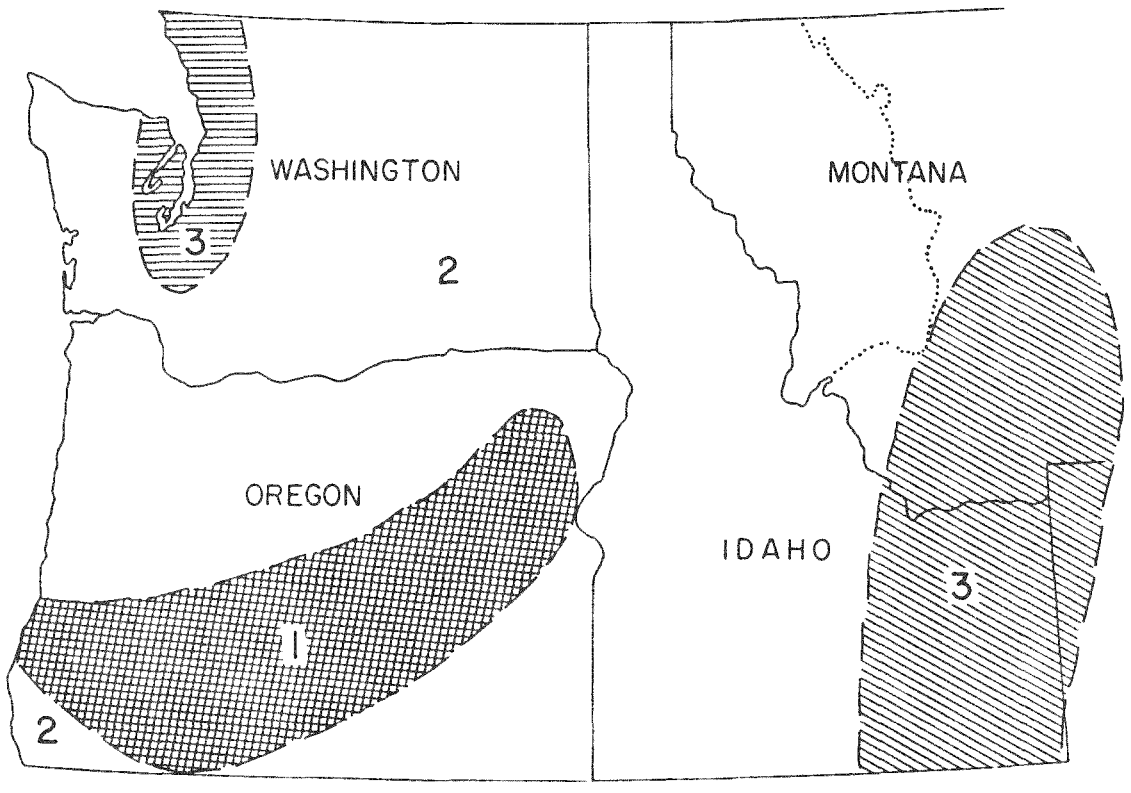


FIGURE II-E-140. Wetland Wildlife Habitat Loss, 1955-75

Data Source: Ref. 12, Environmental Quality Annual.

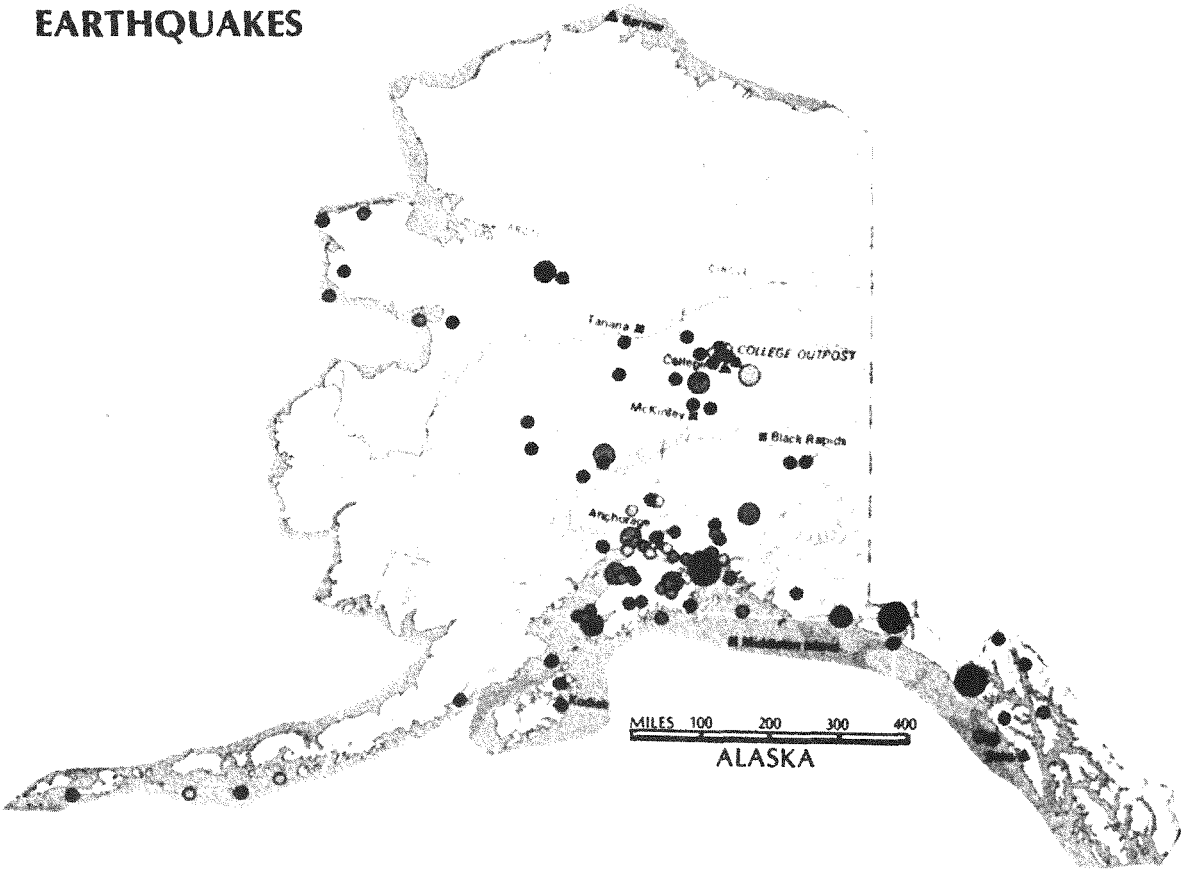


ZONE 1- Minor damage, distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 second; corresponds to intensities V and VI of the M.M.* Scale.
ZONE 2 Moderate damage; corresponds to intensity VII of the M.M.* Scale.
ZONE 3 Major damage; corresponds to intensity VIII and higher of the M.M.* Scale.
*M.M. Modified Mercalli Intensity Scale; see table III-1.

FIGURE II-D-141. Seismic Risk Map of Washington, Oregon, and Idaho

Data Source: Ref. 20, BPA Role EIS, p. III-9.

EARTHQUAKES



INTENSITY

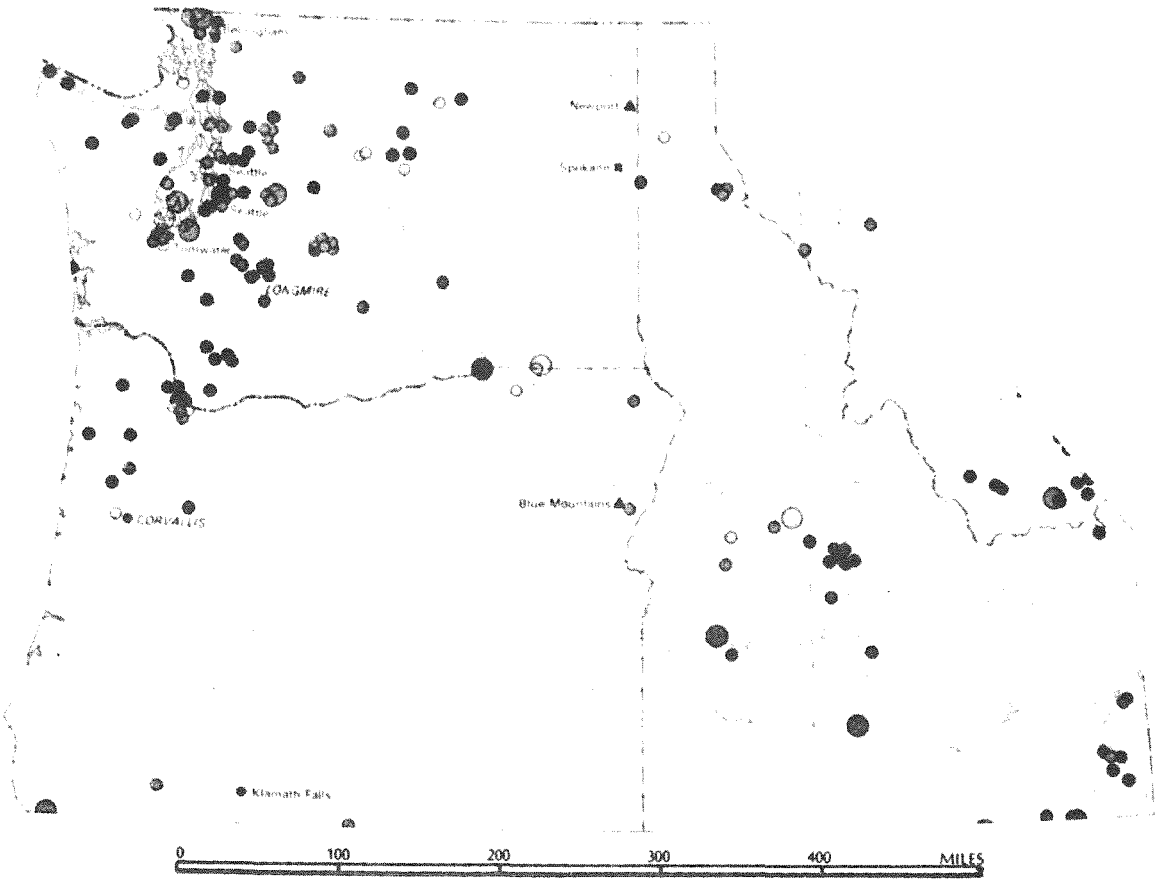
Modified Mercalli Intensity Scale of 1931

INTENSITY		DAMAGE
V–VI	○	Slight damage in buildings of average construction; dishes and windows broken; some furniture moved. Felt area: less than 50,000 sq. mi.
VII–VIII	◯	Moderate to considerable damage in well-built structures; walls and chimneys collapsed. Felt area: 50,000–250,000 sq. mi.
IX–X	◯	Considerable damage; buildings shifted off foundations, ground badly cracked. Felt area: 250,000–750,000 sq. mi.
XI–XII	◯	Near total damage; few buildings and bridges intact. Felt area: more than 750,000 sq. mi.

Information on earthquakes of lesser intensities is available from the U.S. Coast and Geodetic Survey.

TIME OF OCCURRENCE

1638–1864	1920–1934
1865–1889	1935–1944
1890–1904	1945–1954
1905–1919	1955–1965



SEISMOGRAPH STATIONS: 1966

▲ Government stations
U.S. Geological Survey
U.S. Coast and Geodetic Survey
U.S. Department of Defense

● Independent stations

■ University affiliated stations

World Wide Standard Seismograph Stations are labelled in italics

Major earthquakes for which data are lacking on location, intensity or date, are not shown

FIGURE II-E-142. Seismic Risk of the Region

Data Source: Ref. 13, National Atlas, pp. 66-67.

TABLE II-E-56

MODIFIED MERCALLI INTENSITY SCALE OF 1931 (ABRIDGED)

(This table defines earthquake intensities plotted on Seismic activity map of Figure).

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.

IV. During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls made crackling sound. Sensation like heavy truck striking building; standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structure. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Data Source: Ref. 20, BPA Role EIS, P. III-10.

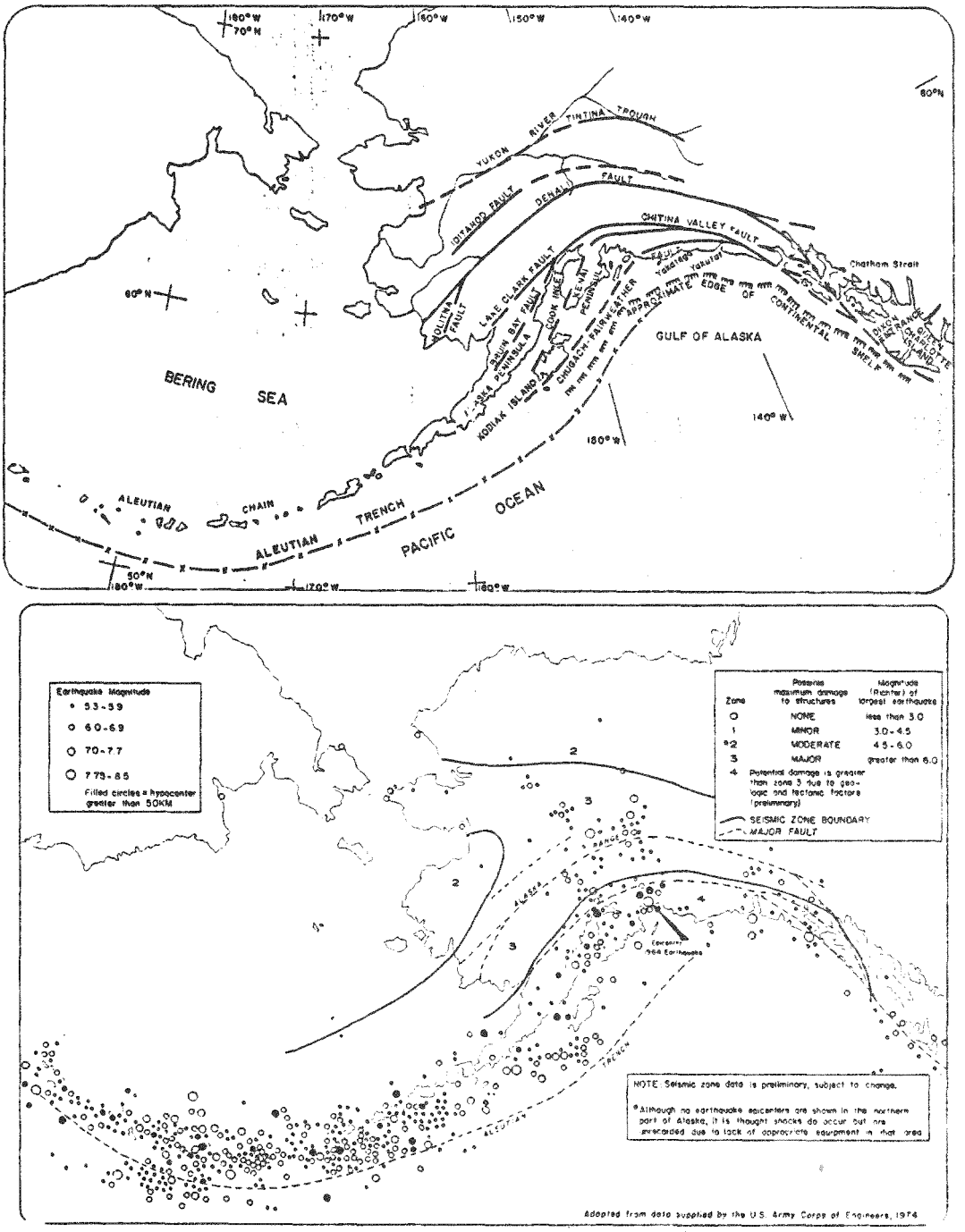


FIGURE II-E-143. Principal Faults and Seismic Zones of Alaska

Data Source: Ref. 11, Alaska Regional Profiles.

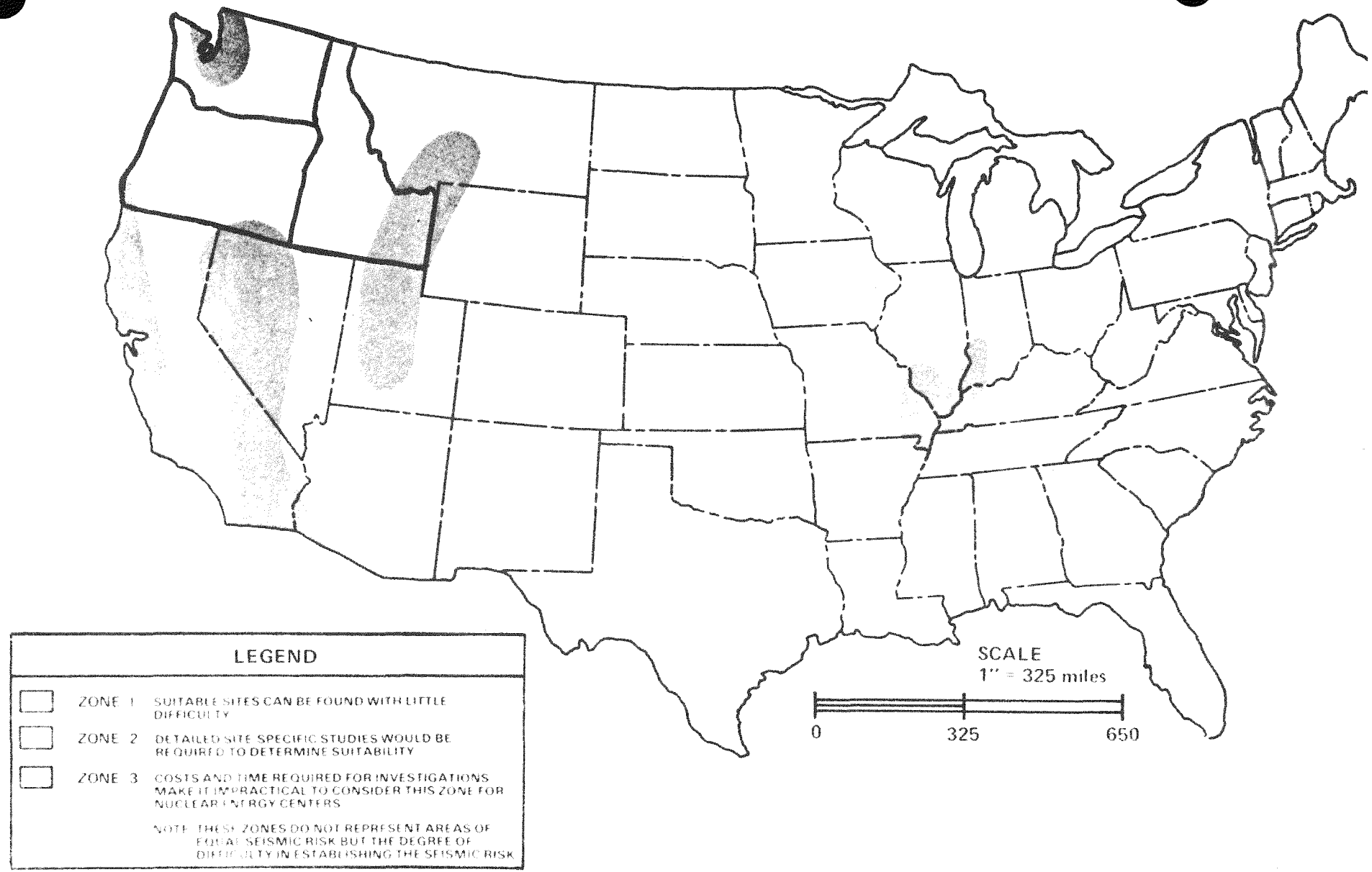


FIGURE II-E-144. Areas of Relative Seismic Suitability for Nuclear Energy Centers

Data Source: Ref. 50, Nuclear Energy Center Site Survey, 1975.

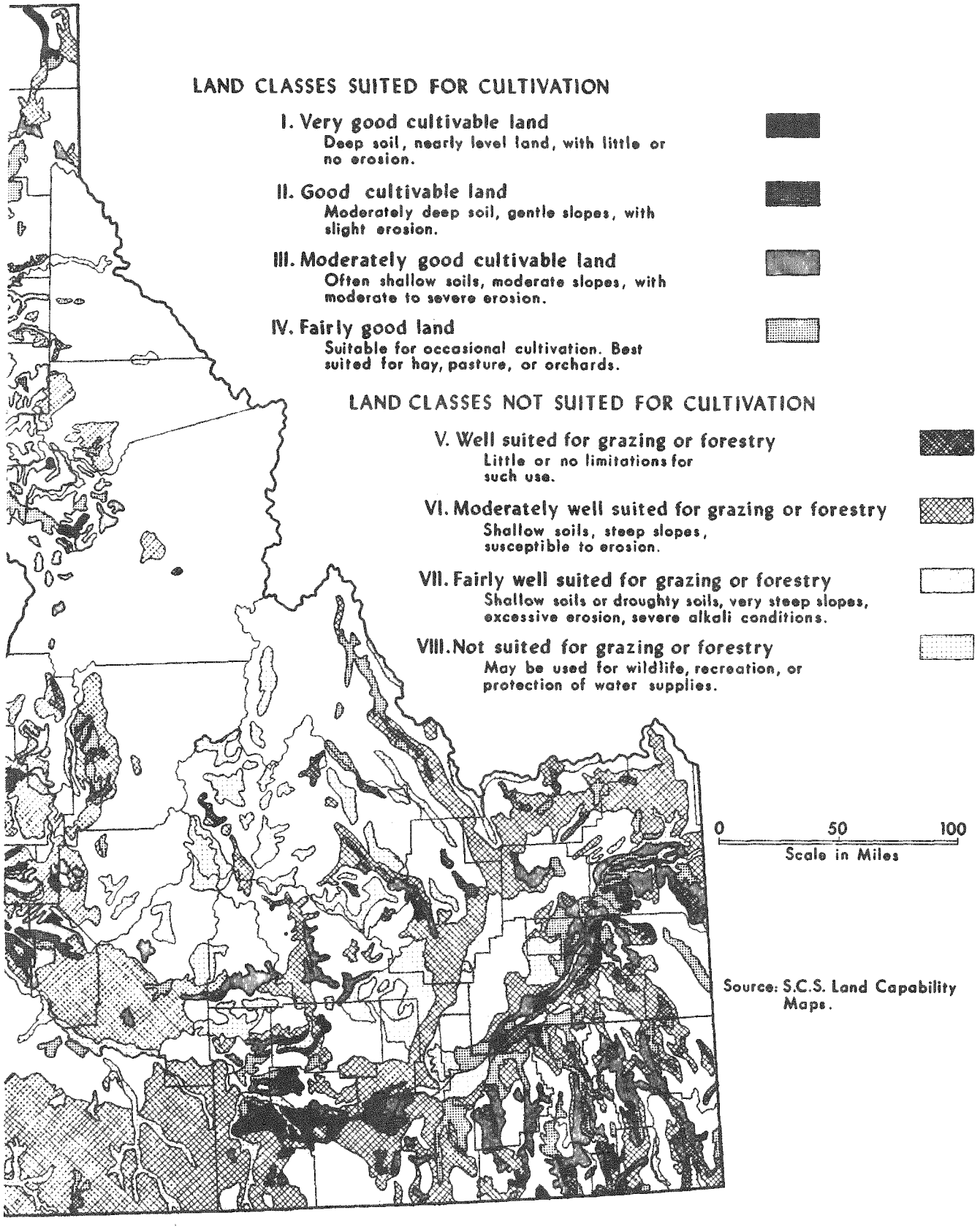
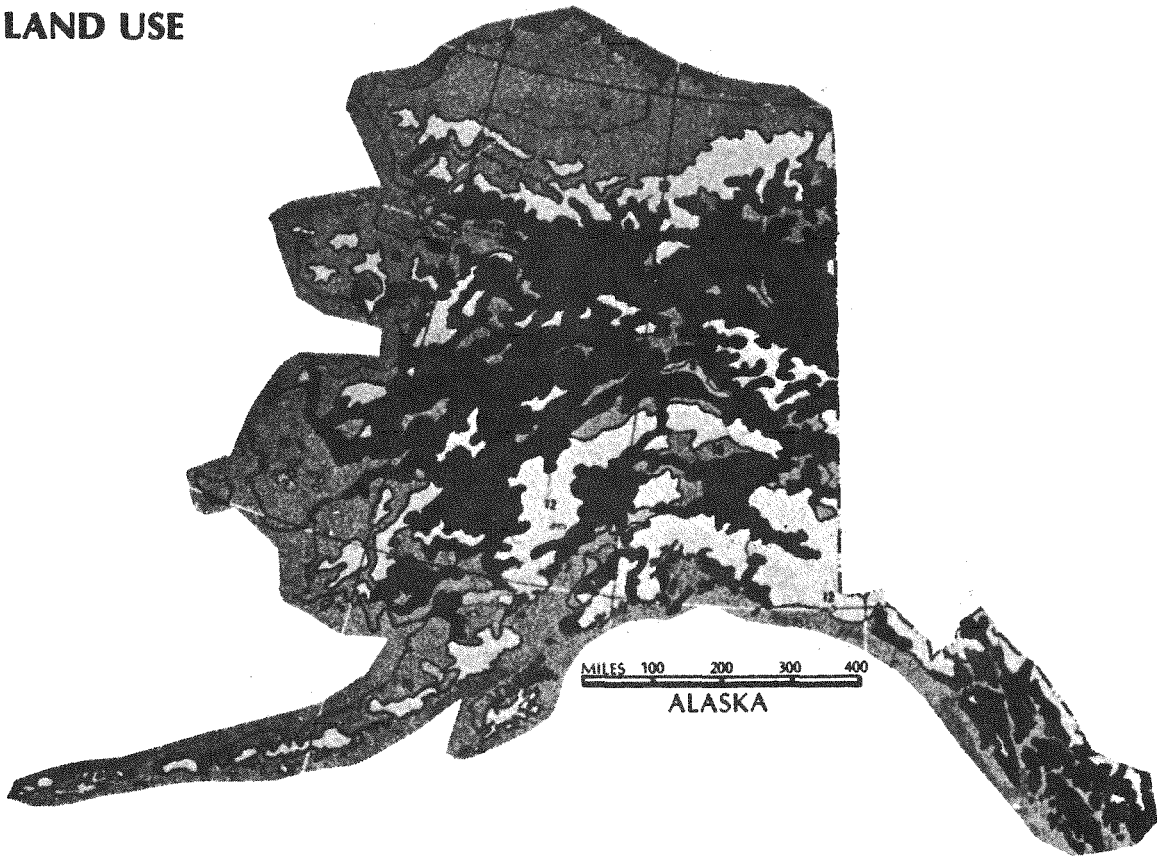
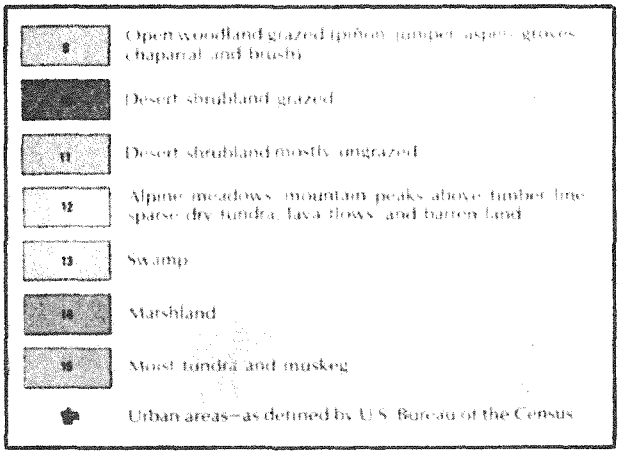


FIGURE II-E-145. Generalized Land Capability Classes

Data Source: Ref. 3, Atlas of the Pacific Northwest.

LAND USE


MILES 100 200 300 400
ALASKA


Open woodland grazed (pinon, juniper, aspen groves, chaparral and brush)
Desert shrubland grazed
Desert shrubland mostly ungrazed
Alpine meadows, mountain peaks above timber line, sparse dry tundra, lava flows, and barren land
Swamp
Marshland
Moist tundra and muskeg
Urban areas—as defined by U.S. Bureau of the Census

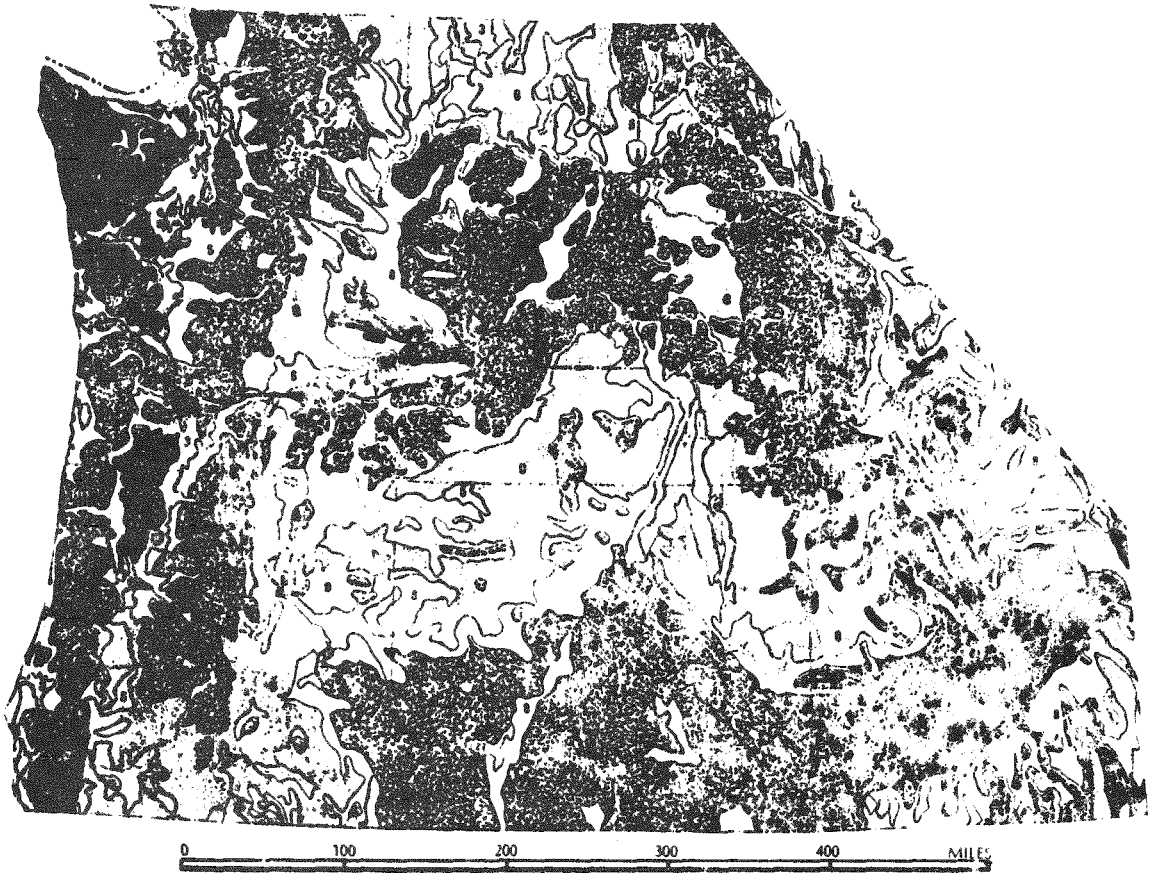


FIGURE II-D-146. Land Use

Data Source: Ref. 13, National Atlas, p. 153.

TABLE II-E-57

LAND AREA INVENTORY ACREAGE IN 1967

State	Total Land Area	Noninventory Acreage - 1,000 acres			
		Federal Noncropland	Urban and Built-up	Water Area	Total
Alaska	362,516	360,035	25	31	360,091
Idaho	52,933	33,852	403	103	34,358
Oregon	61,587	31,938	763	115	32,816
Washington	42,616	12,347	1,080	139	13,567

TABLE II-E-58

MAJOR USES OF LAND, BY STATE, UNITED STATES, 1969

State	1,000 acres					
	Cropland[a]	Grassland Pasture and Range[b]	Forest Land[c]	Special Uses[d]	Other Land[e]	Approximate Land Area[f]
Alaska	18	1,624	118,276	30,529	212,069	362,516
Idaho	6,166	22,073	18,030	4,051	2,593	52,913
Oregon	5,145	22,756	29,387	2,520	1,749	61,557
Washington	8,278	6,982	20,739	5,498	1,108	42,605

a. Total acreage in the crop rotation.

b. Grassland and other nonforested pasture in farms excluding cropland used only for pasture, plus estimates of open or nonforested grazing land not in farms.

c. Forest land, excluding reserved forest land and some unreserved areas duplicated in parks and other special uses of land. Total forest land is shown in appendix table 9.

d. Urban, transportation, recreational, and other special uses of land specified in appendix table 10.

e. Miscellaneous areas with low agricultural use value, such as marshes, open swams, bare rock areas, deserts, and tundra.

f. Approximate land area as developed by the Bureau of the Census in conjunction with the 1970 Census of Population (6, 1972). Includes all dryland and land temporarily or partially covered with water, such as marshland, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than one-eighth mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

Data Source: Ref. 51, Agriculture Economic Report No. 247.

TABLE II-E-59

LAND IN SPECIAL USE AREA, BY STATE, UNITED STATES, 1969

1,000 acres

State	Urban Areas (a)	Rural Transportation Areas (b)	Rural Parks (c)	Wildlife Refuge (d)	National Defense and Industrial Areas (e)	State Institutional and Miscellaneous Uses (f)	Farmsteads, Farm Roads and Lanes (g)	Total
Alaska	59	208	7,784	19,937	2,523	15	3	30,529
Idaho	122	286	2,745	87	691	18	102	4,051
Oregon	362	421	988	553	66	27	103	2,520
Washington	667	363	3,073	498	756	22	119	5,498

a. Areas of urbanized areas and other incorporated and unincorporated places of 1,000 population or more. Estimates are based on area data for urban places developed in conjunction with the 1970 Census of Population (6) but differs in that (1) census reported areas were substantially adjusted to minimize the inclusion of vacant land and (2) places of 1,000-2,500 population are included.

b. Includes rural highways and roads, railroads, and airports. Estimates of area in highways were derived by applying average right-of-way widths reported by State highway departments to the mileage in different highway systems reported by the Federal Highway Administration. Estimates of acreage in railroad rights-of-way are based on state-by-state changes in mileage reported by the Interstate Commerce Commission. Estimates of acreage in airports based on information on active airports supplied by the Federal Aviation Administration. Excludes airports used strictly for personal or military use.

c. Areas in national and State park systems and national forest wilderness and primitive areas plus 2.7 million acres in New York classified as State forest preserves. Excludes, in most instances, parks in urban places and large water bodies. Based on data from reports and records of the National Park Service, U.S. Forest Service, Public Land Law Review Commission, and individual State agencies.

d. Areas administered by the U.S. Fish and Wildlife Service and State wildlife agencies. Does not include Federal areas under the primary jurisdiction of another agency or leased for wildlife purposes. Data are from reports and records of the U.S. Fish and Wildlife Service, Public Land Law Review Commission, and individual State agencies.

e. As reported by the Bureau of Land Management (7). Includes land administered by the Department of Defense for military purposes (23.5 million acres) and land administered by the Atomic Energy Commission (2.1 million acres).

f. Incomplete data on State-owned rural land held for educational, welfare, correctional, and other institutional purposes and miscellaneous uses such as national guard camps, fair grounds, radio stations, gravel pits, and water-storage areas.

g. Estimates calculated on the basis of State-by-State number of farms and acreage of unclassified land in farms.

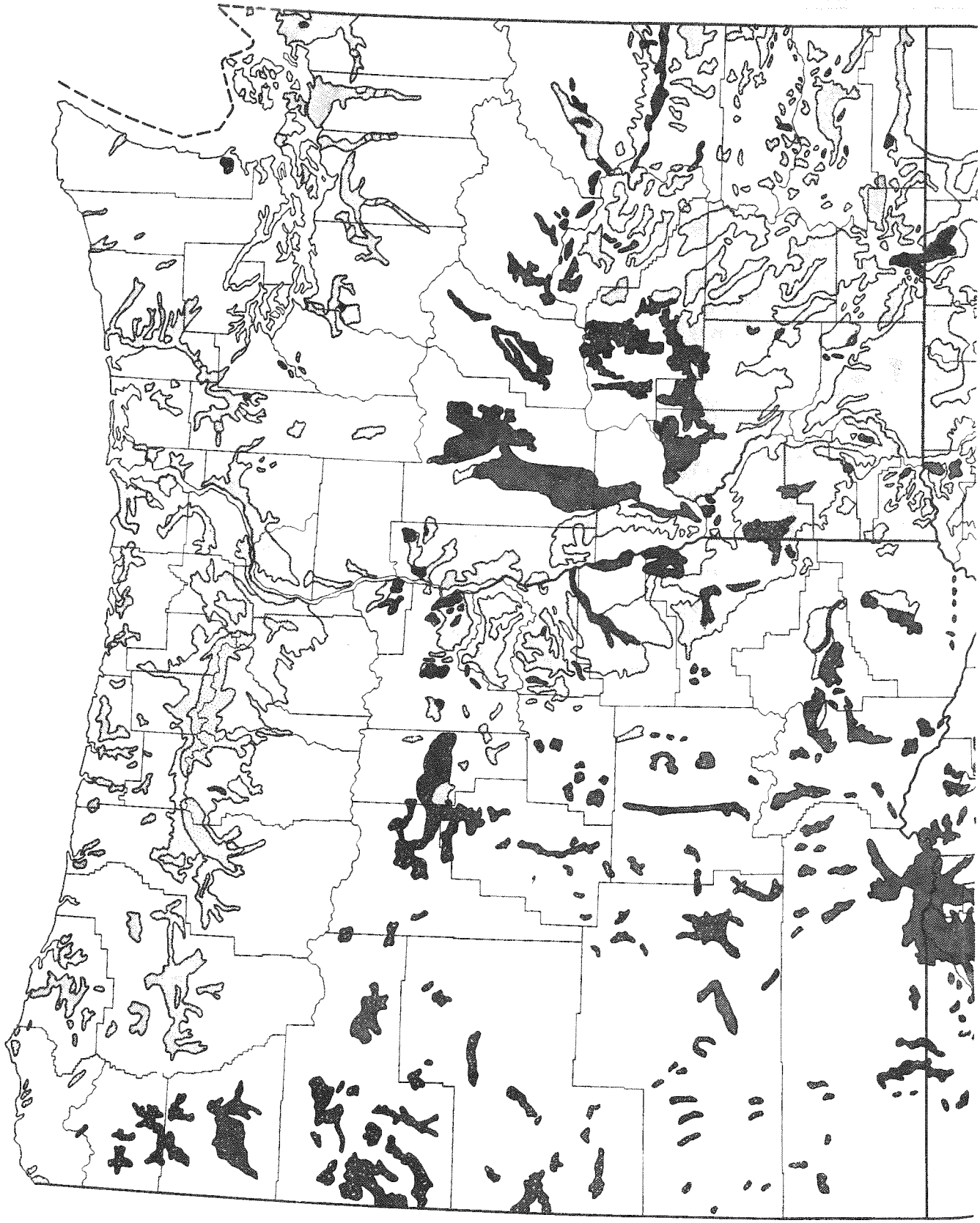
Data Source: Ref. 51, Agriculture Economic Report No. 247.

TABLE II-E-60

USE OF NONFEDERAL RURAL LAND IN 1967, BY STATE

State	1,000 acres					
	Crop-land	Pasture-land	Range-land	Forest Land	Other Land	Total
Alaska	46	1	208	1,608	563	2,426
Idaho	5,983	1,450	6,499	4,321	323	18,575
Oregon	5,481	674	9,650	12,232	735	28,772
Washington	8,136	605	6,345	13,177	785	29,048

Data Source: Reference 52, Conservation Needs Inventory



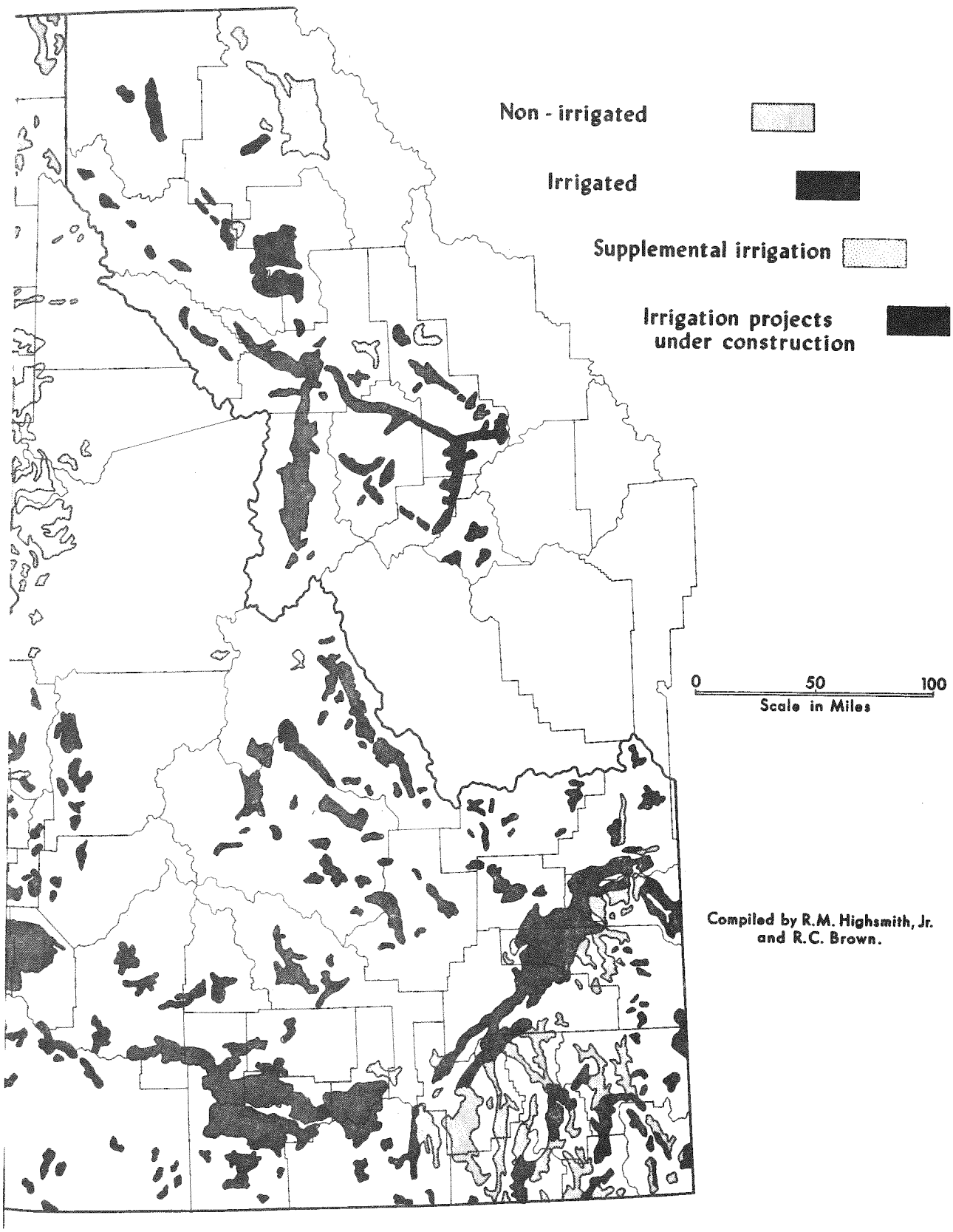


FIGURE II-E-147. Croplands

Data Source: Ref. 3, Atlas of the Pacific Northwest.

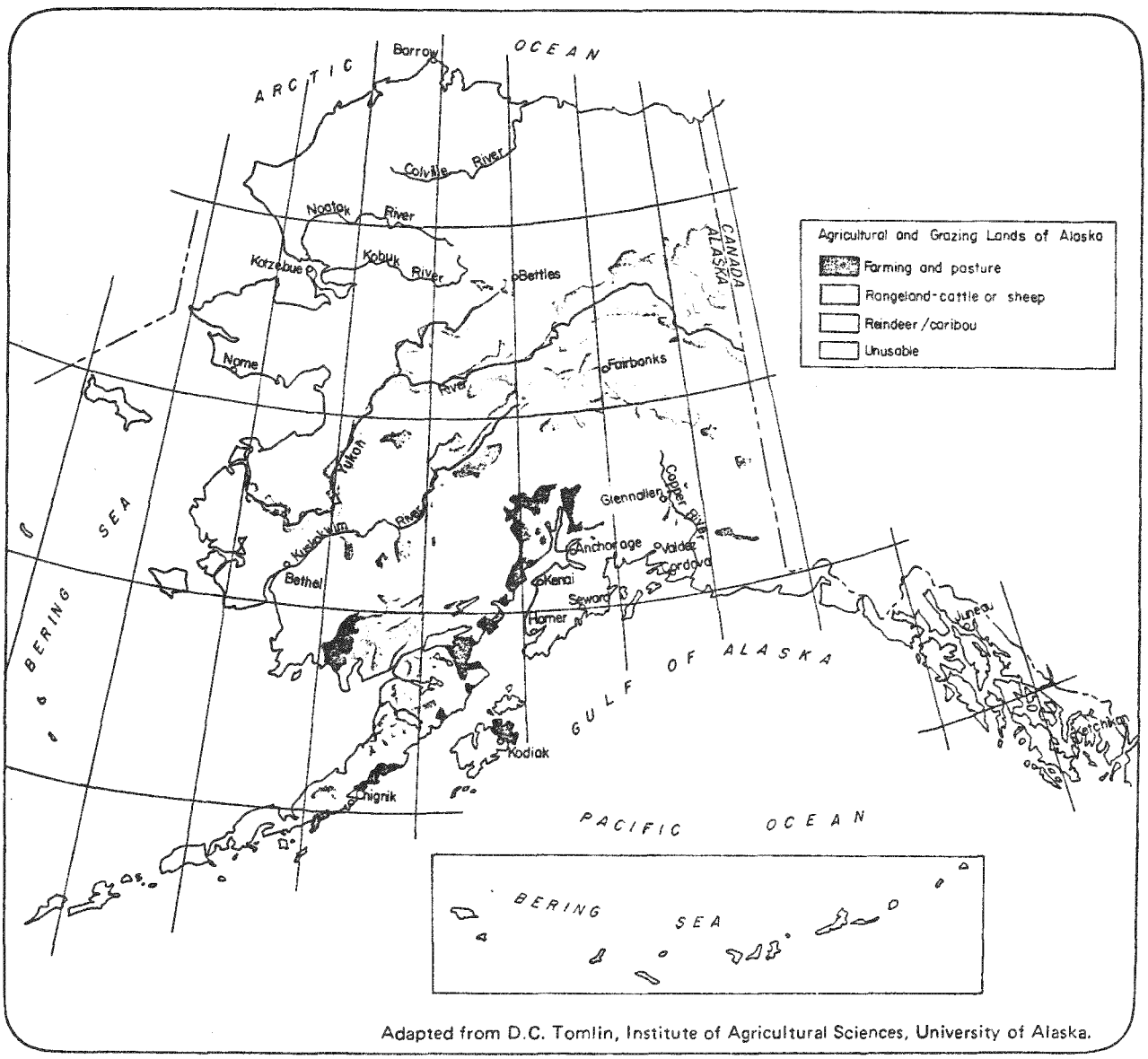


FIGURE II-E-148. Agriculture and Grazing Lands of Alaska

Data Source: Ref. 11, Alaska Regional Profiles.

TABLE II-E-61

AGRICULTURAL ACTIVITY IN COUNTIES OF POTENTIAL POWER PLANT SITING, 1974

	Land in Farms (acres)	Percent of County in Farms	Percent of Farmland Irrigated	Major Farm Products[a]
Idaho				
Bingham	1,048,833	79.4	24.6	Field crops, cattle
Elmore	430,814	22.1	14.9	Field crops, cattle
Gooding	227,994	49.5	36.6	Field crops, cattle
Power	495,745	54.8	16.2	Field crops, cattle
Oregon				
Clatsop	26,560	5.2	3.8	Dairy products, cattle, other livestock
Coos	159,225	15.5	5.2	Dairy products, cattle, fruits-nuts-berries
Gilliam	744,653	96.3	1.0	Wheat, cattle
Malheur	1,477,029	23.4	14.2	Cattle, field crops, vegetables
Morrow	1,107,480	84.0	5.3	Wheat, field crops, cattle
Sherman	474,495	89.3	0.1	Wheat, cattle, poultry
Washington				
Cowlitz	38,020	5.2	5.0	Dairy products, poultry, cattle
Douglas	955,630	81.5	2.3	Wheat, fruits-nuts-berries, cattle
Franklin	600,959	74.9	24.2	Field crops, wheat, forage
Grant	1,081,599	63.2	27.0	Field crops, wheat, cattle
Grays Harbor	49,581	4.1	6.7	Dairy products, cattle
Klickitat	786,736	64.4	2.1	Wheat, cattle, forage
Lewis	137,078	8.8	5.0	Dairy products, poultry, cattle
Lincoln	1,469,010	99.6	2.4	Wheat, cattle
Whatcom	132,921	9.8	18.6	Dairy products, poultry, cattle

(a) Highest value cash crops in order

Data Source: Ref. 4, The Impact of Increased Coal Consumption.

TABLE II-E-62

FARMS: NUMBER AND ACREAGE, BY STATES, 1974 and 1975

State	Number of Farms		Land in Farms (1,000 acres)	
	1974	1975	1974	1975
Alaska[a]	310	300	1,710	1,710
Idaho	27,200	27,000	15,500	15,600
Oregon	32,500	32,500	19,600	19,500
Washington	40,000	40,000	16,500	16,500

(a) Exclusive of grazing land leased from U.S. Government, Alaska farmland totals about 70,000 acres.

Data Source: Ref. 53 and 54, 1974 Census of Agriculture and Agricultural Statistics.

TABLE II-E-63

LAND IN FARMS:[a] IRRIGATED LAND, BY STATES, 1939-69

State	1,000 acres						
	1939	1944	1949	1954	1959	1964	1969
Alaska	-	-	-	-	-	(b)	1
Idaho	1,895	2,026	2,137	2,325	2,577	2,802	2,761
Oregon	1,030	1,129	1,307	1,490	1,384	1,608	1,519
Washington	494	520	589	778	1,007	1,150	1,224

(a) Data may not add because of rounding
(b) Less than 500 acres

Data Source: Ref. 53, 1974 Census of Agriculture.

TABLE II-E-64

LAND UTILIZATION: LAND IN FARMS AND LAND NOT IN FARMS, BY STATES, 1969

State	Use of Land in Farms, 1,000 acres								Use of Land Not in Farms, 1,000 acres			
	Cropland				Forest and Woodland							
	Used for Crops (a)	Soil Improvement Crops or Idle	Used Only for Pasture	Open Permanent Pasture (b)	Pastured	Not Pastured	Other Land	Total Land in Farms	Pasture and Range (c)	Woodland and Forest not Grazed (d)	Other Land (e)	Approximate Total Land Area (f)
Alaska	14	1	3	1,527	10	24	25	1,604	198	118,141	242,573	362,516
Idaho	4,901	298	967	6,758	770	202	521	14,417	19,889	12,484	6,123	52,913
Oregon	3,818	250	1,077	10,337	1,600	430	506	18,018	22,464	17,312	3,763	61,557
Washington	6,989	455	834	5,722	2,388	720	451	17,559	3,486	15,405	6,155	42,605

(a) Cropland harvested, crop failure, and cultivated summer fallow
(b) Open or nonforested permanent pasture in farms.
(c) Land used chiefly for grazing. Includes open or nonforested grazing land, forest and arid woodland grazed, and shrub and brush grazing land.
(d) Excludes part of the forested areas in parks, wildlife refuges, military areas, recreation sites, and arid woodland, brushland, and forest land used for grazing.
(e) Includes urban, industrial, and nonfarm residential areas, parks and wildlife refuges, military lands; also roads, railroads, ungrazed desert, rock, swamp, and miscellaneous other areas.
(f) Remeasurement and increases in reservoirs account for changes in total land area.
Data Source: Ref. , Economic Research Service Data from records and reports of the U.S. Departments of Agriculture and Commerce, and public land administering and conservation agencies.

Data Source: Ref. 53, 1974 Census of Agriculture.

TABLE II-E-65

1974 CENSUS OF AGRICULTURE LAND UTILIZATION

State Name	Land in Farms (acres)	Proportion in Farms (%)	Total Cropland (acres)	Total Woodland (acres)	Other Land (acres)
Alaska	1,633,070	0.5	23,970	27,586	1,581,514
Idaho	14,274,258	27.0	6,247,705	818,549	7,208,004
Oregon	18,241,445	29.6	5,074,988	1,730,245	11,436,212
Washington	16,661,902	39.1	7,945,063	2,733,151	5,983,688

TABLE II-E-66

1974 CENSUS OF AGRICULTURE CROP PRODUCTION AND ACREAGE

State Name	Corn (acres)	Sorghums (acres)	Soybeans (acres)	Soybeans (Bushels)	Peanuts for Nuts (acres)	Peanuts for Nuts (pounds)
Alaska	0	0	0	0	0	0
Idaho	114,416	2,106	0	0	0	0
Oregon	38,758	1,239	31	-0,000,000,001	0	0
Washington	71,533	1,149	499	15,034	0	0

TABLE II-E-66 (contd)

1974 CENSUS OF AGRICULTURE CROP PRODUCTION AND ACREAGE

State Name	Vegetables, Sweet Corn or Melons (acres)	Orchards (acres)	Berries (acres)
Alaska	151	1	3
Idaho	45,55		
Oregon	148,977	84,883	16,192
Washington	105,613	156,726	8,371

Data Source: Ref. 53, 1974 Census of Agriculture.

TABLE II-E-66 (contd)

1974 CENSUS OF AGRICULTURE CROP PRODUCTION AND ACREAGE

State Name	Wheat (acres)	Wheat (Bushels)	Small Grain for Grain (acres)	Cotton (acres)	Cotton (bales)	Tobacco (acres)	Tobacco (pounds)
Alaska	14	358	1,132	0	0	0	0
Idaho	1,413,811	57,552,348	808,634	0	0	0	0
Oregon	1,250,119	50,087,492	252,830	0	0	0	0
Washington	3,022,861	118,994,947	290,699	0	0	0	0

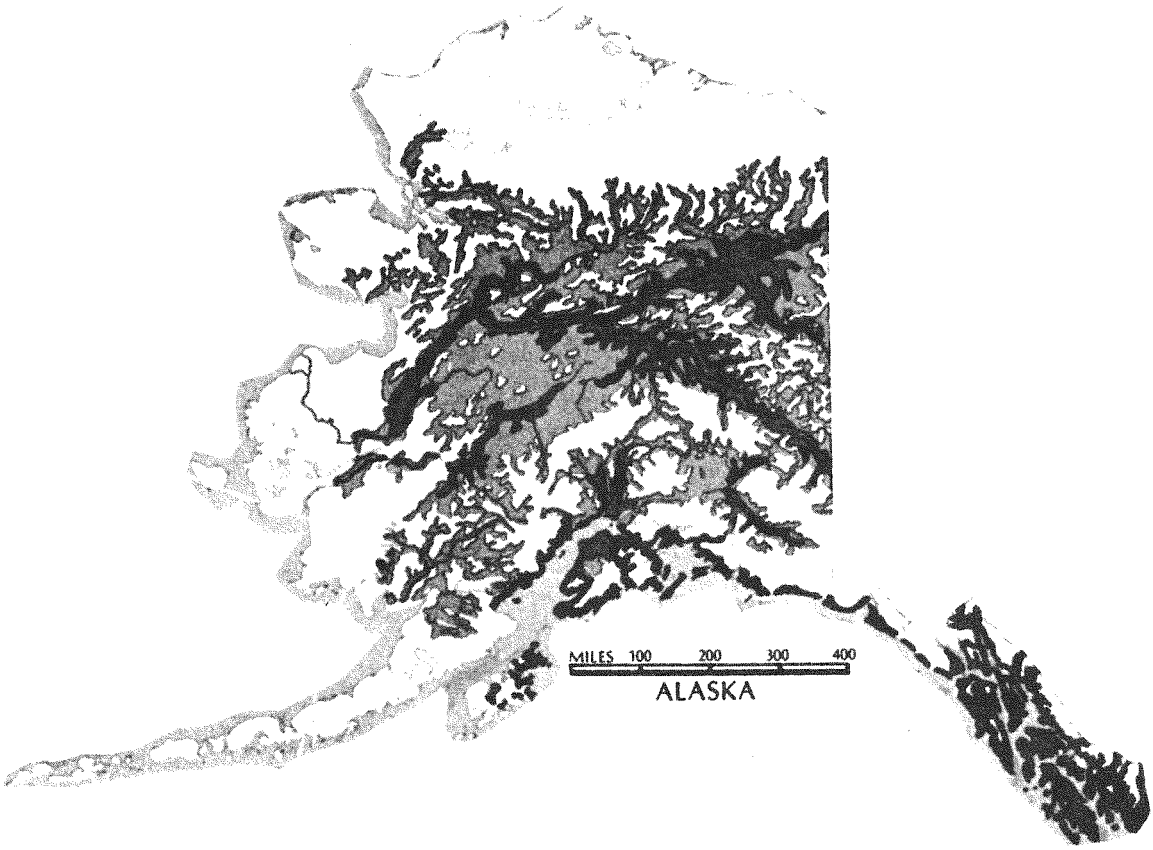
TABLE II-E-66 (contd)

1974 CENSUS OF AGRICULTURE CROP PRODUCTION AND ACREAGE

State Name	Irish Potatoes (acres)	Irish Potatoes (Hundred Weight)	Sweet Potatoes (acres)	Sweet Potatoes (Bushels)	Hay Crops (acres)	Hay Crops (tons, dry)
Alaska	551	91,987	0	0	14,528	20,015
Idaho	315,921	78,025,304	0	0	1,323,140	3,760,095
Oregon	55,611	17,689,953	2	181	980,967	2,217,388
Washington	92,470	35,416,510	19	1,396	741,981	2,177,510

Data Source: Ref. 53, 1974 Census of Agriculture.

FOREST TYPES



ALASKA FORESTS

COASTAL FORESTS

Hemlock–Sitka spruce

INTERIOR FORESTS

Spruce–hardwoods
Well stocked, commercial

Spruce–hardwoods
Medium to poor, noncommercial

NONFOREST

Land that has never supported forests and land formerly forested which is now developed for other uses

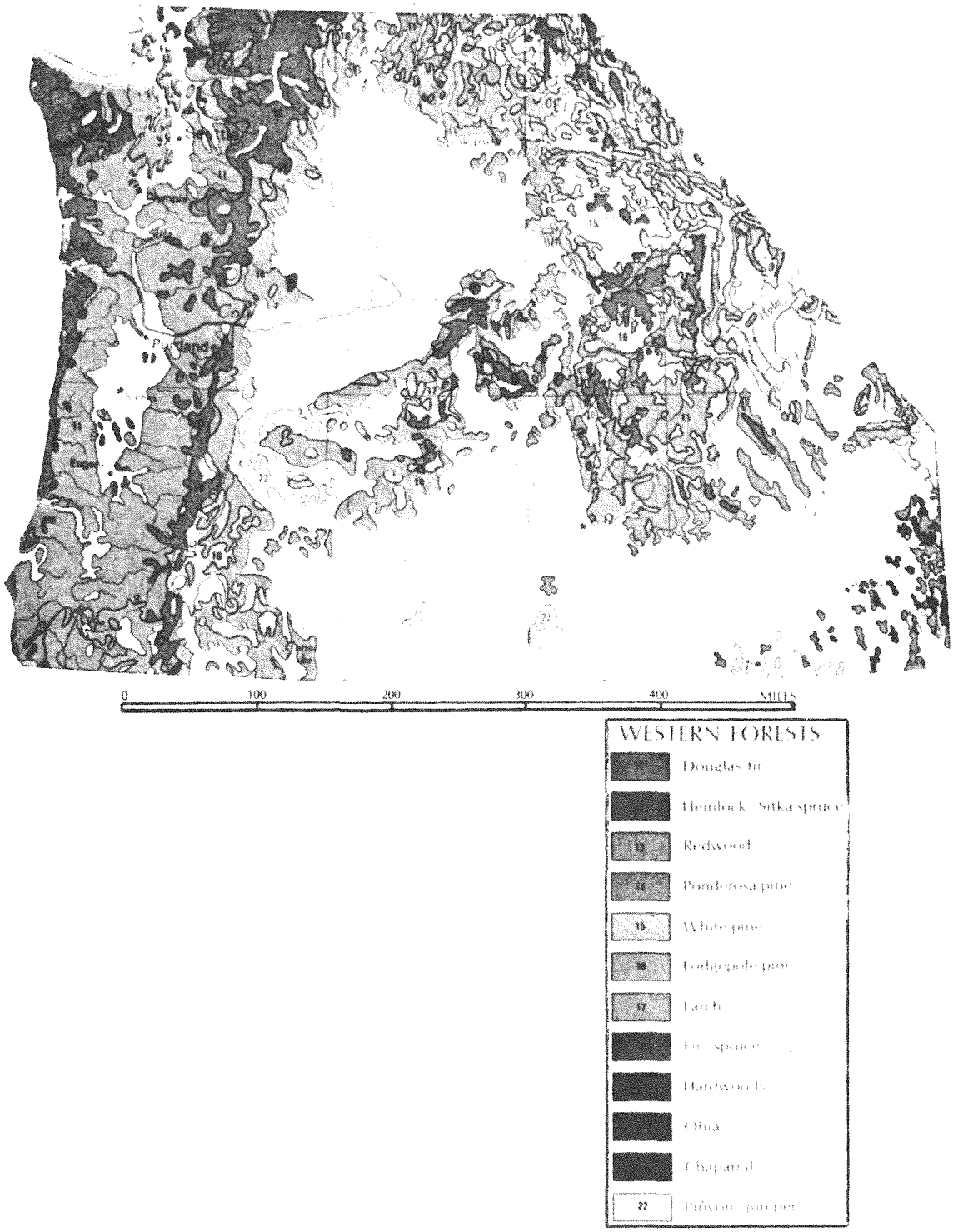
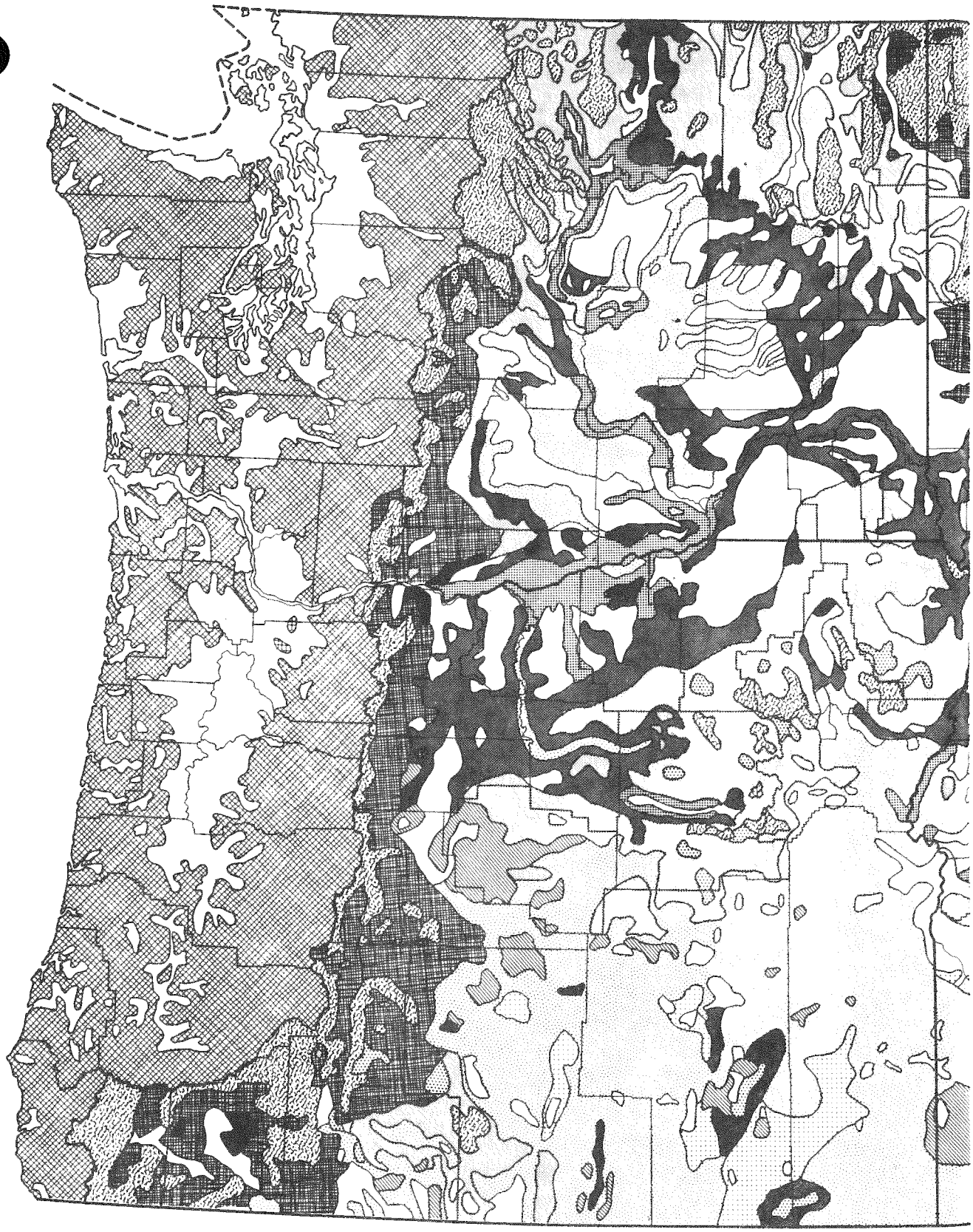


FIGURE II-E-149. Forest Types

Data Source: Ref. 13, National Atlas.



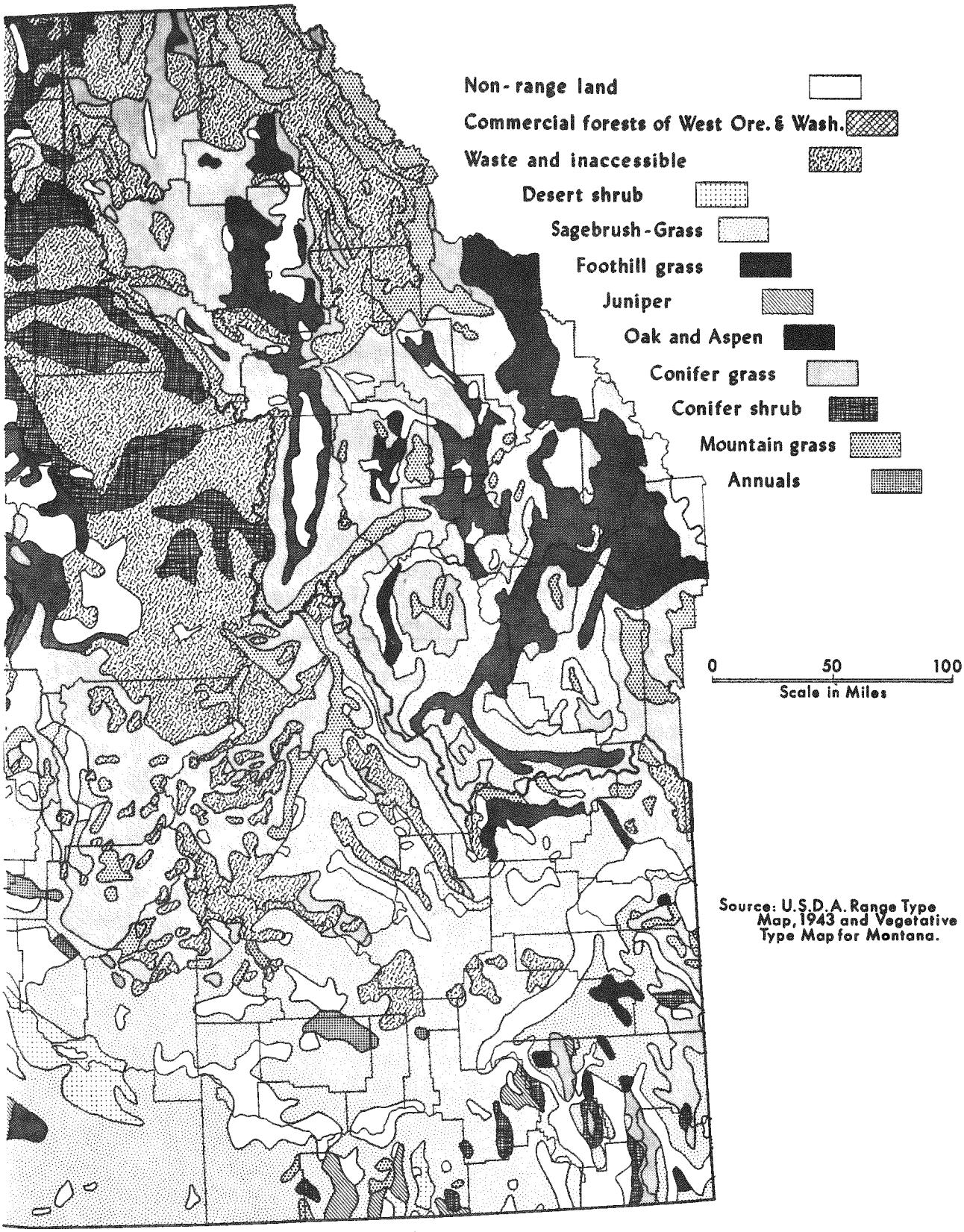


FIGURE II-E-150. Generalized Range Types

Data Source: Ref. 3, Atlas of the Pacific Northwest.

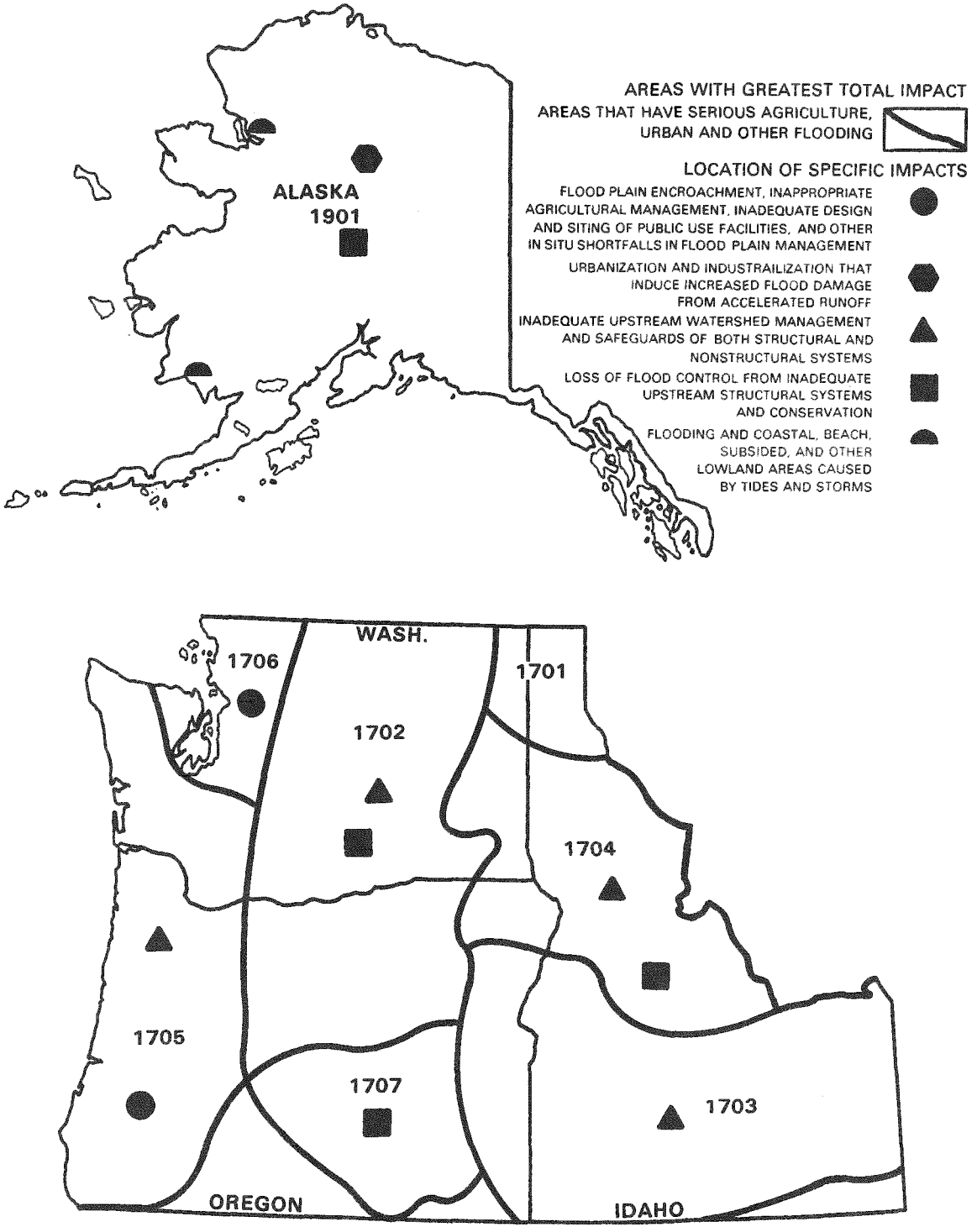


FIGURE II-E-151. Flood Damage

Data Source: Ref. 15, Preliminary Water Resources Problem Statements.

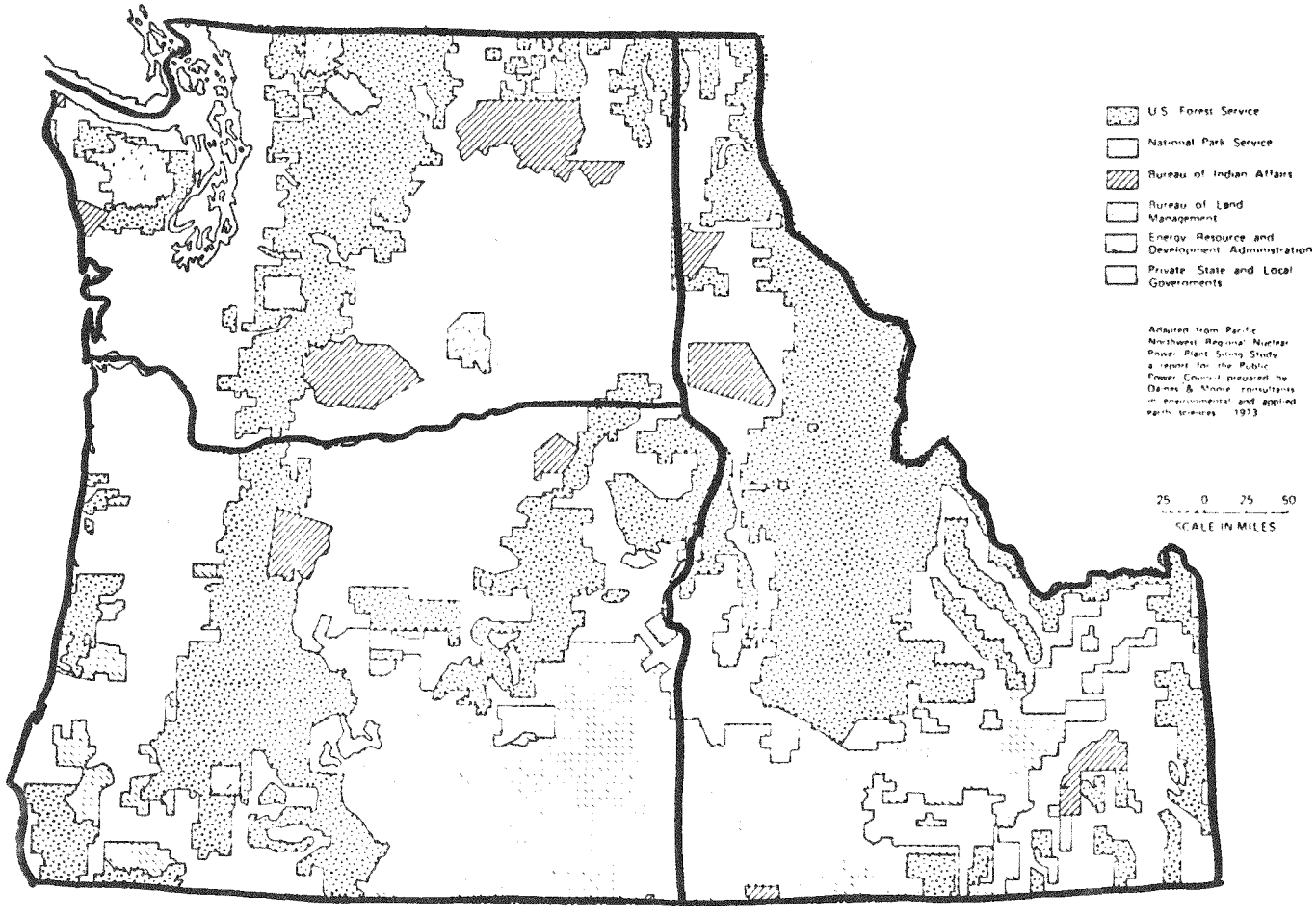


FIGURE II-E-152. Land Ownership

Data Source: Ref. 20, BPA Role EIS.

TABLE II-E-67

Land Classes and Ownership - Pacific Northwest Region, 1966,

Ownership	Cropland[c]	Forest Land	Rangeland	Urban and Other Land	Total
Department of Agriculture					
Forest Service[a]	-	45,727.3	6,677.6	2,001.3	54,406.2
Other Agriculture	.4	-	46.8	.5	47.7
	.4	45,727.3	6,724.4	2,001.8	54,453.9
Department of the Interior					
Bureau of Land Management	-	4,486.6	24,275.9	754.9	29,517.4
Bureau of Indian Affairs[b]	364.1	2,658.3	1,635.7	133.9	4,792.0
National Park Service	-	2,503.9	255.7	634.5	3,394.1
Fish and Wildlife Service	28.5	64.2	373.1	142.7	608.5
Bureau of Reclamation	14.0	17.0	1,033.5	71.6	1,136.1
	406.6	9,730.0	27,573.9	1,737.6	39,448.1
Department of Defense	-	83.4	459.6	204.0	747.0
Other Federal	-	2.3	946.3	21.1	969.7
Federal Subtotal	407.0	55,543.0	35,704.2	3,964.5	95,618.7
State	247.4	4,341.3	3,111.8	751.8	8,452.3
County	-	227.0	-	260.4	487.4
Municipal	-	222.6	3.6	251.9	478.1
Public Total	654.4	60,333.9	38,819.6	5,228.6	105,036.5
Private Total	20,149.4	25,509.6	19,925.0	3,094.8	68,678.8
Total Land Area	20,803.8	85,843.5	58,744.6	8,323.4	173,715.3

(a) Updated to 1969.
(b) Private lands held in trust by the Federal government.
(c) Unit of measure is in thousands of acres (e.g. cropland total is 20,803,800 acres).

Data Source: Ref. 20, BPA Role EIS, p. III-30.

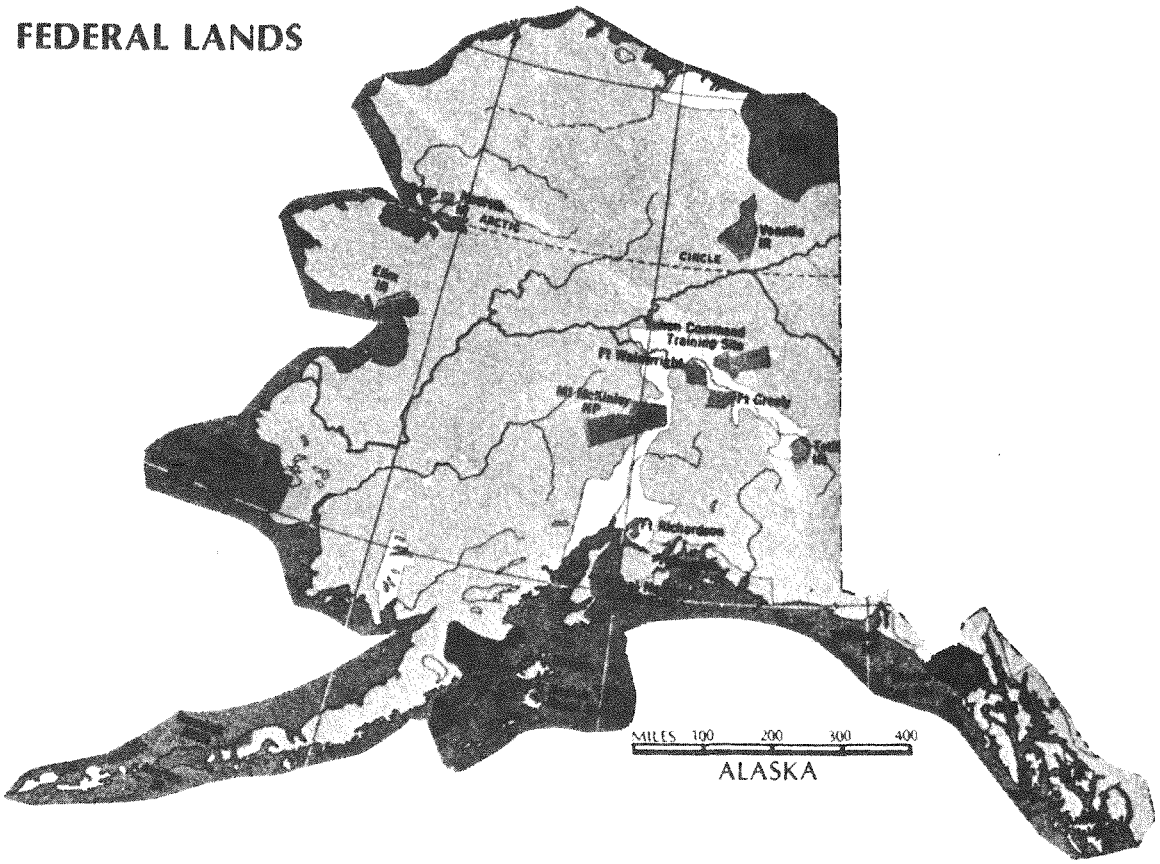
TABLE II-E-68

FEDERALLY OWNED LANDS COMPARISON FOR THE STATES, REGION, AND UNITED STATES AS OF JUNE 30, 1975 (IN THOUSANDS OF ACRES)

Area	Total Land Area (Acres)	Federally Owned Land (Acres)	Percent of Respective Total Area	Percent of Region	Percent of United States
Alaska	365,482	352,408	96.4	81.8	46.3
Idaho	52,933	33,742	63.7	7.8	4.4
Oregon	61,599	32,370	52.6	7.5	4.2
Washington	42,694	12,588	29.5	2.9	1.7
Region	522,708	431,108	82.5	100.0	56.7
U.S.	2,271,343	760,414	33.5	-	100.0

Data Source: Ref. 1, The Impact of Increased Coal Consumption.

FEDERAL LANDS



DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

Tracts, 50-100% density

Scattered tracts, approximately 25-50% density
Small scattered tracts not shown

NATIONAL PARK SERVICE

National park (NP)

National monument (NM), national seashore (NS) and national recreation area (NRA)

BUREAU OF INDIAN AFFAIRS

Indian reservation (IR)

BUREAU OF SPORT FISHERIES AND WILDLIFE

National wildlife refuge (NWR)

BUREAU OF RECLAMATION

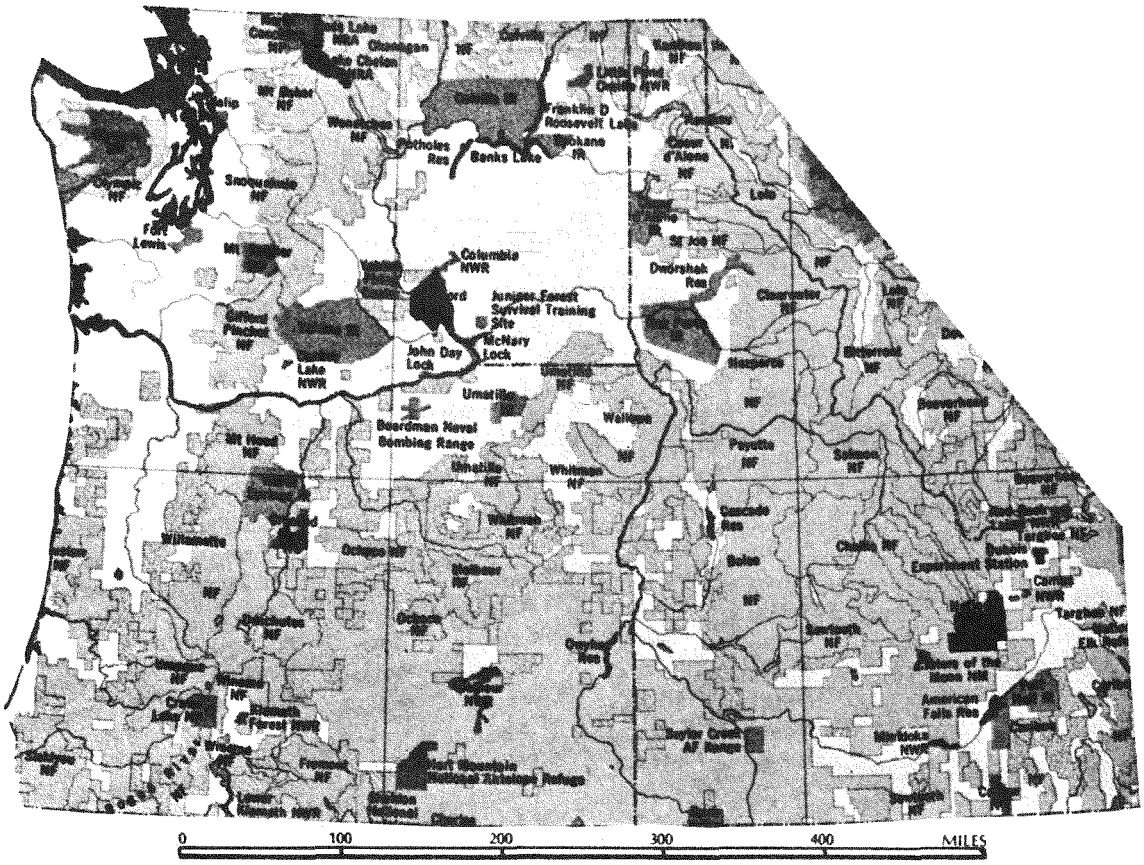


FIGURE II-E-153. Federal Land Ownership

Data Source: Ref. 13, National Atlas, p. 272.

TABLE II-E-69

LAND OWNERSHIP, PACIFIC NORTHWEST REGION,[a] 1970

Administrative Agency or Owner	State, 1,000 acres			
	Alaska	Idaho	Oregon	Washington
Federal				
Forest Service		19,790.2	13,866.7	9,016.0
Other Agriculture		32.7	14.6	0.4
Bureau of Land Management		11,839.4	15,313.6	275.2
Bureau of Indian Affairs		831.1	690.0	2,507.8
National Park Service		84.9	63.5	1,903.0
Fish & Wildlife Service		20.2	433.3	110.0
Bureau of Reclamation		581.8	160.9	393.0
Other Interior		0.1	2.7	7.1
Department of Defense		94.0	160.4	504.3
Other Federal		575.1	3.3	381.6
Federal Subtotal		33,849.5	30,709.0	15,097.8
(Federal Percentage)		(67)	(53)	(35)
State		2,745.6	1,699.5	3,315.6
County		105.2	282.9	96.9
Municipal		40.0	137.7	293.3
Public Non-Federal Subtotal		2,890.8	2,120.1	3,705.8
Total Public		36,740.3	32,829.1	18,803.6
Private		14,044.8	24,731.5	23,872.0
Total Land Area		50,785.1	57,560.6	42,675.6

(a) Area under planning jurisdiction of Pacific Northwest River Basins Commission.

Data Source: Ref. 21, Critical Water Problems Facing the Eleven Western States.

TABLE II-E-70

PURPOSE OF MANAGEMENT FOR STATE LANDS BY STATE, 1977

	Acres				
		Purpose of Management			
State	Total	Parks	Forests Including Multiple-Use Lands	Fish and Wildlife Areas	Other
Alaska	37,357,699	957,699	0	0	36.4 million
Idaho	1,161,234	44,640	993,054	123,540	
Oregon	988,060	91,515	785,798	110,747	
Washington	5,150,188	86,677	4,688,845	374,666	

Data Source: Ref. 55, U.S. Forest Service.

TABLE II-E-71

NATIONAL FOREST SYSTEM: NATIONAL FOREST SYSTEM LANDS AND OTHER LANDS WITHIN UNIT BOUNDARIES, IN STATES, JUNE 30, 1974

State	Gross Area Within Unit Boundaries	National Forest System Lands(a)	Other Lands Within Unit Boundaries(b)
Alaska	20,777	20,715	62
Idaho	21,635	20,363	1,272
Oregon	17,298	15,442	1,856
Washington	10,023	9,068	955

(a) National Forest System lands--the national forests, national forest purchase units, national grasslands, and other lands administered by the Forest Service. Includes national forest lands withdrawn for use of other federal agencies where the National Forest reservation has not been revoked. National forests--areas formally designated or proclaimed as national forests. Data also include administrative sites outside national forest boundaries. Purchase units--portions of approved national forest acquisition areas established by the Secretary of Agriculture with the concurrence of the National Forest Reservation Commission, located outside designated or proclaimed national forest boundaries. National grasslands--lands designated "National grasslands" by the Secretary of Agriculture and permanently held by the Department of Agriculture under Title III of the Bankhead-Jones Farm Tenant Act. The acreage shown for the national grasslands are the areas of such lands administered by the indicated unit headquarters or regions. Land utilization projects--lands administered by the Forest Service for programs of land utilization and adjustment under Title III of the Bankhead-Jones Farm Tenant Act. Research and experimental areas--areas outside of the national forests and grasslands which have been reserved and dedicated to forest or range research and experimentation. Other areas--lands administered by the Forest Service that are not included in the above groups.

(b) Other lands within unit boundaries--lands within the unit boundaries in private, state, county, and municipal ownership and federal lands over which the Forest Service has no jurisdiction. Areas of such lands which have been offered to the U.S. and have been approved for acquisition and subsequent Forest Service administration but to which the title had not yet been accepted by the United States.

Data Source: Ref. 55, U.S. Forest Service.

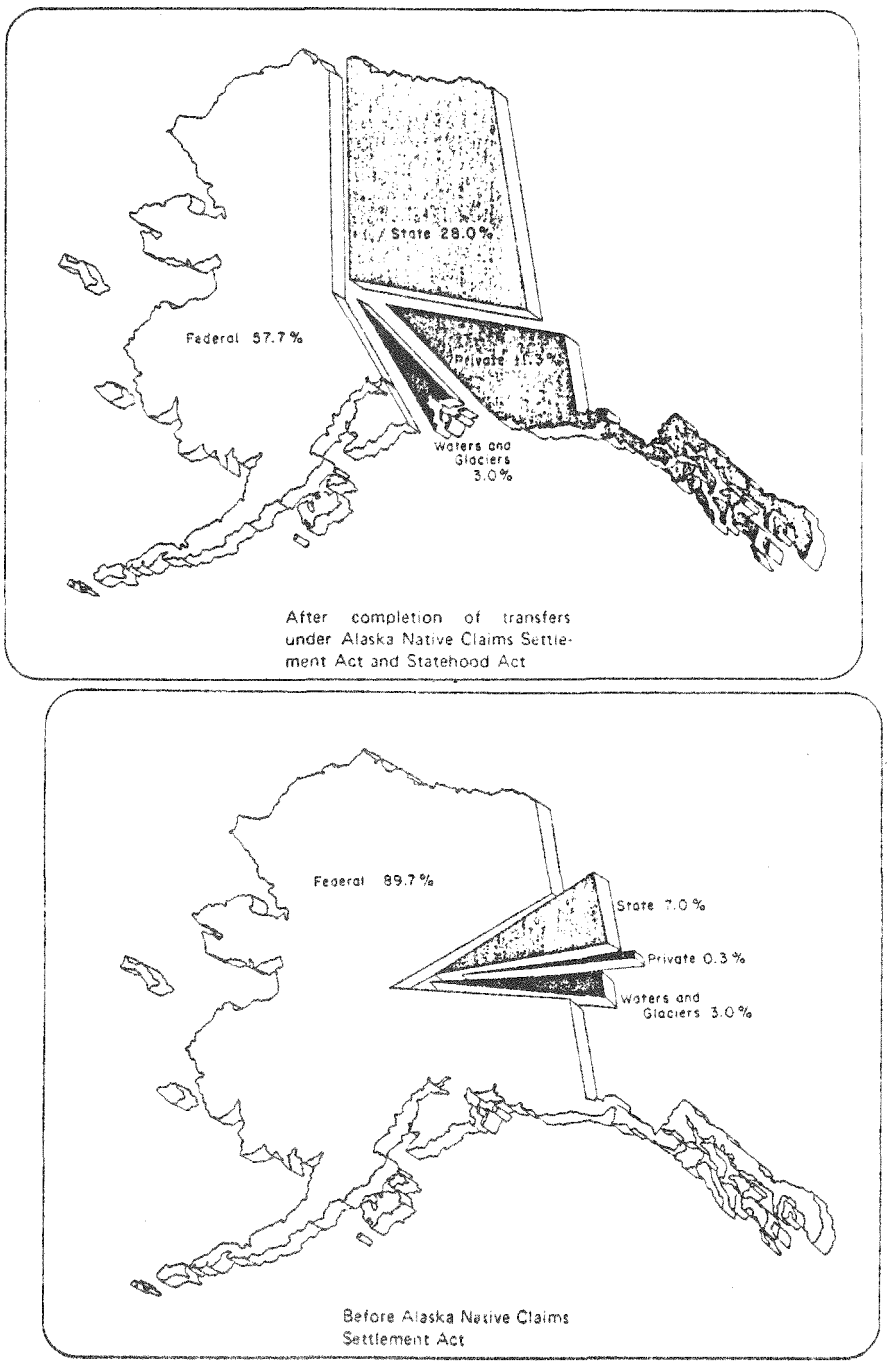


FIGURE II-E-154. Alaska's Land Status 1971 and 1984

Data Source: Ref. 11, Alaska Regional Profiles.

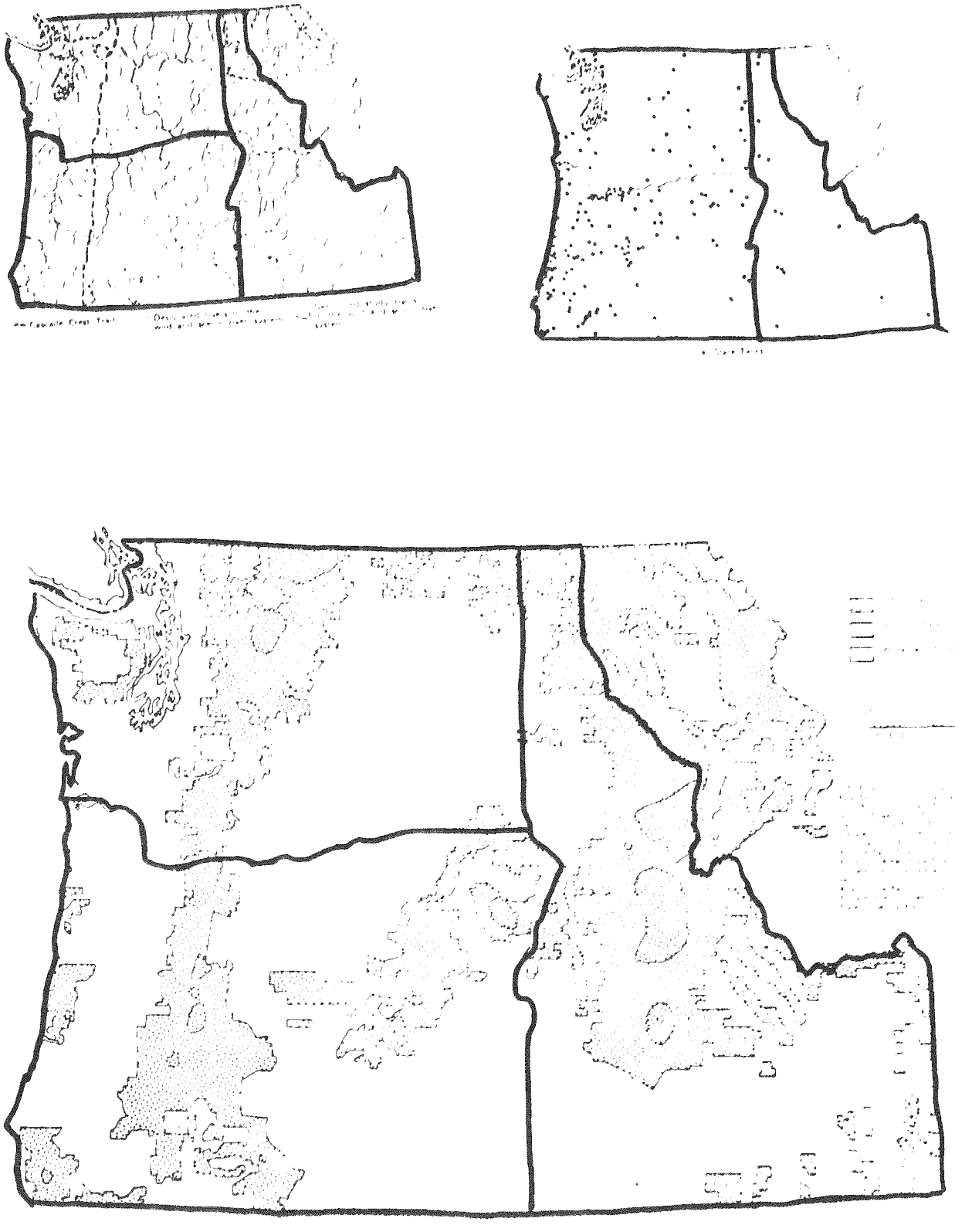


FIGURE II-E-155. Recreation

Data Source: Ref. 20, BPA Role EIS, p. III-35.

TABLE II-E-72

RECREATIONAL VISITOR DAYS AND VISITOR PARTY DAYS IN NATIONAL PARK SERVICE CONTROLLED AREAS, BY AIR QUALITY CONTROL REGION IN THE WEST

State	Air Quality Control Region	Visitor Days (1,000)	Visitor Party Days (1,000)
WA	171	1,154.06	329.73
WA	170	290.40	82.97
WA	22	1,486.28	424.65
WA	172	14.11	4.03
OR/WA	35	14.86	4.25
OR	203	7.13	2.04
OR	202	47.78	13.65
OR	200	156.83	44.81
OR	201	---	---
ID/WA	83	28.13	8.04
ID	236	59.42	16.98
ID	49	---	---
ID	173	272.11	77.75

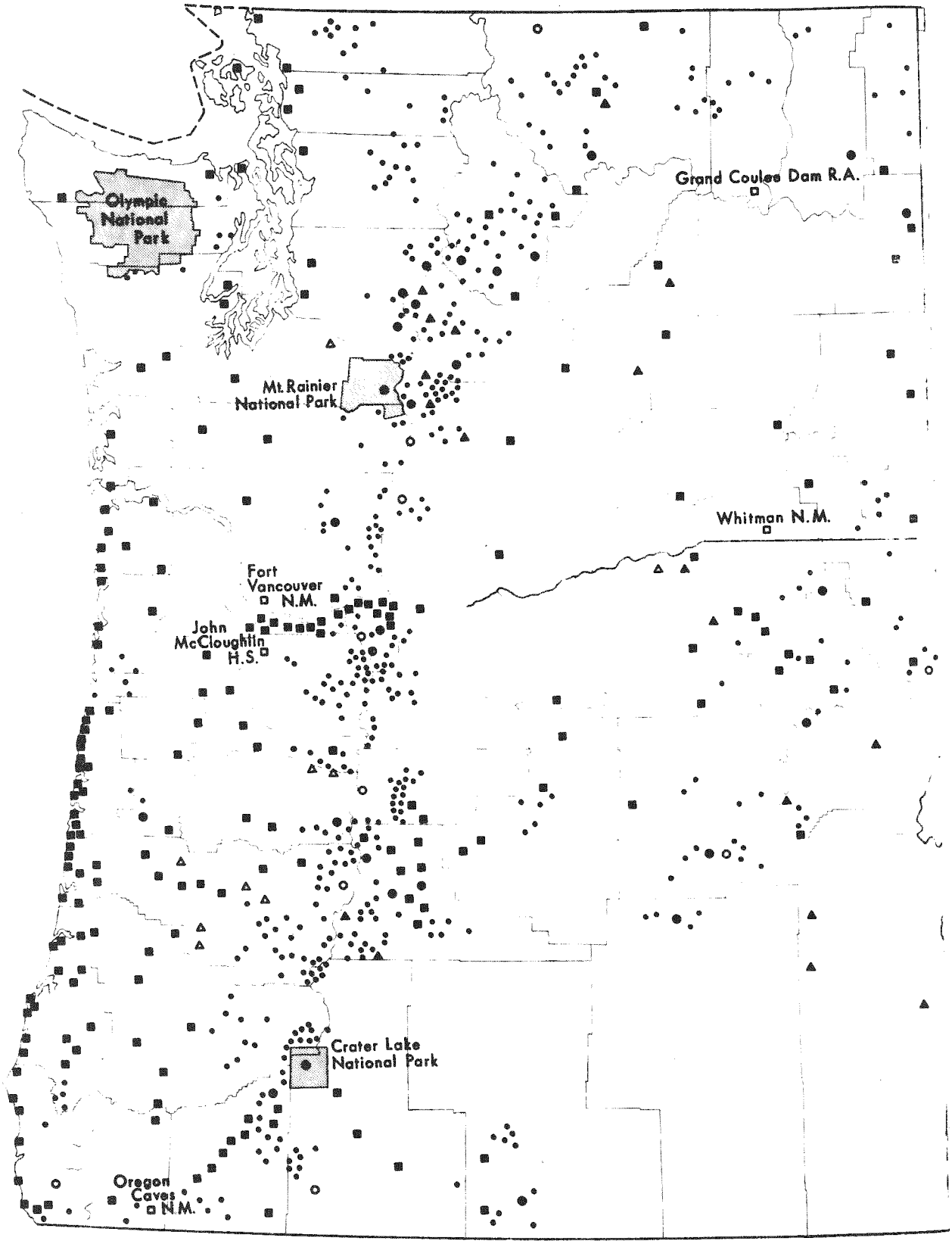
Data Source: Ref. 22, An Approach to Valuing Visual Pollution from Western Electricity Production.

TABLE II-E-73

1975 NATIONAL PARK SERVICE VISITATION DATA FOR AIR QUALITY CONTROL REGIONS IN THE WEST

State	Air Quality Control Region	National Park, National Monument, National Recreation Area, or National Historical Site	1975 Visitor Days (1,000)
WA	171	San Juan Island - NHP	4.60
WA	171	Olympic - NP	1062.86
WA	171	Ross Lake - NRA	---
WA	171/170	North Cascades - NP	173.19
WA	170	Lake Chelan - NRA	---
WA	170	Coulee Dam - NRA	203.80
WA	22	Mount Rainier - NP	1486.28
WA	172	Whitman Mission - NHS	14.11
WA	35	Fort Vancouver - NHS	14.86
OR	203	Fort Clatsop - NMem	7.13
OR	202	Oregon Caves - NM	47.78
OR	200	Crater Lake - NP	156.83
OR	201	None	0
ID	83	Nez Perce - NHP	28.13
ID	236	Craters of the Moon - NM	59.42
ID	49	None	0
ID	173	Yellowstone (part - 5%) - NP	272.11

Data Source: Ref. 1, The Impact of Increased Coal Consumption.


Olympic National Park
Grand Coulee Dam R.A.
Mt. Rainier National Park
Whitman N.M.
Fort Vancouver N.M.
John McCloughlin H.S.
Crater Lake National Park
Oregon Caves N.M.

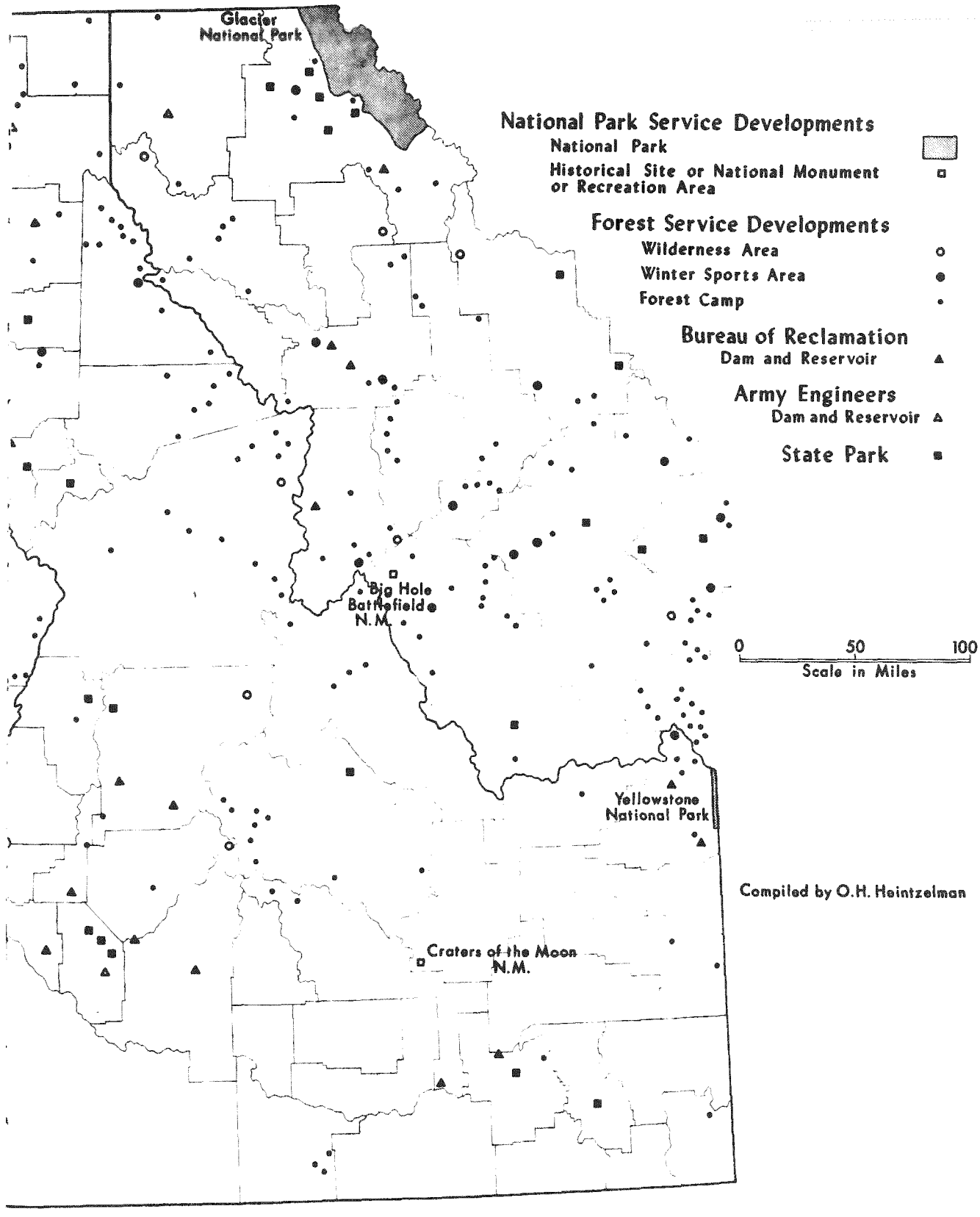


FIGURE II-E-156. Recreation Developments of Public Agencies

Data Source: Ref. 3, Atlas of the Pacific Northwest.

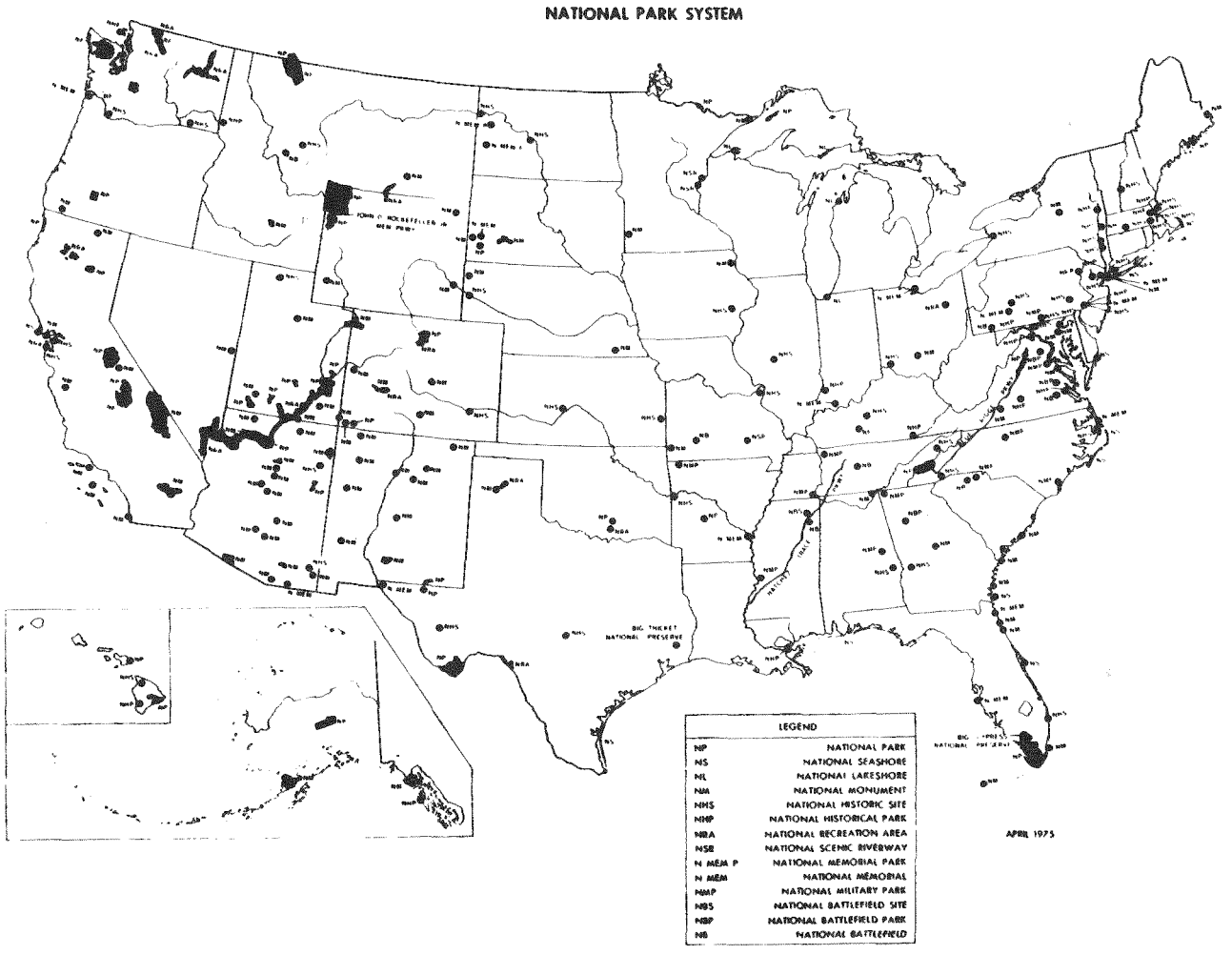


FIGURE II-E-157. National Park System, April 1975

Data Source: Ref. 7, The Nation's Renewable Resources.

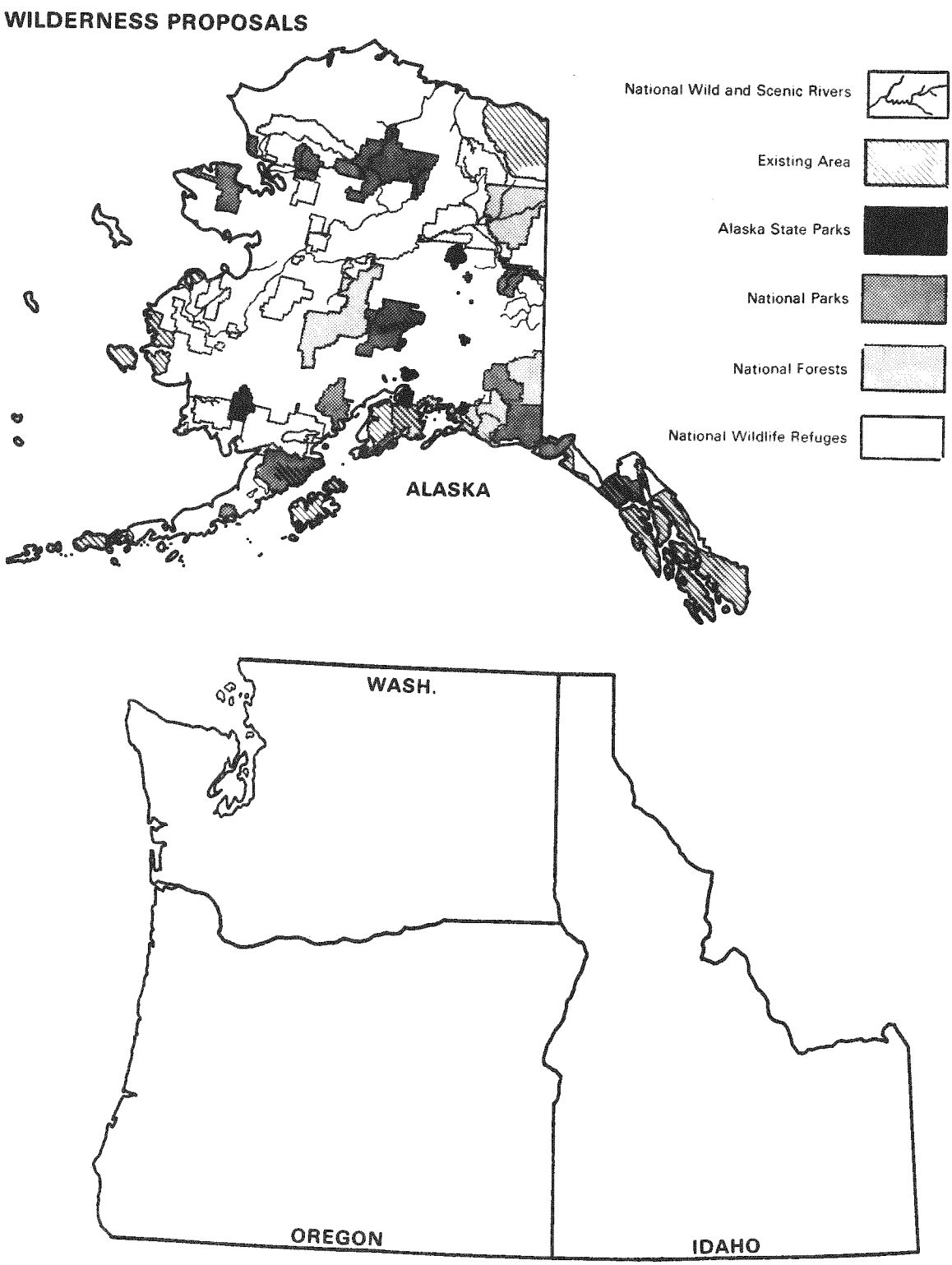


FIGURE II-E-158. Wilderness Proposals and Potential Land Ownership

Data Source: Ref. 56, Alaska Wilderness Proposal.

TABLE II-E-74

NATURAL AREAS ADMINISTERED BY THE NATIONAL PARK SERVICE, AND RELATED PROPERTIES

Name and Location	Acreage			Outstanding Characteristics and Pertinent Data	P.O. Address
	Federal	Non-Federal	Gross		
Crater Lake National Park, Oregon	160,290.33		160,290.33	Lake of unique blue in heart of once-active volcano; encircled by multicolored lava walls 500 to 2,000 ft high. Established May 22, 1902. Boundary changes: June 7, 1924; May 14, 1932.	c/o Klamath Falls Group, NPS, P.O. Box 128, Klamath Falls, OR 97601
Glacier Bay National Monument, Alaska	2,803.610.93	229.07	2,803,840.00	Great tidewater glaciers and examples of early stages of post-glacial forests; rare species of wildlife. Largest area in National Park System. Proclaimed Feb. 26, 1925. Boundary changes: Apr. 18, 1939; Mar. 31, 1955.	c/o Alaska Group, NPS, P.O. Box 2252, Anchorage, AK 99501
Mt. McKinley National Park, Alaska	1,939,492.80		1,939,492.80	Mt. McKinley, 20,320 ft, highest mountain in North America; large glaciers of the Alaska Range; caribou, Dall sheep, moose, grizzly bears, timber wolves, and other wildlife. Second largest national park. A Living History area. Established Feb. 26, 1917. Boundary changes: Jan. 30, 1922; Mar. 19, 1932	c/o Alaska Group, NPS, P.O. Box 2252, Anchorage, AK 99501

TABLE II-E-74 (contd)

Name and Location	Acreage Federal	Acreage Non-Federal	Acreage Gross	Outstanding Characteristics and Pertinent Data	P.O. Address
Mt. Rainier National Park, Washington	241,781.09	210.91	241,992.00	Greatest single-peak glacial system in the U.S. radiating from the summit and slopes of an ancient volcano; dense forests; subalpine flowered meadows. Established Mar. 2, 1899. Boundary changes: May 28, 1926; Jan. 31, 1931; June 27, 1960.	Longmire, WA 98397
North Cascades National Park, WA	503,120.00	1,880.00	505,000.00	Wild alpine region of jagged peaks, mountain lakes, glaciers, plant and animal communities. Established Oct. 2, 1968.	Sedro Woolley, WA 98284
Olympic National Park, Washington	893,344.54	3,254.56	896,599.10	Mountain wilderness containing finest remnant of Pacific Northwest rain forest; active glaciers; rare Roosevelt elk; Pacific shore. Proclaimed as Mt. Olympus National Monument, Mar. 2, 1909; transferred from Forest Service, U.S. Department of Agriculture, Aug. 10, 1933; established as Olympic National Park, June 29, 1938. Boundary changes: Jan. 2, 1940; May 29, 1943; Jan 6, 1953.	600 E. Park Ave., Port Angeles, WA 98362

TABLE II-E-74 (contd)

Name and Location	Acreage Federal	Acreage Non-Federal	Acreage Gross	Outstanding Characteristics and Pertinent Data	P.O. Address
Oregon Caves National Monument, Oregon	480.00		480.00	Cave passages in limestone with intricate flowstone formations.	c/o Klamath Falls Group, NPS, P.O. Box 128, Klamath Falls, OR 97601
Yellowstone National Park, Wyo.-Mont.-Idaho	2,219,736.88	2,035.73	2,221,772.61	World's greatest geyser area, with about 3,000 geysers and hot springs; spectacular falls; Grand Canyon of the Yellowstone. Rich in wildlife. First and largest national park. Federal acreage: 2,039,216.98 in Wyo.; 149,031.90 in Mont.; 31,488.00 in Idaho. Established Mar. 1, 1872. Boundary changes: May 26, 1926; Mar. 1, 1929; Apr. 19, 1930; Oct. 20, 1932.	Yellowstone National Park, WY 82190

Data Source: Reference 57, National Parks and Landmarks

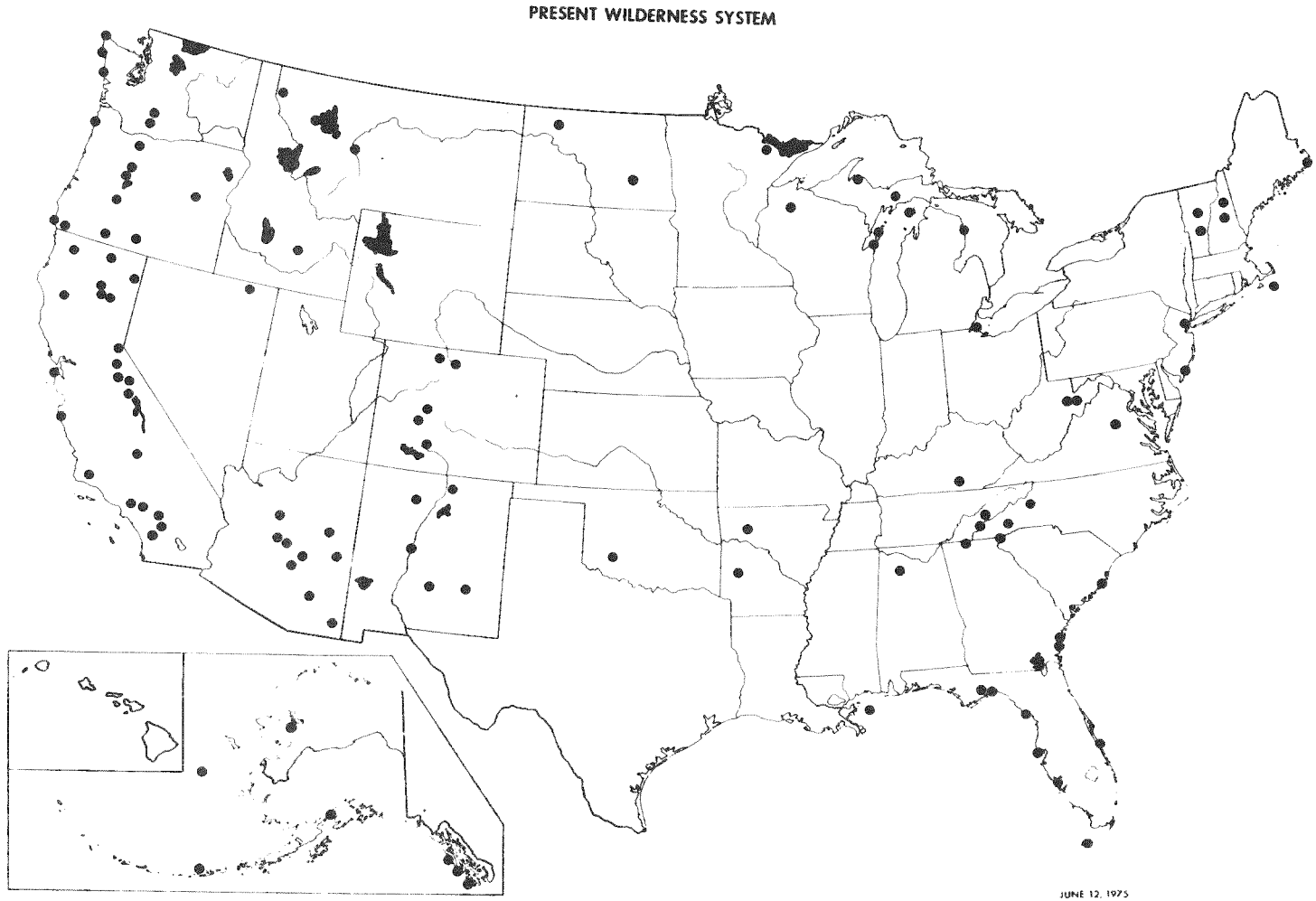


FIGURE II-D-159. Present Wilderness System

Data Source: Ref. 7, The Nation's Renewable Resources, Figure 11.

TABLE II-E-75

NATIONAL WILDERNESS SYSTEM, 1976

State	Areas	Acres	Areas	Acres	Areas	Acres	Areas	Acres	Areas	Acres
Alaska	0	0	8	76,235	0	0	0	0	0	76,235
Idaho	3	1,289,168	0	0	1	43,243	0	0	4	1,332,411
Oregon	11	951,923	2	38	0	0	0	0	13	951,961
Washington	5	1,388,326	2	534	0	0	0	0	7	1,388,860
National Totals	92	12,605,405	52	728,218	17	1,120,213	0	0	161	14,453,836

Note: Data base for the entire National Wilderness Preservation System is maintained by the Council on Environmental Quality. Recent designations and proposed additions to the System are taken directly from legislation. Information on the condition, visitation, and administration of Wilderness Areas is taken from the U.S. Department of Agriculture, Forest Service, and the Department of Interior, National Park Service and Fish and Wildlife Service.

(1) Department of Interior, U.S. Forest Service

(2) Department of Interior, U.S. Fish and Wildlife Service

(3) Department of Interior, U.S. National Park Service

(4) Department of Interior, U.S. Bureau of Land Management

Data Source: Ref. 58, Wilderness Monitoring System.

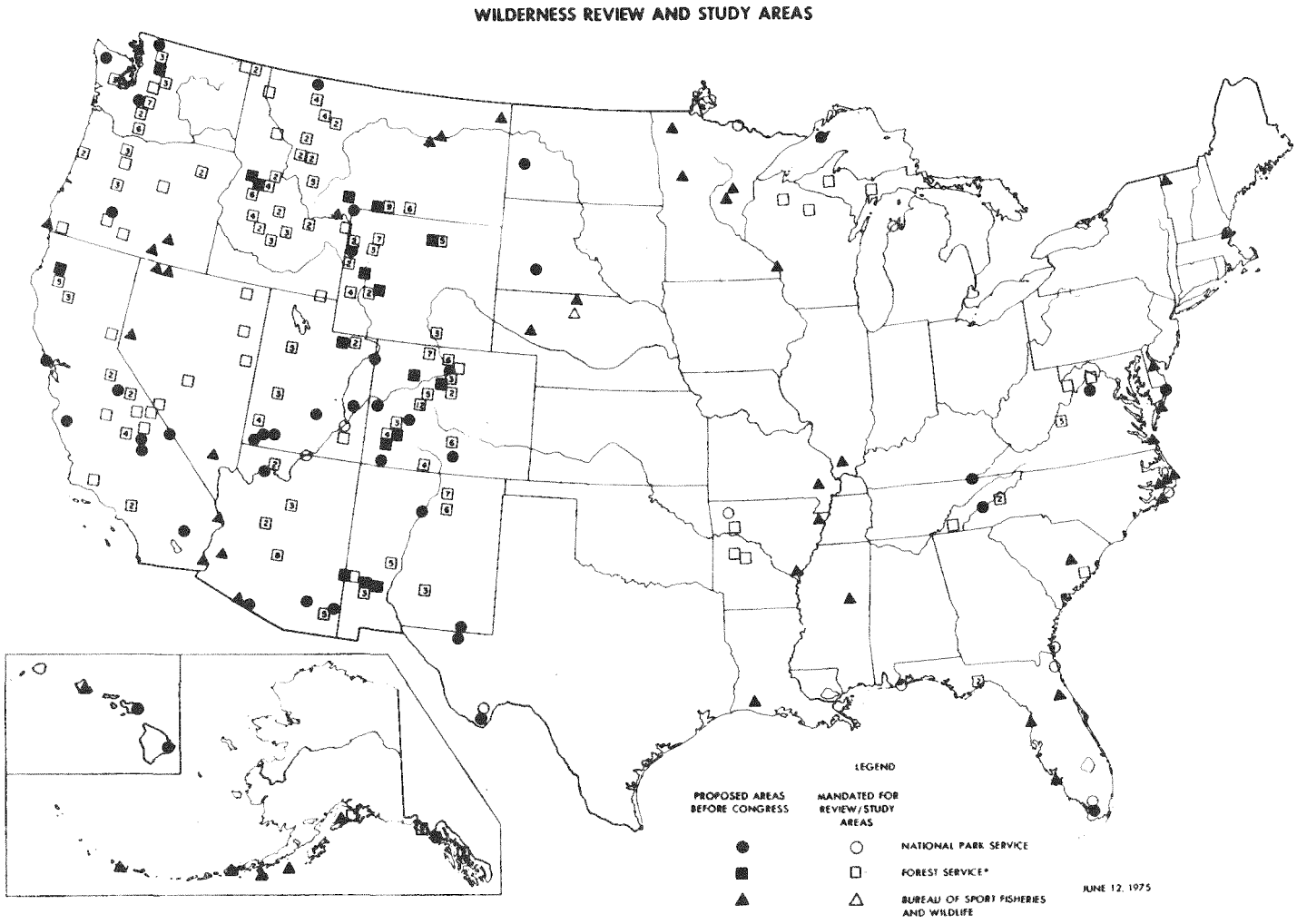


FIGURE II-E-160. Wilderness Review and Study Areas

Data Source: Ref. 7, The Nation's Renewable Resources, Figure 15.

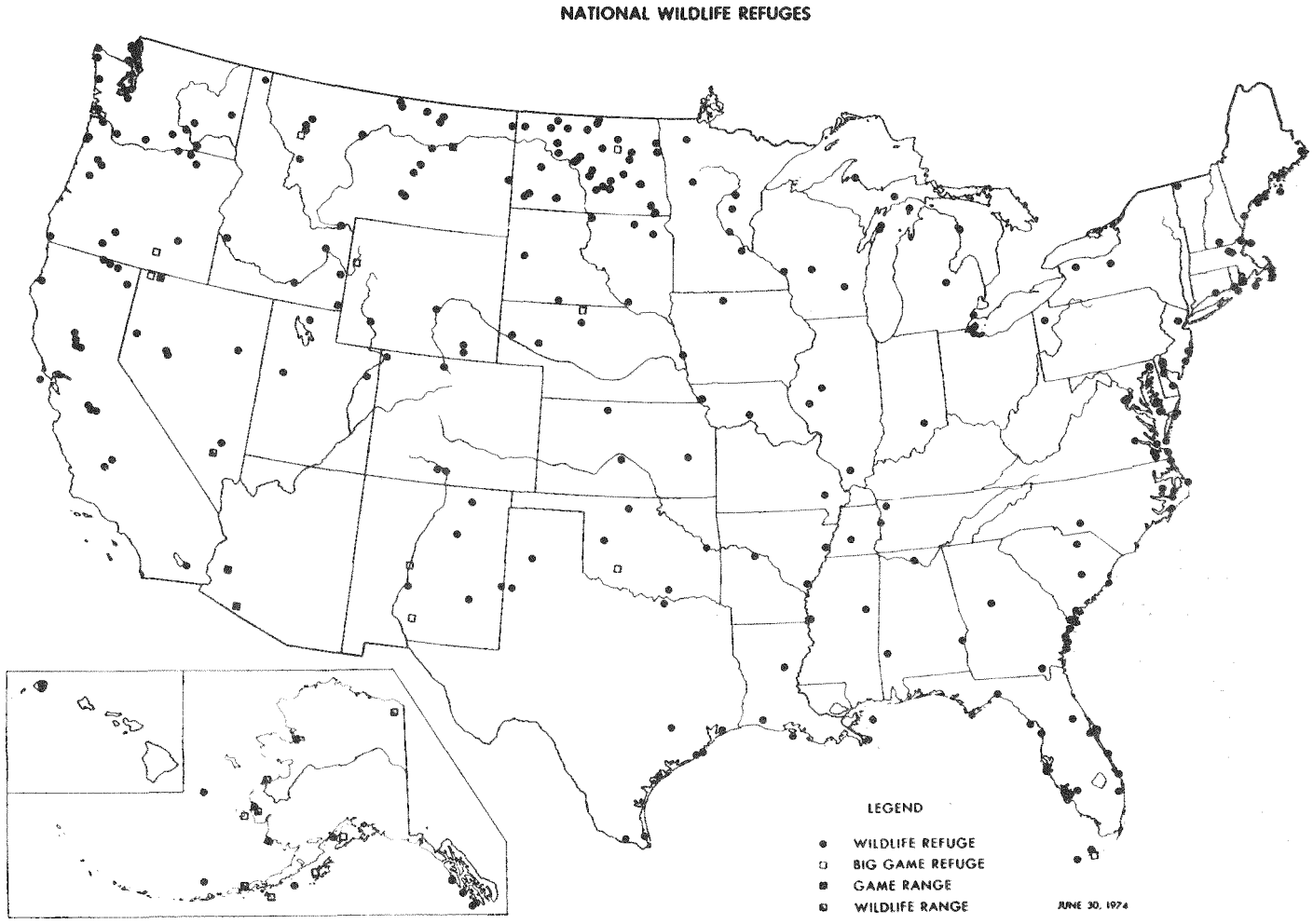


FIGURE II-E-161. National Wildlife Refuges

Data Source: Ref. 7, The Nation's Renewable Resources, Figure 7.

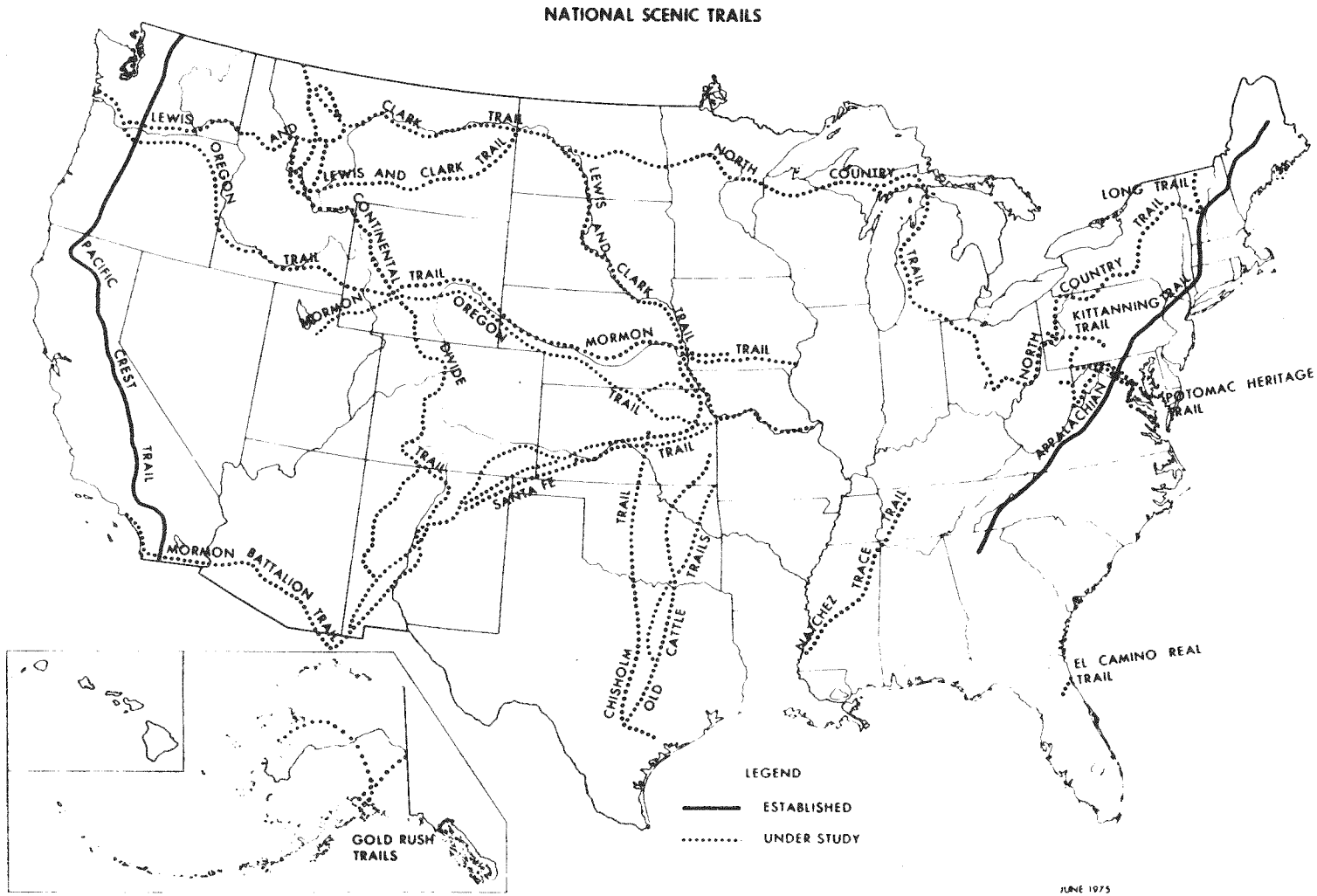


FIGURE II-E-162. National Scenic Trails

Data Source: Ref. 7, The Nation's Renewable Resources, Figure 10.

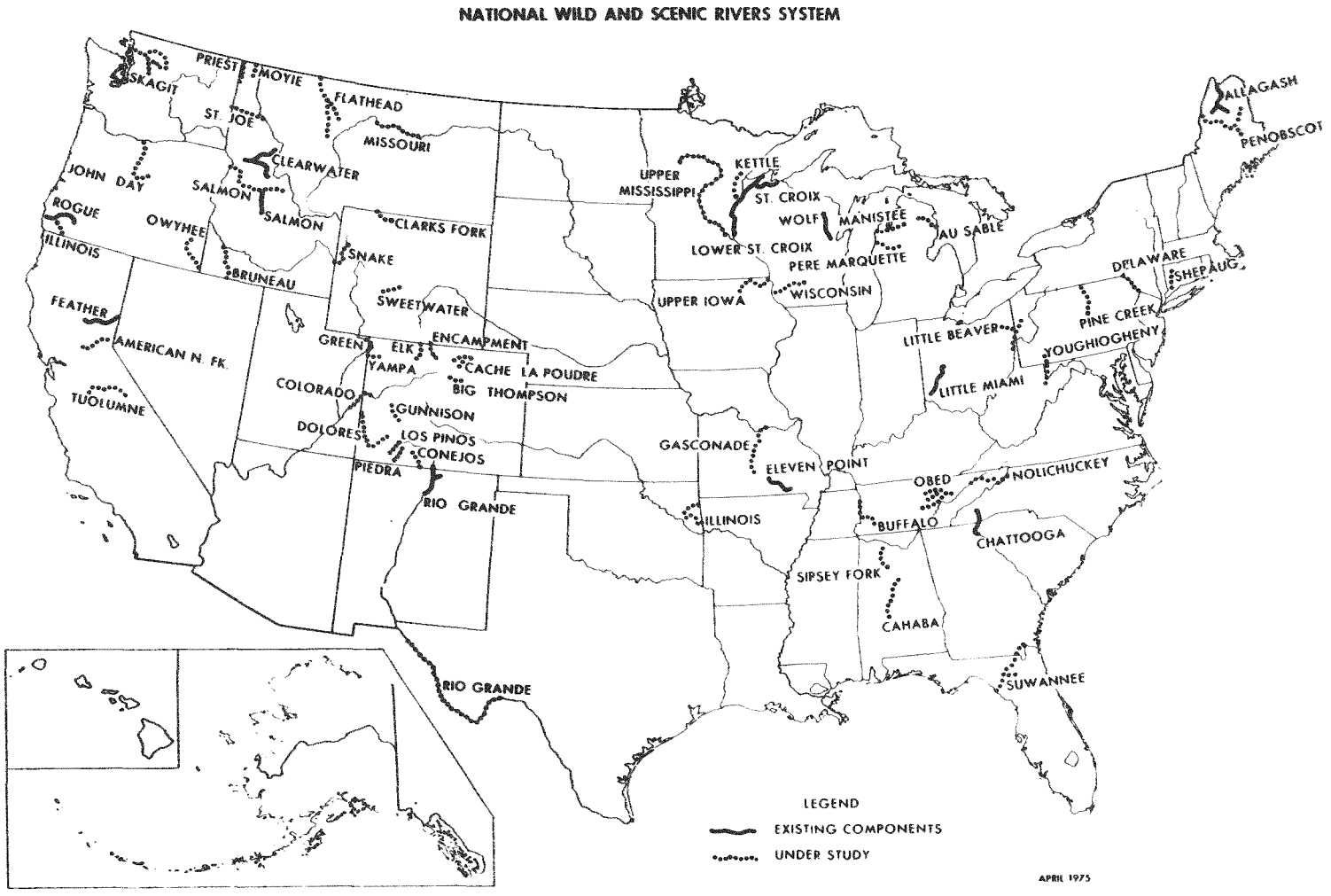


FIGURE II-E-163. National Wild and Scenic Rivers System

Data Source: Ref. 7, The Nation's Renewable Resources, Figure 8.

TABLE II-E-76

EXISTING AND POTENTIAL NATIONAL WILD AND SCENIC RIVERS
November 1, 1977

STREAM DESIGNATED RIVERS	STATE	REACH	STUDY STATUS
M.Fk.Clearwater R.	Idaho	Middle Fork: From town of Kooskia U/S to town of Lowell. Lochsa R.: From its jct. with Selway at Lowell forming Middle Fork, U/S to Power Ranger Station. Selway R. From LowellU/S to its origin	No studies required. Administered by Dept. of Agriculture. (USDA)
Rogue R.	Oregon	Segment extending from mouth of Applegate Cr. Bridge.	A combined plan for development, operation and management completed by BLM and FS.
M.Fk. Salmon R.	Idaho	From its origin to its confluence with the mainstem of the Salmon R.	No studies required. Administered by USDA.
Snake R.	Idaho/ Oregon	The 68 mile reach of the river from Hells Canyon Dam D/S to the northern boundary of the Wallowa-Whitman National Forest.	Authorized by the Hells Canyon National Recreation Area Act of December 31, 1975. Administered by USDA.
Rapid R.	Idaho	From the headwaters D/S to the Nezperce Forest Boundary and the west Fork from the Hells Canyon Wilderness Boundary to its confluence with the mainstem.	Authorized by the Hells Canyon National Recreation Area Act of December 31, 1975. Administered by USDA.
STUDY RIVERS			
Bruneau R.	Idaho	The entire main stem.	Final Report and EIS submitted to CEQ in November 1976. Has not been released by OMB. Approx. 125 miles of river and tributaries recommended for designation. Coordination by Dept. of the Interior (USDI). The President recommended inclusion in the Wild and Scenic Rivers System in his environmental message to Congress on May 23, 1977.
Illinois R.	Oregon	The entire river.	Draft report & EIS submitted to CEQ in May 1977. Coordination by USDA.
Moyie R.	Idaho	Segment from Canadian border to confluence with Kootenai R.	Study underway. Draft Report and EIS in process. Coordination by USDA.
Priest R.	Idaho	The entire main stem.	Study underway. Draft Report and EIS in process. Coordination by USDA.
St. Joe R.	Idaho	The entire main stem.	Final Report and EIS awaiting approval of OMB. Coordination by USDA.
Salmon R.	Idaho	Segment from town of North Fork to confluence with the Snake R.	Study completed. Pending Congressional Action. The President recommended inclusion in the Wild and Scenic Rivers System in his environmental message to Congress on May 23, 1977. Coord. by USDA.
Skagit R.	Washington	Main Stem: From town of Mt. Vernon to and including mouth of Bacon Cr. Cascade R.: Between its mouth and jct. of its North and South Forks. S.Fk. Cascade R.: From its mouth to Glacier Peak Wilderness Boundary at Milk Creek. Sauk R.: From mouth to jct. with Elliot Cr. N.Fk. Sauk R.: From its jct. with S.Fk. Sauk R. to Glacier Pk. Wilderness Boundary.	Final Report and EIS completed. Pending Congressional Action. Nuclear Regulatory Commission requested determination by Sec. of Agr., if Nuclear Power Plan will result in direct and adverse effects in accordance with Sec. 7b of Wild and Scenic River Act. Determination has not been made. Coordination by USDA. The President recommended inclusion in the Wild & Scenic River System in his environment-
Owyhee R.	Oregon/ Idaho	The S.Fk. from the Idaho-Oregon Border D/S to the Owyhee Reservoir. The S.Fk. in Idaho to its confluence with the East Fork. East Fk. U/S to the boundary of the Duck Valley Indian Reservation.	Draft Report and EIS has been submitted for review. Coordination by USDI.
John Day R.	Oregon	The main stem from Service Cr. bridge D/S 147 miles to Tumwater Falls.	Study completed. Draft Report and Draft Environmental Statement being prepared. Coordination by USDI.
Snake R.	Idaho/Oregon/ Washington	31-mile reach D/S from the northern boundary of the Wallowa-Whitman National Forest to the town of Asotin.	Field study completed. Draft Report and Draft Environmental Statement being prepared by and Coordinated by USDI.
POTENTIAL WILD RIVERS (SECTION 5(d)(1) RIVERS) 1/			
Blackfoot R.	Montana	Segment from Landers Fk. to Milltown Dam.	
Columbia R.	Washington	Segment from Priest Rapids Dam to McNary Pool.	Proposed for study by the President in his environmental message to Congress on May 23, 1977.
Deschutes R.	Oregon	Segment from Pelton Reregulating Dam to confluence with Columbia R.	
Grande Ronde R.	Oregon/ Washington	Main Stem: Segment from Rondowa to confluence with Snake R. with its tributaries. Wenaha R.: To Milk Cr. on S.Fk. of the Wenaha. Wallowa R.: To the Minam R. Minam R.: In its entirety.	
Henrys Fork R.	Idaho	Segment from Big Springs to confluence with Warm R.	
John Day R.	Oregon	Main Stem: Segment from mouth to confluence with North Fork. North Fork: From John Day at Kimberly to junction with Baldy Cr. Granite Cr.: To its junction with Clear Cr.	Proposed for study by the President in his environmental message to Congress on May 23, 1977.
Imnaha R.	Oregon	Entire river.	
Wenatchee R.	Washington	Entire river including Lake Wenatchee and its tributaries, the Chiwawa and White Rivers.	Proposed for study by the President in his environmental message to Congress on May 23, 1977.

As [illegible] by the Secretary of Agriculture [illegible]

Data Source: Ref. 59, Review of Power Planning, p. 26.

TABLE II-E-77

COMPONENTS OF THE NATIONAL WILD AND SCENIC RIVERS SYSTEM

River	Location	Administering Agency	Miles by Classification			Total Miles	Status/Public Law
			Wild	Scenic	Recreational		
Middle Fork Clearwater	Idaho	FS	54	-	131	185	P.L. 90-542, 10/2/68
Rogue	Oregon	BLM/FS	33	7.5	44	84.5	P.L. 92-542, 10/2/68
Middle Fork Salmon	Idaho	FS	103	-	1	104	P.L. 90-542, 10/2/68
Snake	Idaho/Oregon	FS	32.5	34.4	-	66.9	P.L. 94-199, 12/31/75
Rapid	Idaho	FS	24	-	-	24	P.L. 94-199, 12/31/75
U.S. Total			681.05	452.7	448.4	1,655.15	

Data Source: Ref. 59, River Mileage Classification.

TABLE II-E-78

OREGON SCENIC WATERWAYS, DECEMBER 31, 1977

Stream	Reach	Approx. Miles
1. Rogue R	Segment from Confluence with Applegate R. D/S to Lobster Cr. Bridge	88
2. Illinois R.	Segment from Confluence with Deer Cr. D/S to Confluence with Rogue R.	46
3. Deschutes R.	Segment from Immediately Below Pelton Reregulating Dam D/S to Confluence with Columbia R., excluding City of Maupin	100
4. Minam R.	Entire River from Minam Lake D/S to its Confluence with Wallowa R.	45
5. S. Fk. Owyhee R.	Segment in Malheur County from Idaho Border D/S to Three Forks, where Main Stem of Owyhee R. is Formed	25
	Segment of Main Stem Owyhee R. from Crooked Cr. (6 miles below Rome) D/S to Mouth of Birch Cr.	45
6. John Day R.	Segment of Main Stem from Service Cr. Bridge (RM 157) D/S to Tumwater Falls (RM 10)	147
7. Sandy	Segment from Dodge Park to Dabny State Park	12
8. Clackamas	Segment from River Mill Dam near Estacada D/S to a Highway Bridge at Carver	15

Data Source: Ref. 60, Review of Power Planning, p. 27.

TABLE II-E-79

WASHINGTON SCENIC RIVER SYSTEM, NOVEMBER 1, 1977

Stream	Reach	Approx. Miles
1. Skykomish R. A.	a. From Junction of North and South Forks D/S to its Junction with the Sultan R.	14
	b. From Junction of North and South Forks U/S on the South Fork to the Junction of the Tye and Foss Rivers	20
	c. From Junction of North and South Forks U/S on the North Fork to its Junction with Bear Creek	11
2. Beckler River	From its Junction with the S. Fork Skykomish U/S to its Junction with Rapid River	8
3. Tye River	From its Junction with the South Fork Skykomish U/S to Tye Lake	14

AREAS ADDED TO THE NATIONAL WILDERNESS PRESERVATION SYSTEM IN 1976

Wilderness	Agency	State	Public Law	Acreage
Alpine Lakes	FS	Washington	94-357	303,508
San Juan Islands	FWS	Washington	94-557	355
Simeonof	FWS	Alaska	94-557	25,141

	Added 1976		Total	
Agency	Areas	Acreage	Areas	Acreage
FS	5	669,833	92	12,605,405
NPS	13	919,268	17	1,120,213
FWS	16	155,156	52	718,087
Total	34	1,744,257	161	14,443,705

Source: P.L. 94-352, 90 Stat. 870, 16 U.S.C. 1132;
P.L. 94-357, 90 Stat. 905, 16 U.S.C. 1132;
P.L. 94-557, 90 Stat. 2633, 16 U.S.C. 1132;
P.L. 94-567, 90 Stat. 2692, 16 U.S.C. 1132.

Note: Idaho, Montana, Utah and Wyoming still have no State River System.

Data Source: Ref. 60, Review of Power Planning, p. 27.

TABLE II-E-80

STATE LAND USE PROGRAMS

State	Coastal Zone Management[a]	Wetlands Management[b]	Designation of Critical Areas[c]	Statewide Shorelands Act[d]
Alaska	x			
Idaho				
Oregon	x		x	
Washington	x	x		x

(a) State is participating in federally funded coastal zone management program authorized by the Coastal Zone Management Act of 1972.
(b) State has authority to plan or review local plans and the ability to control land use in the wetlands.
(c) State has established rules, or is in the process of establishing rules, regulations and guidelines for the identification of areas of critical state concern (e.g., environmentally fragile areas, areas of historical significance).
(d) State has legislation authorizing the regulation of the shorelands of significant bodies of water.

Data Source: Ref. 61, Environmental Quality Annual.

BIOTA

FLORA

Distribtuion of dominant vegetation in the Region is described in terms of potential natural vegetation that could occur under climax conditions. The dominant vegetation existing during pre-climax states is different from that which finally occupies the site at ecological climax. Potential natural vegetation is defined as the vegetation distribution that would exist if man's influence were removed and if natural succession were to run its course.

Many introduced plant species now exist interspersed with natural vegetation. In urban and farming areas especially, plants foreign to the Northwest have been introduced as crops, ornamentals, and weeds, and they compete ecologically with the Region's natural vegetation. Regionwide, the result is a highly diverse mosaic of plant communities under increasingly competitive stress and pushed into early stages of ecological succession. In fact, numerous native plant species are becoming increasing rare, and may soon be listed on official endangered species lists.

Historic and current land use practices of silviculture, farming, grazing, mining, fire control, and settlement have modified original ecosystems extensively in many lowland areas - but, by comparison, have done so only slightly at less accessible, higher altitudes. After sustaining much ecological change, original distributions of the Region's natural climax vegetation still conform to Regional patterns, but much of it is fragmented into isolated pockets associated with man's land uses. Primary areas where original vegetation still remains undisturbed are national, state, and county parks, urban parks, experimental forest preserves, wildlife refuges, and scablends in private ownership.

A vegation zone is an area of similar plant communities occuring over a specific climatic moisture gradient. Plant distributions also are controlled by such factors as soil moisture and type, elevation, topography and temperature, winds, slope, amount of sunlight, and characteristics of predominant soils.

Information Source: Ref. 20, BPA Role EIS, p. II-18

Montane

Needleleaf forests predominate in the mountains and foothills of the Region, and support many industries based on forest products. Lowlands along the coast are used mainly for agriculture. Forest associations of spruce, cedar, hemlock, and Douglas fir occur in the Olympic and Coastal ranges. These forests of western Washington and Western Oregon, including Puget Sound and the Willamette Lowlands, cover some 32,700 square miles of the Region.

Forest types predominating in the Cascades are associations of silver fir, Douglas fir, and true fir-hemlock. Ponderosa pine dominates the drier eastern slopes of the Cascade Range, and rims slopes of the Columbia Basin extending eastward into the Okanogan highlands of Washington and Rocky Mountains of Idaho and Montana. Ponderosa also extends around the perimeter of the Blue and Wallowa Mountains in the Regions interior. In these ranges, Ponderosa covers an area of approximately 19,000 square miles within the Region.

Future land uses in the Cascade Range will probably change little from present uses because of rugged terrain and heavy snowfall. The eastern slopes in particular will likely continue to be utilized for forest products, minerals, and recreation.

Puget Sound and Willamette Lowlands

Stands of Douglas fir, cedar, and hemlock predominate on the lowlands surrounding Puget Sound and in the Willamette Valley. In the Willamette Valley lies a unique mix of oak forest interspersed with stands of Douglas fir, cedar, and hemlock. This forest community occupies an area of 942 square miles in eastern Oregon, much of which is presently used for agriculture. Climatically, it is highly favorable for human occupation, a use it will more than likely be increasingly put to in the future.

Information Source: Ref. 20, BPA Role EIS.

Columbia Basin and Snake River Plateaus

The arid eastern basin and plateau portions of the Region contain extensive areas of grassland and sage brush steppe in a mosaic of diverse combinations controlled locally by moisture and temperature gradients, slope, and soil type.

A fescue-wheatgrass association is common on the northern perimeter of Washington's Columbia Basin. This community extends over 6533 square miles, of which 4855 are in Washington, 1488 are in Idaho, and 192 are in Oregon. The wheatgrass-bluegrass association also extends into these three states. In the eastern portion of the Columbia Basin of Oregon and Washington it ranges over 11,719 square miles, and is found mostly along the northwestern foothills of the Blue Mountains. Idaho has 2232 square miles of this grassland association.

Native sagebrush steppe and grassland combinations with wheatgrass predominating range widely throughout the Columbia Basin of Washington and Oregon and upon the Snake River Plateau of southern Oregon and Idaho. This vegetation covers 78,335 square miles of the three-state area, and has long supported livestock grazing and agriculture.

Improvement of irrigation facilities, as is presently occurring in the Columbia Basin of Washington in Grant, Adams, and Franklin Counties, will cause more native sagebrush and grassland to be converted to agricultural uses in the near future.

True desert conditions, where vegetation is largely absent, exist in south-central Idaho, where desert covers an area of approximately 1,100 square miles, and is also found in the Alvord region of Steen's Mountains.

Throughout the Region original vegetation types exist in complex interrelations with man's prevailing patterns of land use. This interspersion between native plant communities and modified land has induced ecological stress upon native flora, fish, and wildlife populations that depend upon natural habitats. Further changes in land use will increase ecological stress on this flora and fauna.

Information Source: Ref. 20, BPA Role EIS.

Vegetation Types and Zones

Picea sitchensis Zone

Picea sitchensis (Sitka spruce) characterizes this long, narrow zone that stretches the length of Washington's and Oregon's coasts. It is only part of a coastal forest zone that extends north into Alaska and south into northern California, where it grades, in part, into coastal redwood (*Sequoia sempervirens*) forest. The *Picea sitchensis* Zone is generally only a few km in width, except where it extends up river valleys. On the west side of the Olympic Peninsula, where an extensive coastal plain exists, it is much broader. Although the Zone is generally found below elevations of 150 m, it rises to 600 m when mountain masses are immediately adjacent to the ocean. This zone could be considered a variant of the *Tsuga heterophylla* Zone, distinguished by Sitka spruce, frequent summer fogs, and proximity to the ocean.

The *Picea sitchensis* Zone has what could be considered the mildest climate of any northwestern vegetation zone. Extremes in moisture and temperature regimes are minimal; the climate is uniformly wet and mild. Precipitation averages between 79 in. and 118 in., but frequent fog and low clouds during the relatively drier summer months are probably as important in ensuring minimal moisture stresses. Fog drip adds precipitation as a consequence of condensation in tree crowns.

Some of the finest forest soils in the Region are found in this zone; they are deep, relatively rich, and fine-textured. Surface soils are typically acid (pH 5.0 to 5.5), high in organic matter (15% to 20%) high in total nitrogen (0.50%), and low in base saturation (10%).

The coniferous forest stands in this zone are typically dense, tall and among the most productive in the world. Constituent tree species are Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), arborvitae (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), and (in Washington) Pacific silver fir (*A. amabilis*). The first three are by far the most common. Red alder (*Alnus rubra*) is one of the most abundant trees on recently disturbed sites, and lodgepole pine

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Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. E.B-4.

(*Pinus contorta*) is common along the ocean. Coastal redwood (*Sequoia sempervirens*), California Bay (*Umbellularia californica*), and Port Orford cedar (*Chamaecyparis lawsoniana*) are found in this zone in southwestern Oregon.

Tsuga heterophylla Zone

The *Tsuga heterophylla* (western hemlock) Zone is the most extensive vegetation zone in western Washington and Oregon, and the most important in terms of timber production. This is the region famous for subclimax Douglas fir and climax western hemlock-arborvitae (*Thuja plicata*) formations. The *Tsuga heterophylla* Zone extends south from British Columbia through the Olympic Peninsula, Coast Ranges, Puget Trough, and both Cascade physiographic provinces in western Washington. In Oregon it is split into two major segments (located in the Coast Ranges and in the Western and High Cascades Provinces) by the Willamette and other dry interior valleys. The southern limits are the Klamath Mountains on the coast (except for the narrow coastal strip) and the divide between the North and South Umpqua Rivers in the Cascade Range (about 43° 15' N. lat.). Elevational range in the Cascade Range varies from essentially sea level to 600 or 700 m at 49° north lattitude, and from 150-1000 m at 45° north latitude. In the Olympic Mountains the *Tsaga heterophylla* Zone occurs between 140 m and 550 m on the western slopes, and from nearly sea level to 1125 m on the drier eastern slopes. Where conditions are favorable, elements of this zone appear on the east side of the Cascade Range and in the northern Rocky Mountains.

The *Tsuga heterophylla* Zone has a wet, mild, maritime climate. Since it lies farther from the ocean, moisture and temperature extremes are greater than in the *Pica sitchensis* (Sitka spruce) Zone. Also, a great deal of climate variation occurs in this widespread zone, associated with latitude, elevation, and the location in relation to mountain massifs. Precipitation averages between 60 in. and 120 in., and occurs mainly during the winter. Summers are relatively dry, producing only 6% to 9% of the total precipitation. Moisture stresses are sufficient to result in distinctive community spectra along moisture gradients. Mean annual temperatures average 8° to 9°C, and neither January nor July temperatures are extreme.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, pp. E.4-E.5.

Despite the fact that soils in the *Tsuga heterphylla* Zone are derived from a wide variety of parent rocks, they tend to have some common features. Surface horizons are well aggregated and porous. Organic matter content ranges from moderate in the Cascades to high in portions of the Coast Ranges and Olympic Peninsula, where thick, very dark A1 horizons are especially common. Forest floor depths are generally less than 7 cm except at higher elevations, where depths may reach 15 cm. Depending upon the degree of profile development, amounts of clay accumulation in the B horizon vary from low to medium. Most soils in the zone are of medium texture, ranging from sandy loam to clay loam. In some areas, well-developed soils are limited to moderate slope positions, but on the steeper slopes, poorly developed, often shallow soils are encountered most often.

Mixed-Evergreen (*Pseudotsuga-Sclerophyll*) Zone

In the western Siskiyou Mountains, modal sites are generally occupied by a mixed forest of evergreen needle-leaved trees (upper strata) and *sclerophyllus* broad-leaved trees (lower strata). Mixed-Evergreen Forests could be recognized as a major community type of North America. Several studies of the vegetation in this zone are in progress and should greatly expand our knowledge of it during the next decade.

The environmental characteristics of this zone are essentially unknown. It is relatively warm and wet during the winter months and hot and dry during the summer. Annual precipitation would appear to be between 24 in. and 67 in. or more, depending upon elevation and distance from the coast. Less than 20% falls during the growing season. Average annual temperature of about 47° to 49°F, average July temperatures of 62° to 66°F, and average January temperatures of 32° to 36°F are likely.

Mixed-Conifer (*Pinus-Pseudotsuga-Abies*) Zone

Mixed forest of Douglas fir (*Pseudotsuga menziesii*), Sugar pine (*Pinus lambertiana*), Ponderosa pine (*P. ponderosa*), incense cedar (*Libocedrus decurrens*), and white fir (*Abies concolor*)[or grand fir (*A. grandis*)] characterize

Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. E.5.

mid-elevations in the southwestern Oregon Cascade Range and eastern Siskiyou Mountains. The Mixed-Conifer Zone occurs from about 43° north latitude south along the western flanks of the Cascade Range at elevations of about 750 to 1400 m. It is also found in the eastern Siskiyou Mountains, but usually at slightly higher elevations. The Mixed-Conifer Zone is generally bounded by the Interior Valley and the *Abies concolor* (white fir) Zone at its lower and upper limits, respectively; to the north it grades into the *Tsuga neterophylla* (western hemlock) Zone.

Very few environmental data are available for the Mixed-Conifer Zones, except for the eastern Siskiyou Mountains. Precipitation varies between 36 in. and 51 in. with very little occurring during the summer months. Mean temperatures are about the same as in the *Tsuga heterophylla* Zone, but summers are distinctly warmer and drier.

Forest soils in the Mixed-Conifer Zone of southwestern Oregon are extremely varied due to the complex geological history and topography.

Pinus ponderosa Zone

Ponderosa pine (*Pinus ponderosa*) forests are widely distributed in eastern Oregon and Washington. They occupy:

- a narrow band (9.3 to 18.6 mi) on the eastern flanks of the entire Cascade Range (generally);
- much of the high pumice plateau extending east from the High Cascades Province;
- large areas in the Blue Mountains Province (Ochoco, Blue, and Wallowa Mountains) of northeastern Oregon and extreme southeastern Washington; and
- extensive tracts in the Okanogan Highlands Province of northeastern Washington.

The band of Ponderosa pine forests generally increases in elevation from North to South. Throughout much of Washington they are at approximately 600 to 1200 m. In the Blue Mountains Province and northeastern Oregon the

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Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. E.6.

elevational range is about 900 to 1500 m. Elevations in the south-central Oregon pumice area are considerably higher--about 1450 to 2000 m.

At their upper limits, Ponderosa pine forests may grade into forests of Douglas fir, grand fir (*Abiers grandis*), or white fir (*A. concolor*) depending upon the locale. Throughout much of Oregon, they abut Great Basin sage (*Aretemisia tridentata*) steppe or open juniper (*Juniperus occidentalis*) at upper limits--Great Basin sage woodland at their lower limits. At lower elevational limits in Washington, Ponderosa pine forests grade into either grassland or sage shrub-steppe. At some locations in northern Oregon and southern Washington, an ecotonal belt of Oregon oak (*Quercus garryana*) stands between Ponderosa pine forest and steppe.

The climate of the *Pinus ponderosa* Zone is characterized by a short growing season and minimal summer precipitation. Average annual precipitation ranges from 14 in. to 30 in., much of it falling as winter snow. Diurnal summer temperatures fluctuate widely, with hot days and cold nights. In many areas frost may occur any night of the year. The months of July, August and September are very dry, with rainfall averaging less than 1 inch. Much of this summer rain is ineffective, as it usually comes during brief, high-intensity convention storms. Winter temperatures are generally low; as a result, snow often accumulates to considerable depths.

Since Ponderosa pine occupies drier sites than any other forest type [except juniper (*Juniperus occidentalis*)], its distribution is closely correlated with supplies of available soil moisture. This is often reflected by a distinct relationship between the occurrence of Ponderosa pine and the soil texture, especially at the dry end of its range. On xeric sites, a mosaic of Ponderosa pine communities (on coarse-textured soils) is common. An extreme example is a disjunct stand of Ponderosa pine trees. Despite less than 10 in. annual precipitation, abundant regeneration attests that the stand is maintaining itself. The existence of this anachronistic forest is primarily due to the uniformly sandy soil it occupies.

Information Source: Ref. 1. The Impact of Increased Coal Consumption, p. E.6.

Abies grandis Zone

The *Abies grandis* (grand fir) Zone is the most extensive midslope forest zone in the Oregon and southern Washington Cascade Range and in the Blue Mountains of eastern Oregon. The *Abies grandis* Zone typically occurs at 1100-1500 m in the central Oregon Cascade Range, 1500-2000 m in the Ochoco and Blue Mountains, and 1650-2000 m [*Abies concolor* (white fir) Zone] in south-central Oregon.

The *Abies grandis* Zone is typically bounded by the *Abies lasiocarpa* (subalpine fir) Zone at its upper limits, and by the *Pseudotsuga menziesii* (Douglas fir) or *Pinus ponderosa* (Ponderosa pine) Zones at its lower limits. However, locally at higher elevations or on more mesic sites in the Cascade Range it may abut forests in which Pacific silver fir (*Abies amabilis*), western hemlock (*Tsuga heterophylla*), arborvitae (*Thuja plicata*), or black hemlock (*Tsuga mertensiana*) are climax. At its lower limits it may be adjacent to sage shrub-steppe without an intervening belt of climax Douglas fir or Ponderosa pine.

The *Abies grandis* Zone provides the most moderate environmental regime of any of the eastside forest zones (except for the areas where hemlock or arborvitae are present). Neither moisture nor temperature conditions are extreme. Precipitation is generally higher and temperature lower than in lower forested zones. Differences in summer dryness and soil drought differentiate the grand fir and western hemlock from the Douglas fir associations. Soil drought is of minor ecologic significance in the *Abies grandis* Zone. The *Abies grandis* Zone is distinguished climatically from subalpine forests by its higher temperatures and lesser accumulations of snow.

Tsuga heterophylla Zone

Habitats where the western hemlock or arborvitae are climax are encountered on the eastern slopes of the Cascade Range in Washington and northern Oregon. These constitute the *Tsuga heterophylla* Zone. It is essentially an eastern extension of the widespread coastal *Tsuga heterophylla* Zone, although the composition of several forests and understory is somewhat altered.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. E.7.

Interior western hemlock and arborvitae forests are most common in the eastern Washington Cascades at elevations between 800 m and 1200 m. In Oregon they are increasingly rare to their southern limit--about 44° 30' north latitude. Both species are absent from the Blue and Wallowa Mountains. Habitats sufficiently mesic to support western hemlock or arborvitae are very often disjunct, occurring within areas of *Abies grandis* Zone.

The *Tsuga heterophylla* Zone occurs under what appears to be the most equitable climatic regime of all the interior forest zones: a precipitation range of 22 in. to 67 in. and a mean annual temperature of 2.5° to 7.5°C.

Shrub-steppe Zonal Associations

Nine zonal associations (communities that can occur as climatic climaxes) have been recognized in the steppe region of the Columbia Basin province. Six occur in the counties that are likely candidates for energy facility siting. These are:

- *Artemesia tridentata* (Great Basin sage)/*Agropyron spicatum* (bluebunch wheatgrass)--in Douglas, Franklin, Grant and Lincoln Counties.
- *Artemesia tridentata/Festuca idahoensis* (fescue)--in Lincoln County.
- *Agropyron spicatum-Poa sandbergii* (Sandbergs' bluegrass)--in Douglas and Lincoln Counties.
- *Agropyron spicatum-Festuca idahoensis*--in Franklin County.
- *Festuca idahoensis/Symphoricarpos albus* (snowberry)--in Lincoln County.
- *Artemesia tripartita* (Great Basin sage)/*Festuca idahoensis*--in Douglas and Lincoln Counties.

The last two associations are found on the periphery of the steppe region, near its contact with forest vegetation. These tend to be lush, meadow-like communities with conspicuous amounts of large perennial grasses and broadleaved forbs. The term "meadow steppe" has often been applied to these types. The other four zonal associations lie in the more arid interior of the Columbia Basin Province. Vegetation is more open and forbs are less conspicuous in these communities.

Information Source: Ref. 1, The Impact of Increased Coal Consumption. p. E.7, E.8.

Steppe and shrub-steppe communities are widespread in Oregon, dominating the entire souteastern quarter of the state and a strip around the northwestern and western margins of the Blue Mountains. The communities found in the latter area, near the Columbia River, are very similar to those described for Washington.

In some respects, the steppes of southeastern Oregon are similar to those of the Columbia Basin Province. Both areas have hot, dry summers and cold winters, and there are similar communities, (e.g., the *Artemesia tridentata/Agropyron spicatum* and *Artemisia tridentata/Festuca idahoensis* associations). Contrasts between the two areas are notable, however: southeastern Oregon shrub-steppes average much higher elevations; deep, loamy soils are not common in southeastern Oregon; desert or salt desert shrub communities are common enough to appear on regional vegetation maps; *and Artemisia cana* (silver sage) is present on moister habitats.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, p. E.8.

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Fish and Wildlife

The collective terms "fish" and "wildlife" are used here to denote animals in the five principal vertebrate classes: fish, birds, mammals, reptiles and amphibians. However, nonvertebrate organisms in ecosystems, such as annelids (e.g., worms), molluscs (e.g., snails), crustaceans, spiders and insects represent principal food types necessary to all fish and wildlife. From their habitats animals derive food, water, shelter,, and space for territorial occupation. Within the habitat, species are organized into specific ecological niches and interrelate in complex predator-prey relationships, or "food webs."

Fish and wildlife populations are sustained at optimum levels by the existing quality and carrying capacity of their habitats. Since they are typically highly mobile, fish and wildlife come frequently into competitive situations with man and his activities--activities that alter the structure and function of local communities. Examples of such habitat alterations are the clearcutting of large blocks of timber in needleleaf forest ecosystems, and the building of dams along watercourses. Animal populations usually decline as habitat is destroyed, but the habitat may be altered in such a way as to favor some important element. The ring-necked pheasant, for example, has fluorished in the Columbia Basin where grain from wheat farming provides increased carrying capacity for upland gamebirds.

Recreationists annually take many millions of pounds of shellfish, anadromous fish, and marine fish in the waters of Puget Sound and off the coasts of Washington and Oregon. Inventories of the Region's principal anadromous fish tabulate 12 species, five of them salmon and three, trout. Important marine fish taken commercially constitute 200 species, and shellfish number approximately 29 species--most notably oysters, clams, and crabs. More than 400 species of birds enter the Region; 325 of these play regular significant roles in the environment. Mammal species of the Region number about 139; 27 of these are marine mammals and 112 are land mammals. Reptile and amphibian species together number about 50 species.

Information Source: Ref. 20. BPA Role EIS, p. III-22.

The Region's land ecosystems are inextricably joined with the marine ecosystem at the land-water along the coast and in Puget Sound. This interface includes several thousand miles of coastline, bays, harbors, mudflats, sand dunes and estuaries, most of which sustain fish, shellfish, waterfowl, shorebirds, and marine mammals. These environments are directly influenced by inland management of silt and pollutants in watercourses that discharge at the interface with the sea.

Due to the great diversity of vertebrate species in the Region, this general overview will be limited to a brief discussion of the principal groups that annually contribute most heavily to the economy of the Region, and those that are frequently encountered in the field.

Fish

Fishery resources within the area can be classified as anadromous fish, resident fish, marine fish, and shellfish. Anadromous fish are divided into two groups: salmonids and nonsalmonids. The salmonid group includes Chinook, coho, pink, sockeye, and chum salmon, steelhead and cutthroat trout, and Dolly Varden trout. Nonsalmonids include American shad, white sturgeon, striped bass, eulachon, and Pacific lamprey.

Salmonids are of local, national, and international recreational and commercial importance. Natural spawning stocks of these migratory species are generally distributed throughout streams that remain accessible to the sea. The Columbia, Lower Snake, Umpqua, Rogue, Skagit, Yakima, Willamette, Deschutes, John Day, and Salmon Rivers are a few of the important migration and spawning waterways.

With the blockage of the Columbia River in 1938 by the construction of Grand Coulee Dam, anadromous fish lost access to over 500 miles of the upper river and many miles of tributaries. Dam construction has blocked 50% of the Snake River from anadromous fish. And, for salmonid spawning, impoundments of 450 miles of the Columbia downstream from Grand Coulee Dam have eliminated spawning in all of the river except the reach from Lake Wallula to Priest Rapids Dam.

Information Source: Ref. 20, BPA Role EIS, p. III-22, III-23.

Channeling, dredging, logging, and mining have also destroyed some natural spawning and rearing areas by changing streambed characteristics and altering flows. Where it occurs, pollution from industrial, domestic, mining, and agricultural sources has lowered water quality in streams by introducing silt, pesticides, organic wastes, and toxins. Because in many places natural productive area has been lost, artificial propagation facilities, including fish passage facilities, hatcheries, and trucking programs are now employed to maintain the present harvest.

Dams constructed on the Columbia and Snake Rivers have impounded most of the free-flowing sections of these rivers, resulting in diminished anadromous fish populations. Additional fishing pressure from an increasing number of commercial and sport fishermen also significantly contributes to depletion of anadromous fish populations. During high-water spills over dams, water becomes supersaturated with nitrogen, which can be lethal to fish. Many downstream migrants are also killed passing through turbines, and impoundments slow the rate at which fish may move during migration, resulting in additional mortality. Research on these problems is underway, and initial corrective actions have been started.

Nonsalmonid species are also of commercial and recreational importance. This group is generally more restricted in distribution than are the salmonids. Lampreys inhabit nearly all regional streams, but their sport and commercial importance is minor. There is a good sport fishery for American shad, but commercial harvest is limited. Fishermen usually take sturgeon incidentally during the commercial salmon season. Eulachon (smelt) support a good commercial and sport fishery. Striped bass are found primarily in southern Oregon coastal streams and, although its run is brief, it is a very popular sport fish that is also caught commercially. A good sport fishery exists primarily during spring and fall.

Resident fish include the coldwater trout (rainbow, cutthroat, lake, brook, and brown), walleye and turbot, and the warmwater catfish, bass, sunfish, crappie, and perch. Squawfish, carp, and suckers can also be found in most rivers and streams.

Information Source: Ref. 20, BPA Role EIS, p. III-23.

Rainbows, the most numerous trout, are widely distributed throughout the Region. Most of the easily accessible trout waters are stocked with fish annually because natural production cannot keep pace with demand. Most low-elevation streams, and many lakes, ponds, and reservoirs support populations of warmwater game fish. Although many reservoirs have proven to be good resident game fish producers, others have promoted the growth of undesirable fish, or have proven to be poor fish producers because of a variety of limiting factors. The larger Columbia River reservoirs generally support low game fish populations.

Many species of marine fish are found off the Oregon and Washington coasts and in the bays and estuaries of these states. Principal marine species are tuna, herring, halibut, shark, several species of flounder, sablefish, rockfish, lingcod, ocean perch, and hake. Ocean beaches, bays and estuaries of both Oregon and Washington supply several kinds of clams and oysters. Many species in this group are dependent upon estuaries, but estuaries have for many years served as depositories for silt and pollutants from coastal rivers, and have been dredged, filled, and used as garbage dumps, to the detriment of natural ecosystems.

Birds

The numerous rivers, wetlands, and lakes of the Northwest host millions of ducks, geese, and swans that migrate along the Pacific Flyway. Common species include whistling swan, Canada goose, mallard, widgeon, pintail, gadwall, and teal. Brant and scaup are generally limited to the coastal region. Coot are plentiful in all waterfowl habitats.

Coastal areas, as well as most lakes, rivers and marshes, provide habitat for other water and shore birds such as killdeer, snipe, sandpipers, avocets, and a variety of gulls, terns, murres, and cormorants.

Upland birds, including ring-necked pheasant, Hungarian partridge, chukar, blue grouse, ruffed grouse, spruce grouse, valley and mountain quail, and dove, are founded throughout the Northwest in localized ranges,

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Information Source: Ref. 20, BPA Role EIS, p. III-24.

particularly in farmlands, brushlands, and pastures. Bandtailed pigeons occur as both migrants and residents in western Oregon and Washington. Spruce grouse are limited to thickly timbered, mountainous habitats. Sharp-tailed grouse and sage grouse are found primarily in prairie and sage habitat; both are greatly reduced in numbers through loss of suitable habitat.

Many birds of prey inhabit the Region. Bald and golden eagles are associated with shorelines and remote mountains, respectively; ospreys are seen along sea coasts, rivers, and lakes; peregrine falcons, prairie falcons, pigeon halks, and sparrow hawks may be found close to open fields and ranges. Other hawks include Cooper's, marsh, sharp-shinned, rough-legged, red-tailed, and goshawk. Owls inhabit the same general areas as the hawks, but are nonmigratory. Common owl species include the great horned, barn, screech, and pygmy. The spotted owl and the great gray owl are extremely secretive, and are considered rare throughout their range.

Representatives of most groups of songbirds can be found in the Region, either as residents or as migrants on the Pacific Flyway. Notable major groups include flycatchers, hummingbirds, swallows, jays and crows, chickadees, wrens, thrushes, warblers, blackbirds, woodpeckers, grosbeaks, finches, and sparrows. Many of these birds are limited to specific areas in the Region.

Figure II-F-167 shows the general flight corridors used by migratory birds in the Pacific Flyway. Ducks, geese, and swans comprise major migrants in these corridors. Shore-birds and songbirds also use the Flyway. The Flyway map emphasizes populations of ducks and geese that annually utilize fairly well defined flight corridors over the Region. These groups are significant in supporting a portion of the Region's recreation economy.

Many migrants arrive in the Region in late August, some pausing only briefly to rest and forage for food. Most southbound migrants, however, arrive from late September to mid-November, as do many of the geese and ducks. In late winter and early spring, northbound migrants arrive.

Information Source: Ref. 20, BPA Role EIS, p. III-24, III-26.

Important areas in the Region of the Pacific Flyway are western Washington's Puget Sound, Grays Harbor and Willapa Bay eastern Washington's Turnbull National Wildlife Refuge, Moses Lake, and the Potholes Reservoir of the Columbia Basin, eastern Oregon's Malheur and Klamath Basins, and the numerous harbors and estuaries along the coast. Many ducks tend to stay the winter in the Columbia and Malheur Basins.

Mammals

The Region supports several big game mammals. Blacktail deer are common west of the Cascades. Mule deer inhabit virtually all areas of the Region east of the Cascades. Whitetail deer occur in small numbers in Oregon and Washington and are most abundant in northern Idaho and western Montana. Bighorn sheep inhabit rough, broken terrain east of the Cascades, mostly at high elevations, and mountain goats are limited to steep terrain usually at or above timberline.

Roosevelt elk inhabit the coastal mountains and portions of the Cascades. Rocky Mountain elk are found in mountainous areas of eastern Oregon and Washington, and in the mountains of northern Idaho. Pronghorn antelope are found in open prairie and sagebrush lands of southeast Oregon and Southern Idaho, while only small bands of these animals remain in Washington in scattered populations east of the Cascades. Moose are uncommon, but occur in the northeastern corner of Washington and in northern Idaho.

Black bear populations in Northwest forests are the highest in the nation. Remaining grizzly bear populations are limited to areas in northern Idaho, western Montana, northern Washington, and where protected in National Parks. Mountain lions are generally restricted to forested mountainous areas often corresponding to wilderness.

Furbearers include beaver, mink, muskrat, nutria, and river otter, all of which are often found near water in nonurban areas. Badger and bobcat are associated with open forests, and coyotes are ubiquitous throughout the Region. Fisher, marten, lynx, and wolverine are generally uncommon and limited to

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Information Source: Ref. 3, Atlas of the Pacific Northwest.

wilderness areas or wildlife refuges. Kit fox are becoming increasingly rare in their desert habitat of southeastern Oregon and southern Idaho. Red fox, grey fox, opossum, racoon, skunk, and weasel range throughout the Region and tend to be common around farmland. Muskrat, beaver, mink, and river otter are the most common furbearers.

Fisheries

Fishery resources are the basis for one of the major industries of the Pacific Northwest. Commercial fisheries, located mainly in the lower portions of rivers, in harbors, and in coastal waters of Oregon and Washington, produce an estimated annual catch of approximately 902 M lb, and a fisherman's value of about $455 million. A small commercial fishery occurs in parts of Idaho for whitefish, landlocked sockeye salmon, and certain nongame fishes. Washington, the leading commercial fishery state of the area, produces about 3.1% of the poundage and 4.5% of the value of all commercial fisheries in the United States, including Alaska. Oregon produces about 1.5% of the total volume, having 2.4% of the total value.

Sports fishing, both in fresh water and marine locations, is one of the major recreational attractions of the Region. While commercial fisheries utilize more than 45 different species of fish and shellfish, over 30 kinds of fish are taken by sportsmen in fresh water, in addition to a wide variety of forms caught in marine locations. Some kinds of fish and most shellfish utilized by the commercial industry also are important in sports fisheries, such as Chinook and coho salmon, striped bass in Oregon, flounders, rockfishes, lingcod, sea perches, clams, and crabs.

Commercial landings of the different fishes may fluctuate from year to year because of variations in numbers and availability of particular species, or changes and shifts in some economic or legislative factors.

Five species of Pacific salmon comprise the most important fishery of the area, both in volume and value. These fishes, captured by gill nets in certain bays and rivers, by troll boats in the ocean, and by purse seines and reef nets in parts of Puget Sound, find ready markets as fresh and frozen food, and as canned and smoked products locally and in distant markets. Pacific salmon are

world famous as food products and in the uniqueness of their complicated life cycle. All spawn in fresh waters. The adults die following the spawning act, and the young spend variable periods of time (differing with species) in fresh water before migrating downstream into the ocean. Most make extensive migrations in the sea. On approaching maturity, adults move from ocean habitats into home streams where they lived as juveniles. Since the future of the salmon industry of the Pacific Northwest is in a large part dependent upon the welfare of the freshwater phase of their life cycle, particular attention must be given in water-use development programs to the needs of each species, so as to maintain adequate spawning and nursery areas and unhindered migration routes to the sea. In this connection, state and federal agencies operate a number of salmon hatcheries; extensive fishways and bypasses have been installed at some dams; spawning tributaries are being rehabilitated; articicial rearing impoundments are being constructed; and progress is being made in alleviating detrimental effects of pollution.(1)

Threatened and Endangered Species

The Region's fish and wildlife resources are managed under the mandates of many legislative acts and guidelines that depend upon federal and state agencies for their fullfillment. The U.S. Fish and Wildlife Service is a primary agency that operates to protect and enhance populations of fish and wildlife within the Region. It maintains 33 National Wildlife Refuges in the Region, encompassing approximately 415,000 acres. The game departments of all four states also manage numerous refuges in the Region that serve to protect and enhance migratory and resident fish and wildlife--especially the species that are designated as "threatened" or "endangered."(2)

An estimated 350 Columbia whitetail deer are located along the lower Columbia River near Clatskanie in Clatsop County, Oregon and near Cathlamet in Wahkiakum County, Washington. A second population of from 20 to 300 occurs near Roseburg, in central Douglas County, Oregon.

The Aleutian Canada goose breeds in the Aleutian Islands and is believed to winter in California. Populations of this endangered subspecies migrate

(1) Information Source: Ref. 3, Atlas of the Pacific Northwest.
(2) Information Source: Ref. 20, BPA Role EIS.

along the western portions of Washington and Oregon, presumably with other races of Canada geese. The peregrine falcon is a rare bird of coasts, mountains, and woods in the Pacific Northwest. The brown pelican wanders along the western coast of North America as far north as southern British Columbia. Small numbers of northern Rocky Mountain wolves and grizzly bears are believed to inhabit several National Forests in northern Washington and Idaho.

The most widespread species is the prairie falcon (*Falco mexicanus*), which probably occurs in all nonforested counties (although never in very large numbers). It seems likely that the pairie falcon nests throughout its range in the Northwest wherever suitable sites can be found, (i.e., rocky cliffs far removed from human disturbance).

Another widespread species is the peregrine falcon (*Falco peregrinus anatum*), which may occur in all the counties, although its numbers are so small that it may be observed only irregularly. Elmore, Power, and Bingham Counties in Idaho have habitats favorable for these raptors along the Snake and Boise Rivers. The peregrine may nest in the western counties of Oregon and Washington (particularly in northwestern counties). It may be only a seasonal visitor in the remaining counties, being very sensitive to human disturbance.

Yet another raptor requiring isolated valleys for nesting is the ferruginous hawk (*Buteo regalis*). This species has not yet been officially designated as threatened, but such action is thought appropriate by many familiar with the species. Its population is very small; only 20 pairs nest in Washington. By comparison, 15 or 20 dozen pairs of prairie falcons may nest in the state. The ferruginous hawk is important to note because about two-thirds of the nesting pairs choose Franklin County, Washington for their nest sites.

Another species listed in the Red Book is the Columbian white-tailed deer (*Odocileus virginianus leucurus*). This species occupies river bottom lands along the lower Columbia River. The population is small, possibly only several dozen, and under considerable pressure due to habitat modification along the Columbia River shoreline.[1]

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(1) Information Source: Ref. 1, The Impact of Increased Coal Consumption.

The Olympic mudminnow (*Novumbra hubbsi*) occurs only in the Satsop and Deschutes Rivers inWashington. Its very restricted habitat in Grays Harbor and Lewis Counties leaves it quite vulnerable to elimination.

Three other fish species occurring in the counties that are the most likely energy-siting areas are considered rare. The willicoma dace (*Rhinichthys sp.*), a species (or race) of Cyprimid, is restricted to the Coos River system in Coos County, Oregon. The white sturgeon (*Acipenser transmontanus*) is considered rare in Idaho portions of the Snake River system. White sturgeon are common in the lower Columbia River areas; however, populations have been declining in impoundment areas above Bonneville Dam. The Shoshone Sculpin (*Cottos greenei*) is a rare species in portions of the upper Snake River system, Idaho. The extent of its range is unknown.(1)

Fish and wildlife habitat varies considerably in type, quality, and amount. Although most habitat types have not been inventoried, evidence indicates that winter ranges for deer, elk, and other big game are critical in many areas, but abundant in northern Idaho and northwestern Montana. Summer range for deer and elk, the principal big game species, is generally abundant in relation to winter range. Freeflowing streams, estuaries, and salmon spawning grounds, however, are in short supply.(2)

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(1) Information Source: Ref. 1, The Impact of Increased Coal Consumption.
(2) Information Source: Ref. 20, BPA Role EIS.

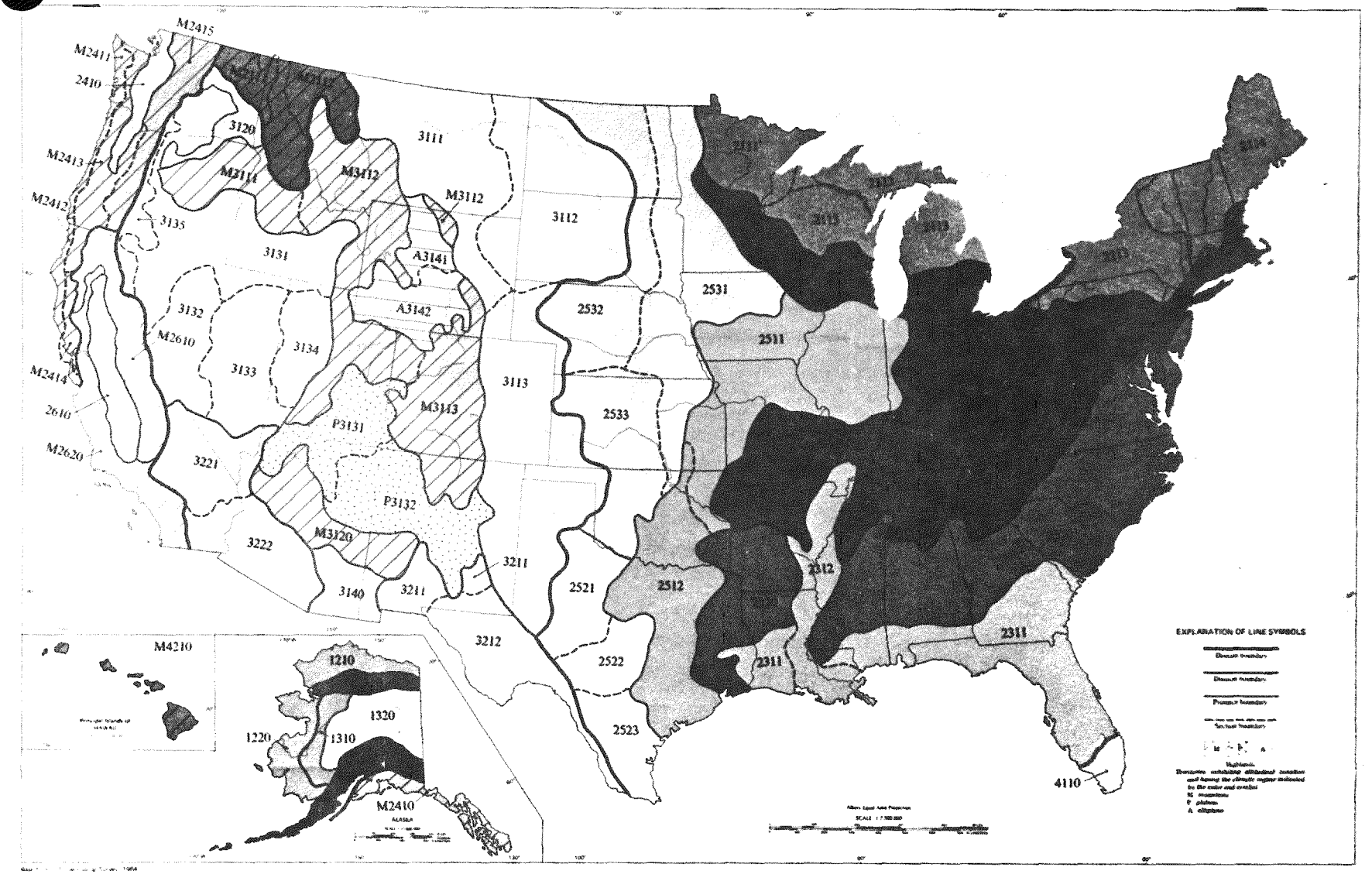


FIGURE II-F-164. Bailey's Ecoregions

Data Source: Ref. 63, Ecoregions of the United States.

TABLE II-F-81

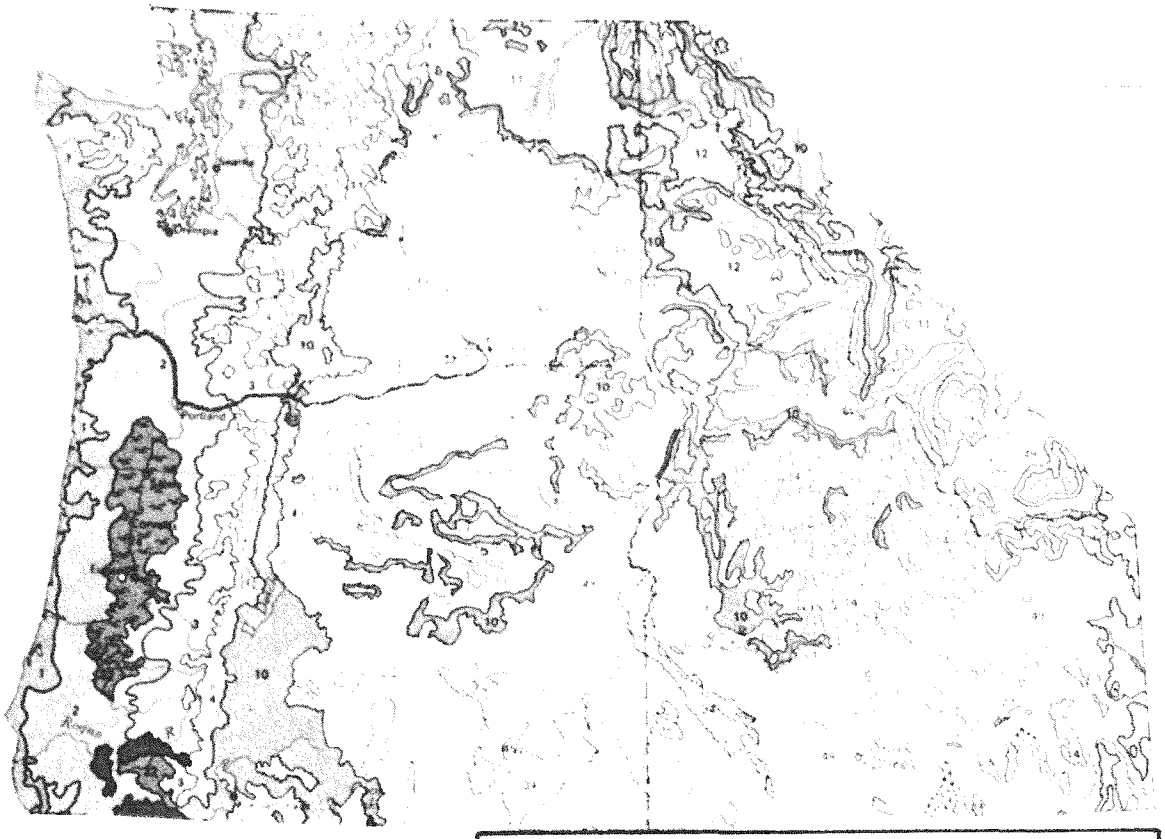
BAILEY'S ECOREGIONS EXPLANATION

DOMAIN	DIVISION	LOWLAND ECOREGIONS		HIGHLAND ECOREGIONS*	
		PROVINCE	SECTION	PROVINCE	SECTION
1000 POLAR	1200 TUNDRA	1210 ARCTIC TUNDRA 1220 BERING TUNDRA		M1210 BROOKS RANGE	
	1300 SUBARCTIC	1310 YUKON PARKLAND 1320 YUKON FOREST		M1310 ALASKA RANGE	
2000 HUMID TEMPERATE	2100 CONTINENTAL COOL - SUMMER	2110 LAURENTIAN MIXED FOREST	2111 SPRUCE-FIR FOREST 2112 NORTHERN HARDWOODS FIR FOREST 2113 NORTHERN HARDWOODS FOREST 2114 NORTHERN HARDWOODS SPRUCE FOREST	M2110 COLUMBIA FOREST (DRY SUMMER)	M2111 DOUGLAS FIR FOREST M2112 CEDAR-HEMLOCK-DOUGLAS FIR FOREST
	2200 CONTINENTAL WARM - SUMMER	2210 EASTERN DECIDUOUS FOREST	2211 MIXED MESOPHYTIC 2212 BEECH-MAPLE FOREST 2213 MAPLE-BASSWOOD FOREST + OAK SAVANNA 2214 APPALACHIAN OAK FOREST 2215 OAK-HICKORY FOREST		
	2300 HOT - SUMMER	2310 OUTER COASTAL PLAIN FOREST 2320 SOUTHEASTERN MIXED FOREST	2311 BEECH-SWEETGUM-MAGNOLIA-PINE OAK FOREST 2312 SOUTHERN FLOOD-PLAIN FOREST		
	2400 MARITIME	2410 WILLAMETTE-PUGET FOREST		M2410 PACIFIC FOREST	M2411 SITKA SPRUCE-CEDAR-HEMLOCK FOREST M2412 REDWOOD FOREST M2413 CEDAR-HEMLOCK DOUGLAS FIR FOREST M2414 CALIFORNIA MIXED EVERGREEN FOREST M2415 SILVER FIR-DOUGLAS FIR FOREST
	2500 PRAIRIE	2510 PRAIRIE PARKLAND	2511 OAK-HICKORY-BLUESTEM PARKLAND 2512 OAK + BLUESTEM PARKLAND		
		2520 PRAIRIE BRUSHLAND	2521 MESQUITE-BUFFALO GRASS 2522 JUNIPER - OAK - MESQUITE 2523 MESQUITE - ACACIA		
		2530 TALL GRASS PRAIRIE	2531 BLUESTEM PRAIRIE 2532 WHEATGRASS - BLUESTEM NEEDLEGRASS 2533 BLUESTEM - GRAMA PRAIRIE		
	2600 MEDITERRANEAN (DRY - SUMMER SUBTROPICAL)	2610 CALIFORNIA GRASSLAND		M2610 SIERRAN FOREST M2620 CALIFORNIA CHAPARRAL	
3000 DRY	3100 STEPPE	3110 GREAT PLAINS SHORT-GRASS PRAIRIE	3111 GRAMA - NEEDLEGRASS-WHEATGRASS 3112 WHEATGRASS - NEEDLEGRASS 3113 GRAMA - BUFFALO GRASS	M3110 ROCKY MOUNTAIN FOREST	M3111 GRAND FIR DOUGLAS-FIR FOREST M3112 DOUGLAS-FIR FOREST M3113 PONDEROSA PINE - DOUGLAS-FIR FOREST
		3120 PALOUSE GRASSLAND		M3120 UPPER GILA MOUNTAINS FOREST	
		3130 INTERMOUNTAIN SAGEBRUSH	3131 SAGEBRUSH - WHEATGRASS 3132 LAHONTAN SALTBUSH-GREASEWOOD 3133 GREAT BASIN SAGEBRUSH 3134 BONNEVILLE SALTBUSH - GREASEWOOD 3135 PONDEROSA SHRUB FOREST	P3130 COLORADO PLATEAU	P3131 JUNIPER PINYON WOODLAND + SAGEBRUSH SALTBRUSH MOSAIC P3132 GRAMA-GALLETA STEPPE + JUNIPER - PINYON WOODLAND MOSAIC
		3140 MEXICAN HIGHLANDS SHRUB STEPPE		A3140 WYOMING BASIN	A3141 WHEATGRASS - NEEDLEGRASS-SAGEBRUSH A3142 SAGEBRUSH - WHEATGRASS
	3200 DESERT	3210 CHIHUAHUAN DESERT	3211 GRAMA - TOBOSA 3212 TARBUSH - CREOSOTE BUSH		
		3220 AMERICAN DESERT (MOJAVE-COLORADO-SONORAN)	3221 CREOSOTE BUSH 3222 CREOSOTE BUSH - BUR SAGE		
4000 HUMID TROPICAL	4100 SAVANNA	4110 EVERGLADES			
	4200 RAINFOREST			M4210 HAWAIIAN ISLANDS	

*Key to letter symbols: M - mountains, P - plateau, A - altiplano

Note: Table shows sections within provinces of the Humid Temperate, Dry and Humid Tropical domains represented in the Southern states.

Data Source: Ref. 63, Ecoregions of the United States.



0 100 200

Juniperus spp. (juniper, red cedar)

Sequoia wellingtonia (giant sequoia)

Yucca brevifolia (Joshua tree)

WESTERN FORESTS

NEEDLELEAF FORESTS

1 Spruce-cedar-hemlock forest (*Picea-Thuja-Tsuga*)

2 Cedar-hemlock-Douglas fir forest (*Thuja-Tsuga-Pseudotsuga*)

3 Silver fir-Douglas fir forest (*Abies-Pseudotsuga*)

4 Fir-hemlock forest (*Abies-Tsuga*)

Mixed conifer forest (*Abies-Pinus-Pseudotsuga*)

6 Redwood forest (*Sequoia-Pseudotsuga*)

7 Red fir forest (*Abies*)

8 Lodgepole pine-subalpine forest (*Pinus-Tsuga*)

Pine-cypress forest (*Pinus-Cupressus*)

10 Western ponderosa forest (*Pinus*)

11 Douglas fir forest (*Pseudotsuga*)

12 Cedar-hemlock-pine forest (*Thuja-Tsuga-Pinus*)

13 Grand fir-Douglas fir forest (*Abies-Pseudotsuga*)

14 Western spruce-fir forest (*Picea-Abies*)

Eastern ponderosa forest (*Pinus*)

Black Hills pine forest (*Pinus*)

17 Pine-Douglas fir forest (*Pinus-Pseudotsuga*)

18 Arizona pine forest (*Pinus*)

19 Spruce-fir-Douglas fir forest (*Picea-Abies-Pseudotsuga*)

20 Southwestern spruce-fir forest (*Picea-Abies*)

Juniper-pinyon woodland (*Juniperus-Pinus*)

BROADLEAF FORESTS

Oregon oakwoods (*Quercus*)

23 Mesquite bosques (*Prosopis*)

BROADLEAF AND NEEDLELEAF FORESTS

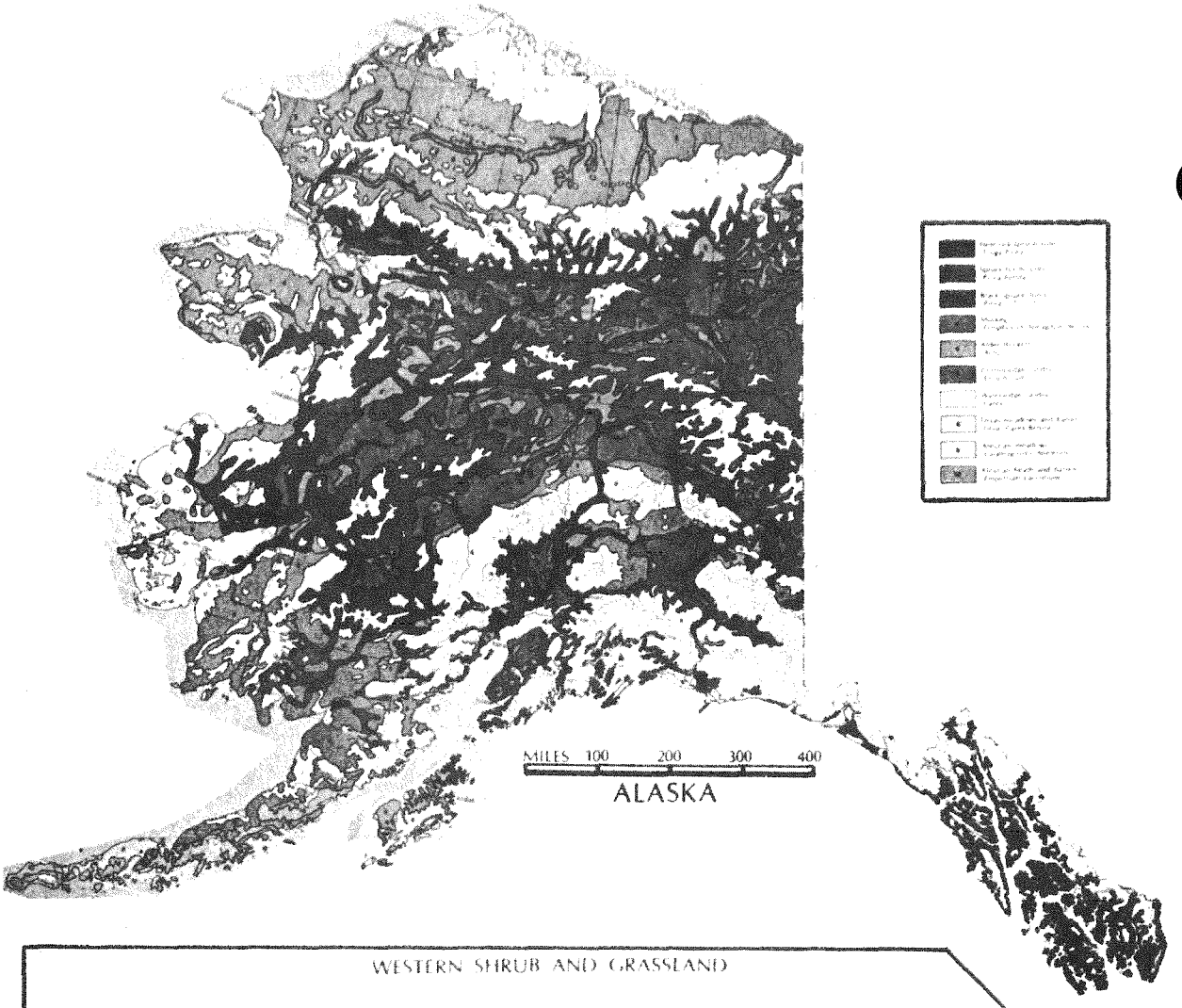
Mosaic of numbers 2 and 22

25 California mixed evergreen forest (*Quercus-Arbutus-Pseudotsuga*)

California oakwoods (*Quercus*)

27 Oak-juniper woodland (*Quercus-Juniperus*)

28 Transition between 27 and 31



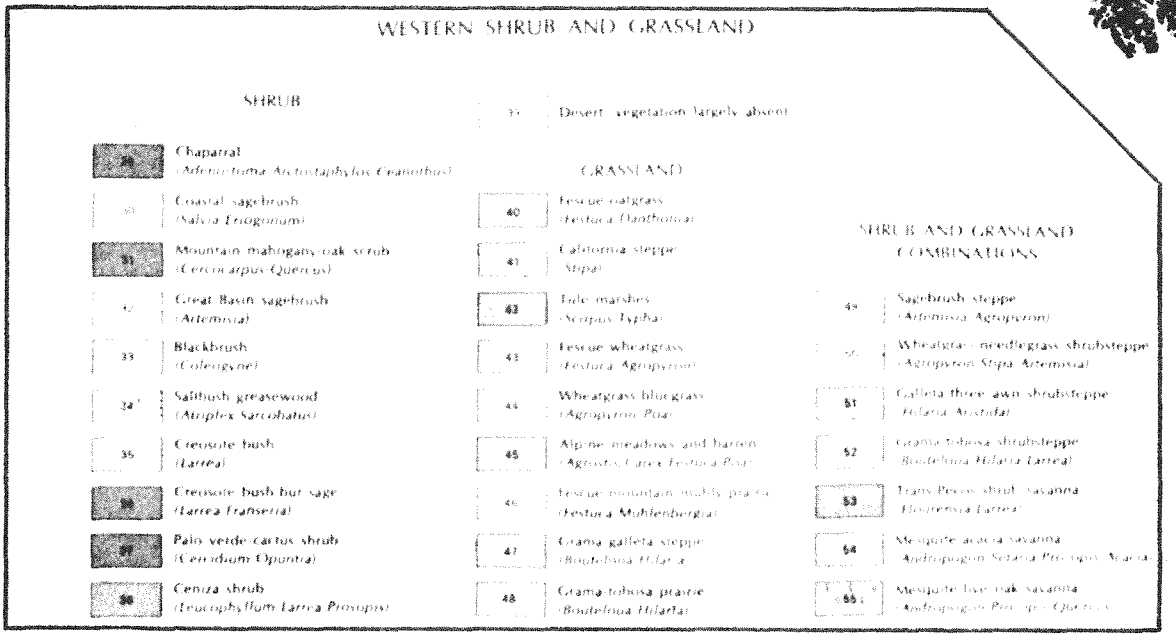


FIGURE II-F-165. Potential Natural Vegetation

Data Source: Ref. 13, National Atlas, pp. 90-92.

TABLE II-F-82

ALASKA'S SPATIAL DISTRIBUTION OF PLANTS

Vegetation Type	Southcentral Acres (Millions)	Southcentral Percent of State Total	Arctic Acres (Millions)	Arctic Percent of State Total	Northwest Acres (Millions)	Northwest Percent of State Total	Southwest Acres (Millions)	Southwest Percent of State Total	Yukon Acres (Millions)	Yukon Percent of State Total	Southeast Acres (Millions)	Southeast Percent of State Total	State Total Acres (Millions)	State Total Percent
Coastal Western Hemlock Sitka-Spruce Forest	5.9	26	–	–	–	–	–	–	–	–	16.6	74	22.5	6
Bottomland Spruce-Poplar Forest	1.1	6	–	–	1.4	8	3.5	19	12.0	67	–	–	18.0	5
Upland Spruce-Hardwood Forest	4.0	6	0.3	1	6.6	10	9.3	14	43.4	68	–	–	64 6	17
Lowland Spruce-Hardwood Forest	4.3	12	–	–	1.0	3	6.6	19	23.2	66	–	–	35.1	9
High Brush	4.0	22	6.3	36	40	23	2.6	15	0.7	4	–	–	17 6	5
Low Brush Muskeg-Bog	0.6	6	–	–	0.1	1	0.5	5	9.2	88	–	–	10.4	3
Moist Tundra	3.6	6	26.5	40	12.3	19	16.8	25	7.0	11	–	–	65.5	17
Wet Tundra	1.0	3	8.5	26	7.0	22	9.2	28	6.6	20	0.3	1	32.6	9
Alpine Tundra and Barren Ground	20.9	25	7.3	8	9.7	11	18.7	22	21.1	25	7.5	9	84 9	23
Total Land Area	45.4		48.9		42.1		67.2		123.2		24.4		351.2	

*Does not include land in glaciers, icefields, or fresh water systems.

Upland Spruce-Hardwood Forest

Trees	
White spruce	*Picea glauca*
Black spruce	*P. mariana*
Quaking aspen	*Populus tremuloides*
Alaska paper birch	*Betula papyrifera spp. humilis*
Black cottonwood	*Populus balsamifera ssp. trichocarpa*
Balsam poplar	*P. balsamifera ssp. balsamifera*
Shrubs	
Willow	*Salix spp.*
Alder	*Alnus spp.*
Rose	*Rosa spp.*
High bush cranberry	*Viburnum edule*
Lingonberry	*Vaccinium vitis-idaea ssp. minus*
Raspberry	*Rubus idaeus subsp. melanolasius*
Currant	*Ribes spp.*
Grasses, herbs, others	
Bluejoint	*Calamagrostis spp.*
Fireweed	*Epilobium angustifolium ssps.*
Horsetail	*Equisetum spp.*
Parsley fern	*Criptogramma crispa var. sitchensis*
Marsh fern	*Thelypteris phegopteris*
Lady fern	*Athyrium filix-femina*
Fragile fern	*Cystopteris fragilis ssps.*
Other ferns	
Lichens	
Mosses	
Mushrooms	
Other fungi	

Trees

Sitka spruce	*Picea sitchensis*
Western hemlock	*Tusga heterophylla*
Mountain hemlock	*T. mertensiana*
Alaska cedar	*Chamaecyparis nootkatensis*
Balsam poplar	*Populus balsamifera ssp. balsamifera*
Black cottonwood	*P. balsamifera ssp. trichocarpa*

Shrubs

Sitka alder	*Alnus crispa ssp. sinuata*
Devil's club	*Echinopanax horridum*
Salmonberry	*Rubus spectabilis*
Willow	*Salix spp.*
Pacific red elder	*Sambucus racimosa ssp. pubens*
Rusty menziesia	*Menziesia ferruginea*
Copperbrush	*Cladathamnus pyrolaeflorus*
Blueberry and huckleberry	*Vaccinium spp.*

Grasses, herbs and others

Bluejoint	*Calamagrostis spp.*
Lyme grass	*Elymus arenarius*
Lichens	
Mosses	
Liverworts	
Mushrooms	

Data Source: Ref. 11, Alaska Regional Profiles.

TABLE II-F-82. (Contd)

Bottomland Spruce-Poplar Forest

Trees

White spruce	*Picea glauca*
Balsam poplar	*Populus balsamifera ssp. balsamifera*
Black cottonwood	*P. balsamifera ssp. trichocarpa*
Alaska paper birch	*Betula papyrifera ssp. humilis*
Quaking aspen	*Populous tremuloides*
Black spruce	*Picea mariana*

Shrubs

American green alder	*Alnus crispa ssp. crispa*
Thinleaf alder	*A. incana ssp. tenuifolia*
Willow	*Salix spp.*
Rose	*Rosa spp.*
Labrador tea	*Ledum palustre ssp. decumbens*
Raspberry	*Rubus spp.*
Blueberry, huckleberry	*Vaccinium spp.*
Bearberry	*Arctostaphylos spp.*
Serviceberry	*Amelanchier spp.*
High bush cranberry	*Viburnum edule*

Grasses, herbs, others

Bluejoint	*Calamagrostis spp.*
Fireweed	*Epilobium angustifolium ssps.*
Horsetail	*Equisetum spp.*
Wintergreen	*Pyrola spp.*
Parsley fern	*Cryptogramma crispa var. sitchensis*
Marsh fern	*Thelypteris phegopteris*
Lady fern	*Athyrium filix-femina*
Lichens	
Mosses	
Liverworts	
Mushrooms	
Other fungi	

Wet Tundra

Shrubs

Willow	*Salix spp.*
Dwarf arctic birch	*Betula nana ssp. exilis*
Labrador tea	*Ledum palustre ssp. groenlandicum*
Shrubby cinquefoil	*Potentilla fruiticosa*
Lingonberry	*Vaccinium vitis-idaea ssp. minus*
Bog cranberry	*Oxycocus microcarpus*

Grasses, others

Lyme grass	*Elymus arenarius*
Pendant grass	*Arctophila fulva*
Cottongrass	*Eriophorum spp.*
Bur reed	*Sparganium spp.*
Mare's tail	*Hippuris spp.*
Rushes	*Juncus spp.*
Sedges	*Carex spp.*
Lichens	
Mosses	
Liverworts	
Lichens	
Mushrooms	
Other fungi	

Lowland Spruce-Hardwood Forest

Trees

Black spruce	*Picea mariana*
White spruce	*P. glauca*
Alaska paper birch	*Betula papyrifera ssp. humilis*
Quaking aspen	*Populus tremuloides*
Balsam poplar	*P. balsamifera ssp. balsamifera*
Black cottonwood	*P. balsamifera ssp. trichocarpa*

Shrubs

Willow	*Salix spp.*
Dwarf arctic birch	*Betula nana ssp. exilis*
Lingonberry	*Vaccinium vitis-idaea ssp. minus*
Blueberry	*Vaccinium spp.*
Labrador tea	*Ledum palustre ssp. groenlandicum*
Crowberry	*Empetrum nigrum ssps.*
Bearberry	*Arctostaphylos uva-ursi ssp. minus*

Grasses, herbs, others

Cottongrass	*Eriophorum spp.*
Horsetail	*Equisetum spp.*
Fireweed	*Epilobium angustifolium ssps.*
Parsley fern	*Cryptogramma crispa var. sitchensis*
Marsh fern	*Thelypteris phegopteris*
Fragile fern	*Cystopteris fragilis ssps.*
Lichens	
Mosses	
Liverworts	
Mushrooms	
Other fungi	

Shrubs

Willow	*Salix spp.*
Dwarf arctic birch	*Betula nana ssp. exilis*
Labrador tea	*Ledum palustre ssp. groenlandicum*
American green alder	*Alnus crispa ssp. crispa*
Lapland rosebay	*Rhododendron lapponicum*
Blueberry	*Vaccinium spp.*
Lingonberry	*V. vitis-idaea ssp. minus*

Grasses, herbs, others

Cottongrass	*Eriophorum spp.*
Polar grass	*Arctagrostis latifolia* vars. *latifolia* and *arundinacea*
Bluejoint	*Calamagrostis spp.*
Hairgrass	*Deschampsia spp.*
Fescue	*Festuca spp.*
Lyme grass	*Elymus arenarius*
Alpine azalea	*Loiseluria procumbens*
Mountain avens	*Dryas spp.*
Bistort	*Polygonum spp.*
Yarrow	*Achillea spp.*
Geranium	*Geranium spp.*
Horsetail	*Equisetum spp.*
Fireweed	*Epilobium angustifdium ssps.*
Wood rush	*Luzula spp.*
Sedges	*Carex spp.*
Lichens	
Mosses	
Liverworts	
Mushrooms	
Other fungi	

Data Source: Ref. 11, Alaska Regional Profiles.

TABLE II-F-82 (Contd)

High Brush

Shrubs

Sitka alder	*Alnus crispa ssp. sinuata*
American green alder	*A. crispa ssp. crispa*
Thinleaf alder	*A. incana ssp. tenuifolia*
Devil's club	*Echinopanax horridum*
Willow	*salix spp.*
Currant	*Vaccinium spp.*
Blueberry	*Rubus spp.*
Raspberry	*Shepherdia canadensis*
Soapberry	*Vaccinium vitis-idaea ssp. minus*
Lingonberry	*Spirea beauverdiana*
Alaska spirea	*Rubus parviflorus* var. *grandiflorus*
Thimbleberry	*R. spectabilis*
Salmonberry	*Cornus spp.*
Dogwood	

Grasses, herbs, others

Bluejoint	*Calamagrostis spp.*
Fescue	*Festuca spp.*
Yarrow	*Achillea spp.*
Lupine	*Lupinus spp.*
Jacob's ladder	*Polemonium spp.*
Horsetail	*Equisetum spp.*
Fireweed	*Epilobium angustifolium ssps.*
Parsley fern	*Cryptogramma crispa* var. *sitchensis*
Marsh fern	*Thelpteris phegopteris*
Lady fern	*Athyrium filix-femina*
Fragile fern	*Cystopteris fragilis ssps.*
Lichens	
Mosses	

Low Brush Bog and Muskeg

Trees

Western hemlock	*Tsuga heterophylla*
Alaska cedar	*Chamaecyparis nootkatensis*
Black spruce	*Picea mariana*

Shrubs

Labrador tea	*Ledum palustre ssp. groenlandicum*
Bog cranberry	*Oxycocus microcarpus*
Willow	*Salix spp.*
Crowberry	*Empetrum nigrum ssps.*
Blueberry	*Vaccinium spp.*
Resin birch	*Betula glandulosa*
Dwarf arctic birch	*B. nana ssp. exilis*
Bog rosemary	*Andromeda polifolia*

Grasses, herbs, other

Cottongrass	*Eriophorum spp.*
Sedges	*Carex spp.*
Rushes	*Juncus spp.*
Lichens	
Mosses	
Liverworts	
Mushrooms	
Other fungi	

alpine tundra

Shrubs

Resin birch	*Betula glandulosa*
Dwarf arctic birch	*B. nana ssp. exilis*
Arctic willow	*Salix arctica ssps.*
Crowberry	*Empetrum nigrum ssps.*
Labrador tea	*Ledum palustre ssp. groenlandicum*
Mountain heather	*Phyllodoce spp.*
Rhododendron	*Rhododendron lapponicum*
Dwarf blueberry	*Vaccinium caespitosum*
Alpine blueberry	*V. uliginosum ssp. alpinum*
Alpine bearberry	*Arctostaphylos alpina*

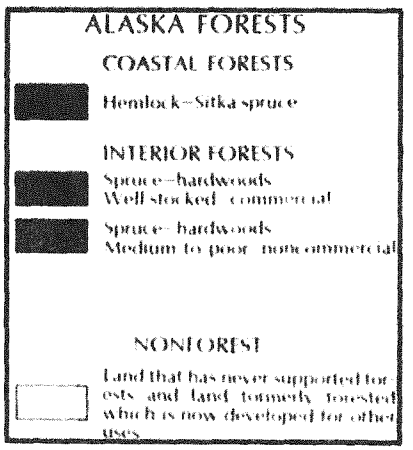
Grasses, herbs, others

Mountain avens	*Dryas spp.*
Moss campion	*Silene acaulis ssps.*
Arctic sandwort	*Minuartia arctica*
Cassiope	*Cassiope spp.*
Alpine azalea	*Loiseluria procumbens*
Sedges	*Juncus spp.*
Lichens	
Mosses	
Misc. fungi	

Data Source:

Ref. 11, Alaska Regional Profiles.

FOREST TYPES



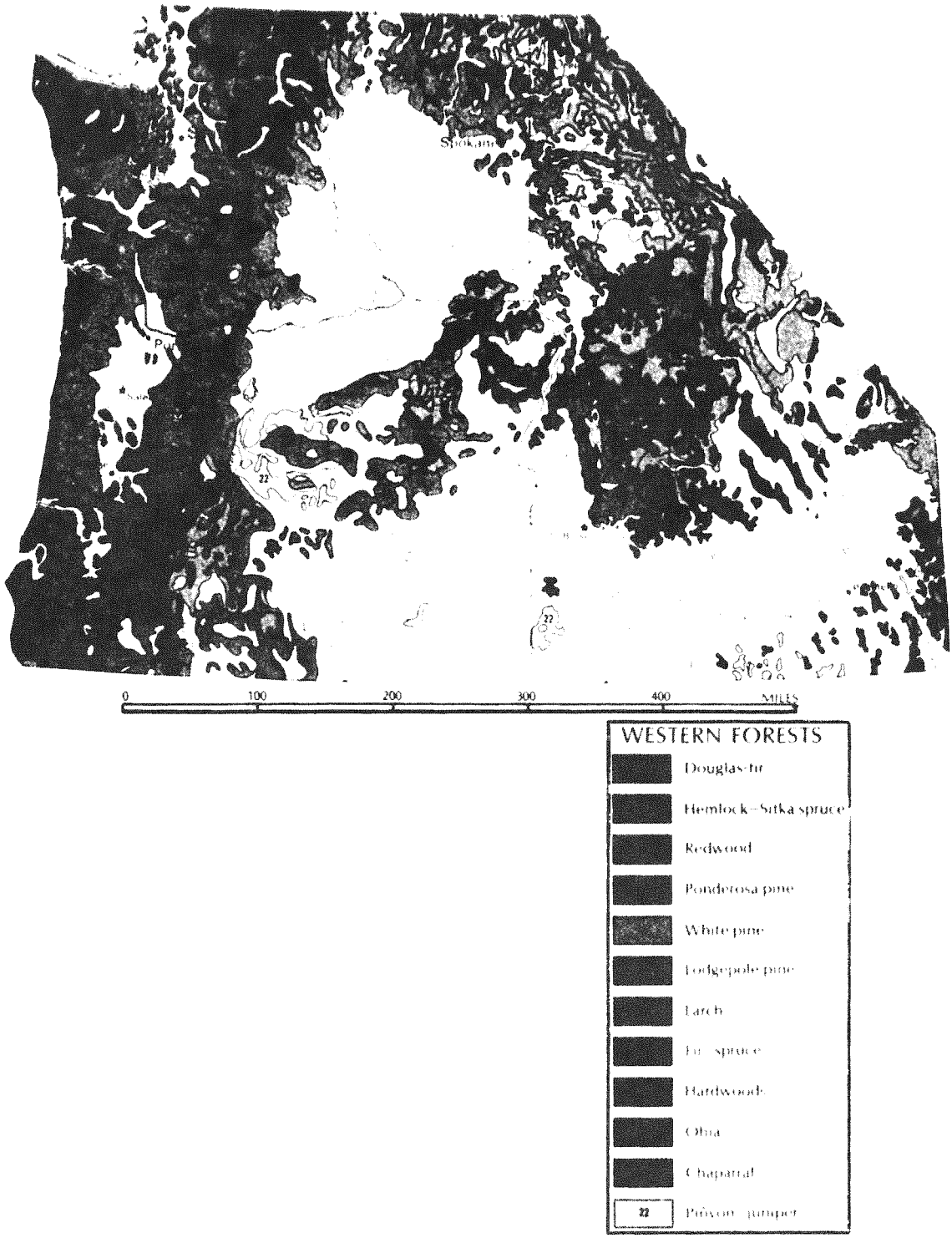


FIGURE II-F-166. Major Forest Types

Data Source: Ref. 13, National Atlas, pp. 154 and 155.

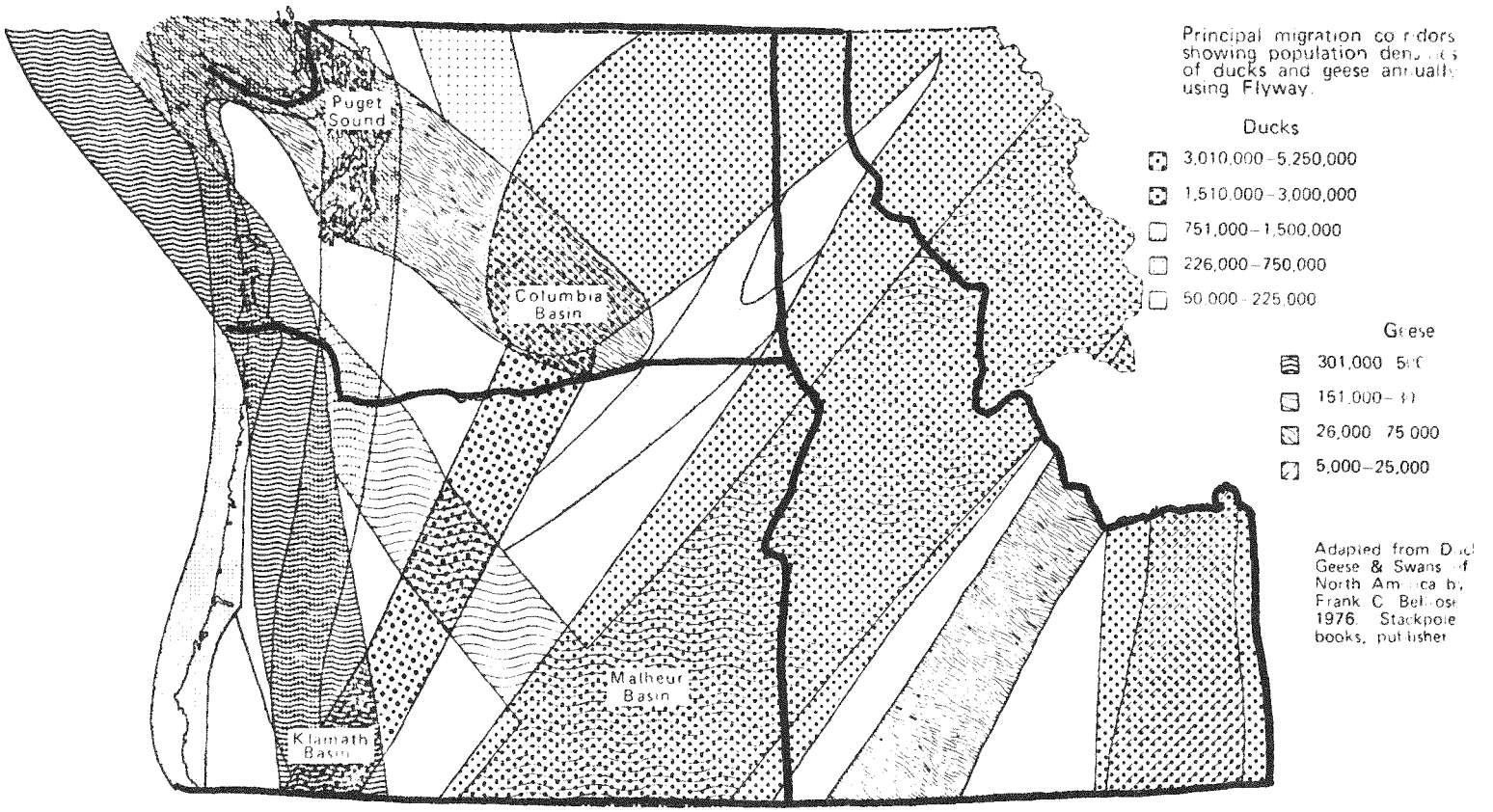


FIGURE II-F-167. Pacific Flyway

Data Source: Ref. 20, BPA Role EIS, P. III-25.

TABLE II-F-83

COMMON AND SCIENTIFIC NAMES OF IMPORTANT COMMERCIAL AND SPORTS FISHES AND SHELLFISH OF THE PACIFIC NORTHWEST

Common and scientific name	Remarks
Albacore, *Thunnus alalunga*	A major ocean fishery since 1936, but numbers fluctuate greatly from year to year.
Anchovy, Pacific, *Engraulis mordax*	A latent marine fishery, some rendered to meal and oil while others are used as bait
*Brook trout, *Salvelinus fontinalis*	Excellent game fish in cold lakes and streams.
*Brown trout, *Salmo trutta*	Introduced from Europe to U. S. Excellent game fish.
*Bullheads:	
*Black bullhead, *Ictalurus melas*	Ponds, warm-water lakes, sloughs, and slow-moving rivers.
*Brown bullhead, *Ictalurus nebulosus*	
*Yellow bullhead, *Ictalurus natalis*	
*Carp, *Cyprinus carpio*	Some commercial value, but considered a trash fish in most locations.
Clams:	
Razor clam, *Siliqua patula*	A major clam of the sandy ocean beaches.
Washington clam, *Saxidomus giganteus*	A major clam resource in Washington, minor in Oregon.
Littleneck clam, Pacific, *Protothaca staminea*	Delectable clam of bays, sounds, and protected ocean beaches.
Littleneck clam, Japanese, *Tapes semidecussata*	Established in Puget Sound from Japan.
Gaper clam (Horseneck), *Schizothaerus nuttalli*	Large clam of bays.
Geoduck, *Panope generosa*	Largest clam of the area; present in Puget Sound; extremely scarce in Oregon.
Basket cockle, *Clinocardium nuttalli*	The most important bait clam of the area.
*Eastern softshell, *Mya arenaria*	A bay clam introduced from the Atlantic Coast.
Crab, Dungeness (market crab), *Cancer magister*	A major shellfish industry.
Crayfish, *Astacus*—5 species	A minor commercial fishery in Oregon.
Cod, Pacific, *Gadus macrocephalus*	Closely related to the Atlantic cod.
Cutthroat trout:	
Coastal cutthroat, *Salmo clarki*	Streams and bays of western Oregon and Washington.
Blackspotted cutthroat trout, *Salmo clarki*	Middle and upper Columbia River drainage.
Flounders:	
Slippery flounder (Dover sole) *Microstomus pacificus*	Increasing commercial landings in recent years.
Petrale sole (Roundnose flounder), *Eopsetta jordani*	An important commercial flounder of the area.
English sole (Lemon flounder), *Paraphrys vetulus*	Important commercial species.
Starry flounder, *Platichthys stellatus*	Frequently caught by anglers in bays.
Grayling, American, *Thymallus signifer*	Important Montana game fish.
Hake, Pacific, *Merluccius productus*	An undeveloped fishery; plentiful.
Halibut, Pacific, *Hippoglossus stenolepsis*	An outstanding example of a managed major fishery on sustained yield basis.
*Lake trout, *Salvelinus namaycush*	A game fish in numerous cold lakes where it has been introduced.
Ling cod, *Ophiodon elongatus*	A commercial and game fish of marine waters.
Rainbow trout:	
Steelhead trout, *Salmo gairdneri*	Anadromous form of the rainbow trout, a major game fish, of some commercial value in Oregon.

Data Source: Ref. 3, Atlas of the Pacific Northwest, pp. 97 and 98.

TABLE II-F-83. (Contd)

Kamloops trout, *Salmo gairdneri*	A rainbow trout growing to large size, especially in Pend Oreille Lake, Idaho, and Diamond Lake, Oregon.
Rainbow trout, *Salmo gairdneri*	Nonocean-going rainbow trout; mountain streams and lakes.
Oysters:	
Native oyster, *Ostrea lurida*	A premium oyster usually produced under extensive cultivation methods.
*Pacific oysters, *Crassostrea gigas*	Introduced oyster supporting an extensive industry.
Rockfishes:	More than 30 species in area; several kinds could support increased commercial fishery activity.
Yellow-tailed rockfish, *Sebastodes flavidus*	Excellent food fish.
Canary rockfish, *Sebastodes pinniger*	Important rockfish.
Raspheud rockfish, *Sebastodes ruberrimus*	Called "red snapper" in some areas; used extensively.
Pacific Ocean perch, *Sebastodes alutus*	Sometimes called "long-jawed rockfish"; of excellent food qualities.
Sablefish (Black "cod"), *Anoplopoma fimbria*	A northern marine fishery.
Salmon, Pacific:	The major fishery of the region.
Chinook salmon (King) *Oncorhynchus tshawytscha*	Most important salmon species of the Columbia River; commercial and sports fish.
Sockeye and Blueback salmon (Red salmon), *Oncorhynchus nerka*	Excellent quality salmon of Puget Sound and Columbia River.
Kokanee salmon, *Oncorhynchus nerka*	Landlocked form of the red salmon. A sports fish having commercial value in Idaho.
Pink salmon, *Oncorhynchus gorbuscha*	Important commercial salmon of the Puget Sound area.
Chum salmon, *Oncorhynchus keta*	A commercial salmon usually spawning near the sea.
Coho salmon (Silver), *Oncorhynchus kisutch*	Important sports and commercial salmon in all coastal streams and sea.
Sea-perches, *Embiotocidae* family	Several species giving birth to living young. Sports fishes with minor commercial value.
*Shad, American, *Alosa sapidissima*	Anadromous commercial fish introduced from Atlantic Coast.
Sharks:	
Dogfish, spiny, *Squalus acanthias*	High liver potency of Vitamin A.
Soupfin shark, *Galeorhinus zyopterus*	Most important commercial shark on the Pacific Coast; liver high in Vitamin A
Scallops, *Pecten caurinus*	Small commercial fishery having latent possibilities.
Smelt:	
Eulachon (Columbia River smelt), *Thaleichthys pacificus*	Supports the famous smelt runs of the Cowlitz, Lewis, and Sandy Rivers.
Surf smelt (Silver smelt), *Hypomesus pretiosus*	Good food fish spawning in surf on coarse sandy and gravel beaches.
*Striped bass, *Roccus saxatilis*	A sports and commercial fish in Coos Bay.
Sturgeons:	
White sturgeon, *Acipenser transmontanus*	The big sturgeon of large rivers; an excellent food fish, also taken by sports fishermen
Green sturgeon, *Acipenser medirostris*	The greenish-fleshed sturgeon of marine locations, of little commercial value.
*Sunfishes, family *Centrarchidae*	Several introduced species. No sunfishes native to Oregon and Washington.
*Black crappie, *Pomoxis nigromaculatus*	A popular panfish.
*Bluegill, *Lepomis macrochirus*	Numerous in warm-water locations.
*Largemouth blackbass, *Micropterus salmoides*	Well distributed in suitable habitats.
*Smallmouth blackbass, *Micropterus dolomieui*	Present in only a few river and lake locations.
*White crappie, *Pomoxis annularis*	A popular game fish in several areas.
Whitefish (Rocky Mountain) *Prosopium williamsoni*	Excellent game fish in inland cool waters; small commercial fishery in some areas.

*Introduced species.

Data Source: Ref. 3, Atlas of the Pacific Northwest, pp. 97 and 98.

TABLE II-F-83a

COMMERCIAL FISHERIES

U.S. COMMERCIAL LANDINGS, BY STATES, 1976 AND 1977

State	1976		1977		Record Landings	
	Thousand Pounds	Thousand Dollars	Thousand Pounds	Thousand Dollars	Year	Thousand Pounds
Alaska	616,351	227,208	644,014	326,245	1936	932,341
Idaho	400	34	391	38	--	(4)
Oregon	98,853	48,727	112,503	48,532	1977	112,503
Washington	131,310	80,942	146,075	80,785	1941	197,253
Region	846,914	356,911	902,983	455,600		
Total	5,350,400	1,352,700	5,198,100	1,515,100	1962	5,354,000

Data Source: Ref. 62, Fisheries of the United States, 1972, p. 4.

TABLE II-F-84

CURRENT ESTIMATES OF BIG GAME POPULATIONS IN THE WESTERN STATES,[a] 1975

State	Bison	Pronghorn	Bighorn	Mule and Blacktail Deer	Elk	Total
Idaho	25	13,250	2,975	178,000	50,600	244,850
Oregon	-	11,000	400	1,050,000	107,000	1,168,400
Washington	-	50	435	373,500	60,000	433,985
Totals	495	270,569	20,410	3,604,800	454,692	4,350,966
% of Pre-Columbian Nos.	<1	2-3	<1?	>100?	25	15-20

(a) These estimates were provided by officials of the fish and game departments in each state.

Data Source: Reference 64, Council on Environmental Quality

TABLE II-F-85

STATE-PROTECTED WILDLIFE HABITAT, 1975

(Acres in Thousands)

State	Areas Managed Specifically for Wildlife		Others, Such as Forests and Parks		Natural Areas		Total Acres in Wildlife Habitat
	Number	Acres	Number	Acres	Number	Acres	
Alaska	11	908	5	1418	9	489	2815
Idaho	33	77	28	442	--	--	519
Oregon	17	105	--	1659	--	--	1764
Washington	360	784[a]	73	115	6	(b)	899

(a) Includes 364,000 actually owned and 420,000 controlled.
(b) Less than 500 acres.

Data Source: Ref. 64, Council on Environmental Quality.

TABLE II-F-86

ALASKA'S ECOSYSTEMS AND RELATED FAUNA

Low Brush Bog and Muskeg

Mammals	
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*
Black bear	*Ursus americanus*
Brown-grizzly bear	*U. arctos*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Caribou	*Rangifer tarandus granti*
Moose	*Alces alces*
Beaver	*Castor canadensis*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Mink	*Mustela vison*
Weasel	*M. erminea*
Muskrat	*Ondatra zibethica*
Land otter	*Lutra canadensis*
Birds	
Dabbling ducks	*Anatinae*
Diving ducks	*Aythyinae*
Geese	*Anserinae*
Swans	*Cygninae*
Grebes	*Podicipedidae*
Loons	*Gaviidae*
Sandhill crane	*Grus canadensis*
Marsh hawk	*Circus cyaneus*
Gyrfalcon	*Falco rusticolus*
Shorebirds	
Owls of the open country	

Alpine tundra and barren ground

Mammals	
Dall sheep	*Ovis dall*
Mountain goat	*Oreamnos americanus*
Hoary marmot	*Marmota caligata*
Pika	*Ochotna collaris*
Black bear	*Ursus americanus*
Brown-grizzly bear	*U. arctos*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Caribou	*Rangifer tarandus granti*
Elk	*Cervus canadensis*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Lemmings	
Ground Squirrel	
Birds	
Ptarmigan	*Lagopus* spp.
Raven	*Corvus corax*
Golden eagle	*Aquila chrysaetos*
Marsh hawk	*Circus cyaneus*
Gyrfalcon	*Falco rusticolus*
Songbirds	
Shorebirds	
Open country owls	

Moist Tundra

Mammals	
Brown-grizzly bear	*Ursus arctos*
Moose	*Alces alces*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Caribou	*Rangifer tarandus granti*
Red fox	*Vulpes vulpes*
Birds	
Ptarmigan	*Lagopus* spp.
Raven	*Corvus corax*
Bald eagle	*Haliaeetus leucocephalus*
Jaegers	*Stercorarius* spp.
Dabbling ducks	*Anatinae*
Diving ducks	*Aythyinae*
Geese	*Anserinae*
Swans	*Cygninae*
Grebes	*Podicipedidae*
Loons	*Gaviidae*
Sandhill crane	*Grus canadensis*
Songbirds	
Hawks	
Owls of the open country	
Shorebirds	

Coastal Western Hemlock-Sitka Spruce Forest

Mammals	
Black bear	*Ursus americanus*
Brown-grizzly bear	*U. arctos*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Lynx	*Lynx canadensis*
Marten	*Martes americana*
Red squirrel	*Tamiasciurus hudsonicus*
Roosevelt elk	*Cervus canadensis (on Afognak Island)*
Birds	
Raven	*Corvus corax*
Crow	*C. caurinus*
Bald eagle	*Haliaeetus leucocephalus*
Hawks	
Songbirds	
Woodland owls	

Data Source: Ref. 11, Alaska Regional Profiles.

TABLE II-F-86. (Contd)

Upland Spruce-Hardwood Forest

Mammals	
Black bear	*Urus americanus*
Brown-grizzly bear	*U. arctos*
Wolf	*Canis lupus*
Caribou	*Rangifer tarandus granti*
Bison	*Bison bison*
Moose	*Alces alces*
Snowshoe hare	*Lepus americanus*
Red fox	*Vulpes vulpes*
Lynx	*Lynx canadensis*
Weasel	*Mustela erminea*
Marten	*Martes americana*
Red squirrel	*Tamiasciurus hudsonicus*
Flying squirrel	*Glaucomys sabrinus*
Birds	
Ptarmigan	*Lagopus* spp.
Raven	*Corvus corax*
Spruce grouse	*Canachites canadensis*
Ruffed grouse	*Bonasa umbellus*
Woodland owls	
Hawks	
Songbirds	

High Brush

Mammals	
Black bear	*Ursus americanus*
Brown-grizzly bear	*U. arctos*
Moose	*Alces alces*
Caribou	*Rangifer tarandus granti*
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*
Dall sheep	*Ovis dalli*
Mountain goat	*Oreamnos americanus*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Snowshoe hare	*Lepus americanus*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Lynx	*Lynx candensis*
Birds	
Ptarmigan	*Lagopus* spp.
Raven	*Corvus corax*
Hawks	
Owls	
Songbirds	

Lowland Spruce-Hardwood Forest

Mammals	
Black bear	*Ursus americana*
Brown-grizzly bear	*U. arctos*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Caribou	*Rangifer tarandus granti*
Moose	*Alces alces*
Bison	*Bison bison*
Snowshoe hare	*Lepus americanus*
Red fox	*Vulpes vulpes*
Lynx	*Lynx canadensis*
Red squirrel	*Tamiasciurus hudsonicus*
Birds	
Spruce grouse	*Canachites canadensis*
Raven	*Corvus corax*
Hawks	
Woodland owls	
Songbirds	

Wet Tundra

Mammals	
Brown-grizzly bear	*Ursus arctos*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Moose	*Alces alces*
Mink	*Mustela vison*
Weasel	*M. erminea*
Muskrat	*Ondatra zibethica*
Land otter	*Lutra candensis*
Birds	
Swans	*Cygninae*
Geese	*Anatinae*
Dabbling ducks	*Anat*
Diving ducks	*Aythyinae*
Loons	*Gaviidae*
Grebes	*Podicipedidae*
Raven	*Corvus corax*
Marsh hawk	*Circus syaneus*
Jaegers	*Circus cyaneus*
Shorebirds	
Open country owls	

Bottomland Spruce-Poplar Forest

Mammals	
Black bear	*Ursus americanus*
Brown-grizzly bear	*U. arctos*
Wolverine	*Gulo gulo*
Bison	*Bison bison* (in local a.[illegible]s
Moose	*Alces alces*
Beaver	*Castor canadensis*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Lynx	*Lynx canadensis*
Mink	*Mustela vison*
Weasel	*M. erminea*
Marten	*Martes americana*
Land otter	*Lutra canadensis*
Red squirrel	*Tamiasciurus hudson[illegible]u*
Mice	
Birds	
Spruce grouse	*Canachites canadens[illegible]*
Raven	*Corvus corax*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Hawks	
Songbirds	
Woodlands owls	

Data Source: Ref. 11, Alaska Regional Profiles.

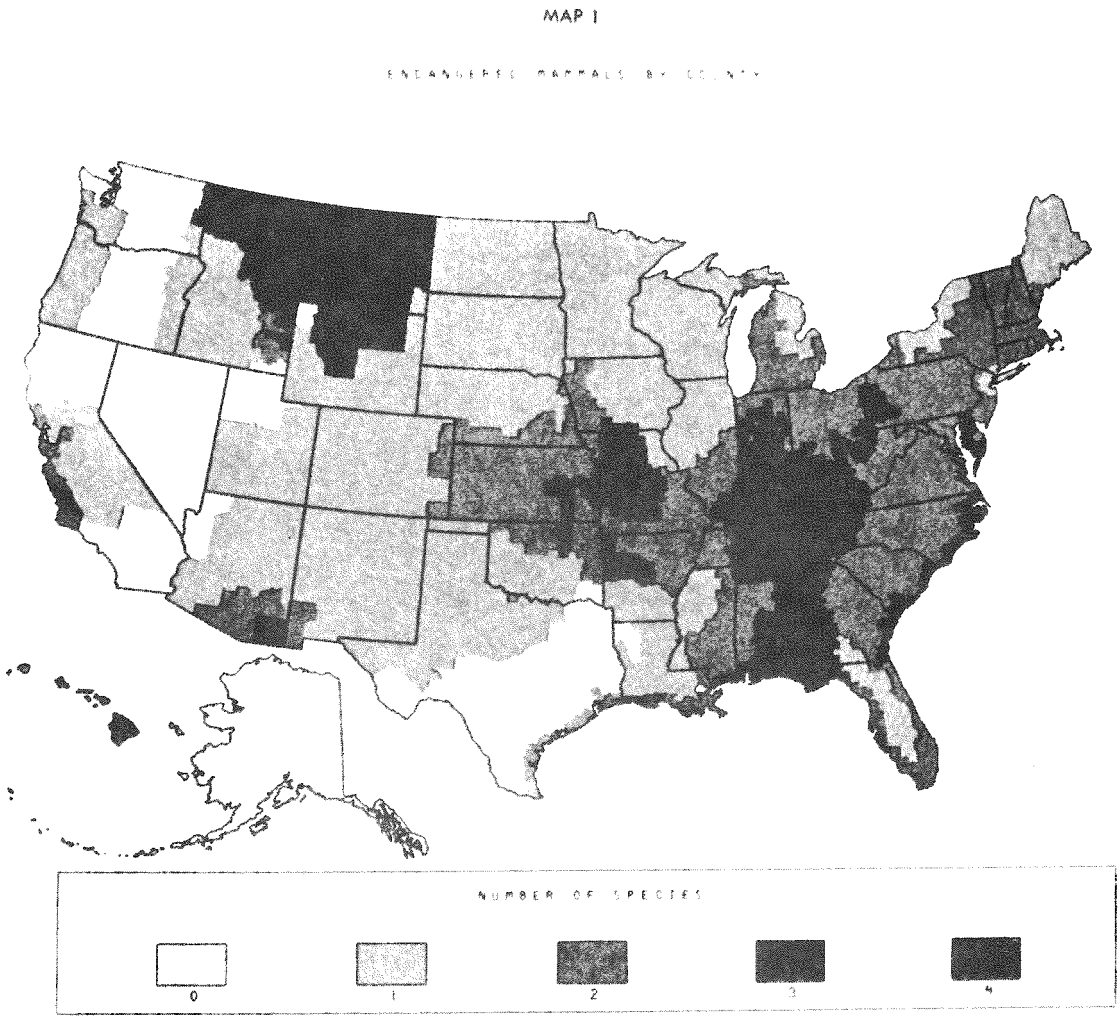


FIGURE II-F-168. Endangered Mammals by County

Data Source: Ref. 65, Endangered Species Act, p. 26.

MAP 2

ENDANGERED BIRDS BY COUNTY

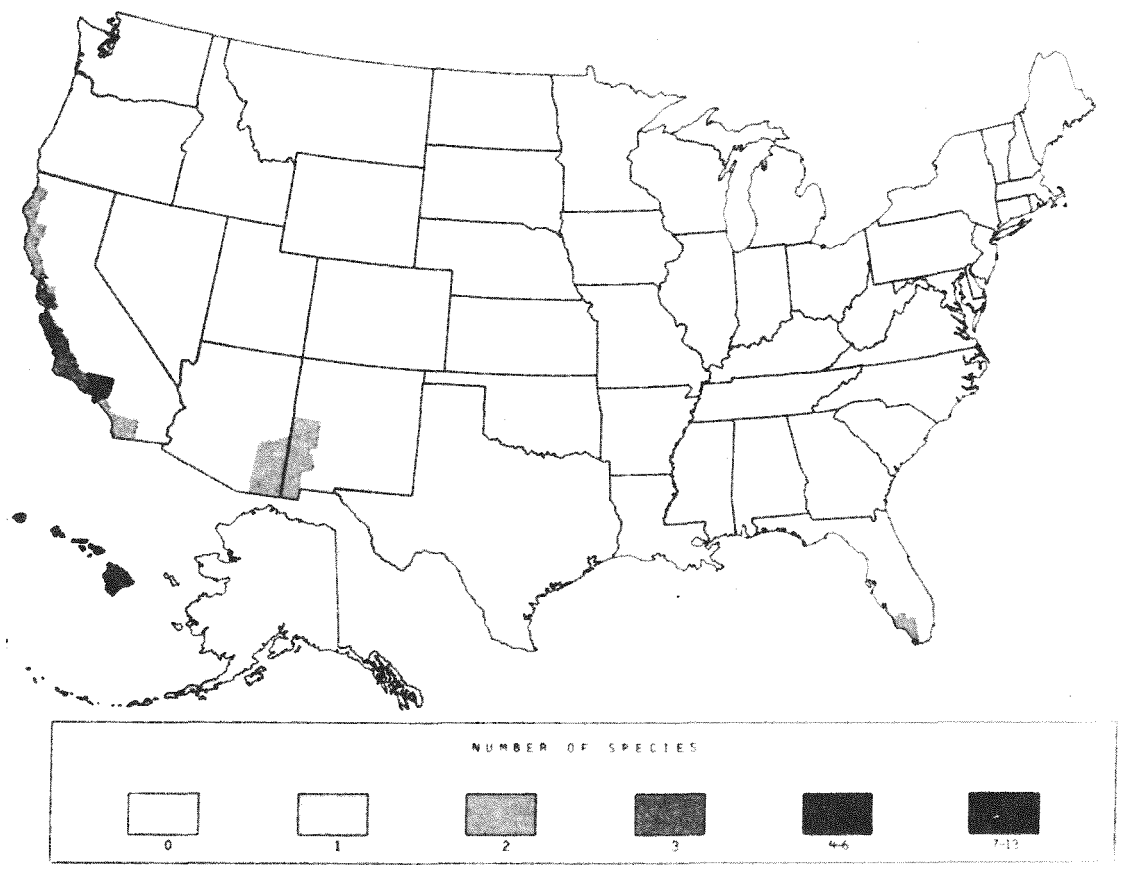


FIGURE II-F-169. Endangered Birds by County

Data Source: Ref. 65, Endangered Species Act, p. 27.

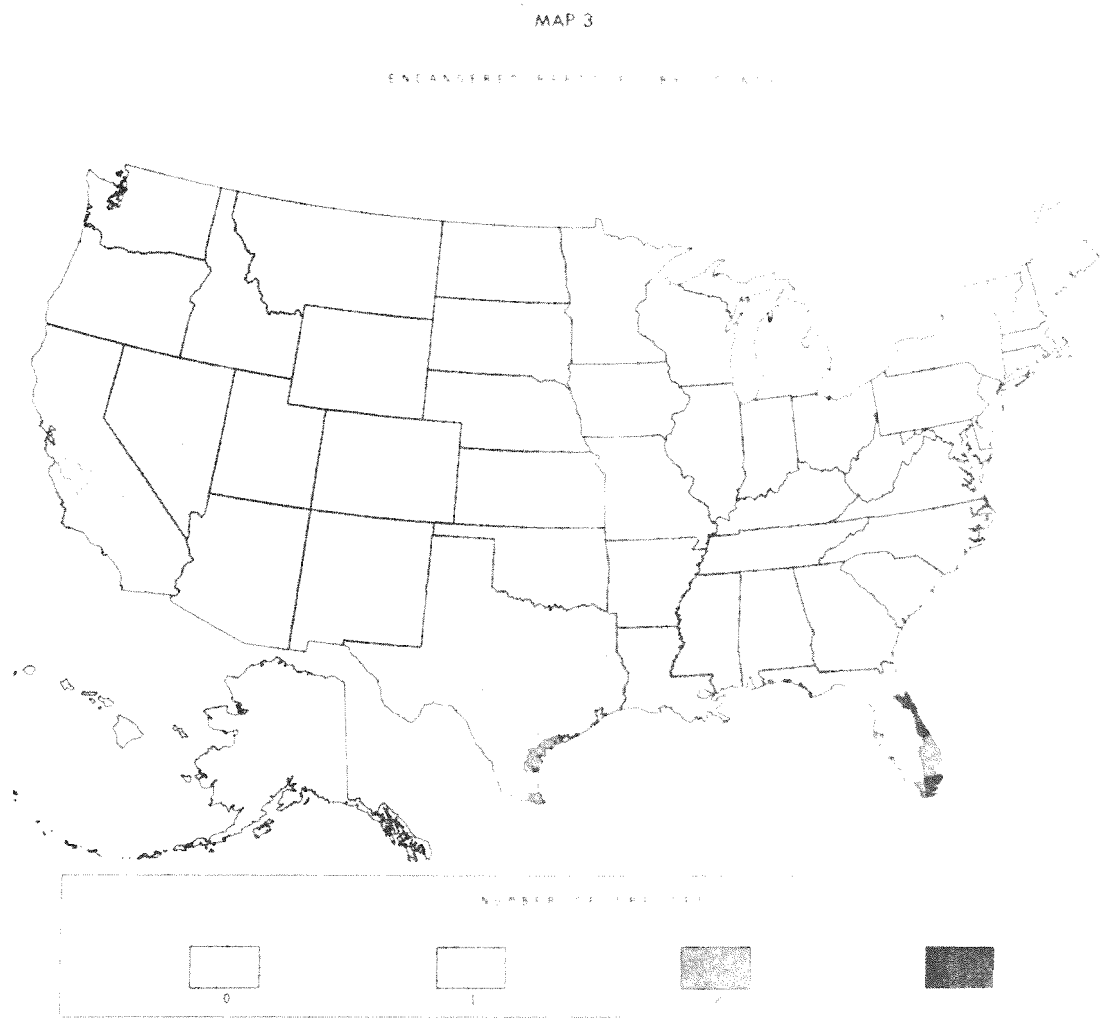


FIGURE II-F-170. Endangered Reptiles by County

Data Source: Ref. 65, Endangered Species Act, p. 28.

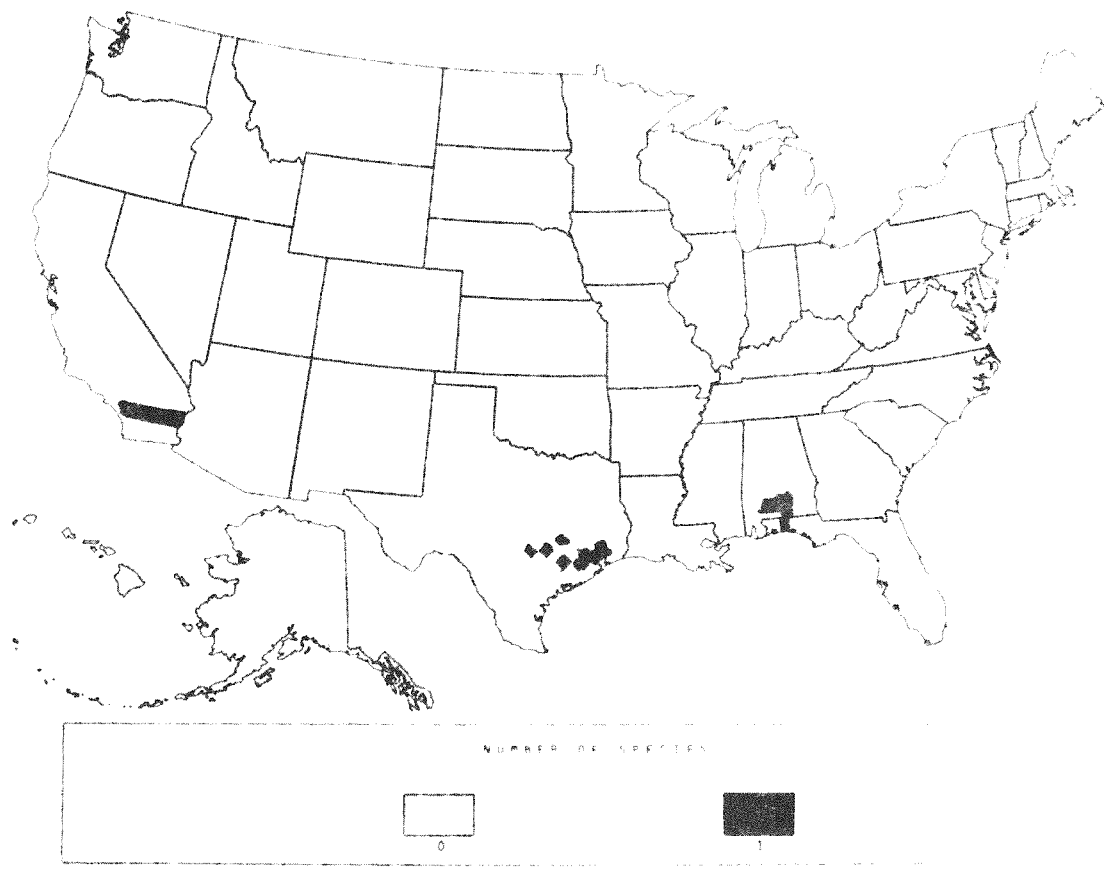


FIGURE II-F-171. Endangered Amphibians by County

Data Source: Ref. 65, Endangered Species Act, p. 29.

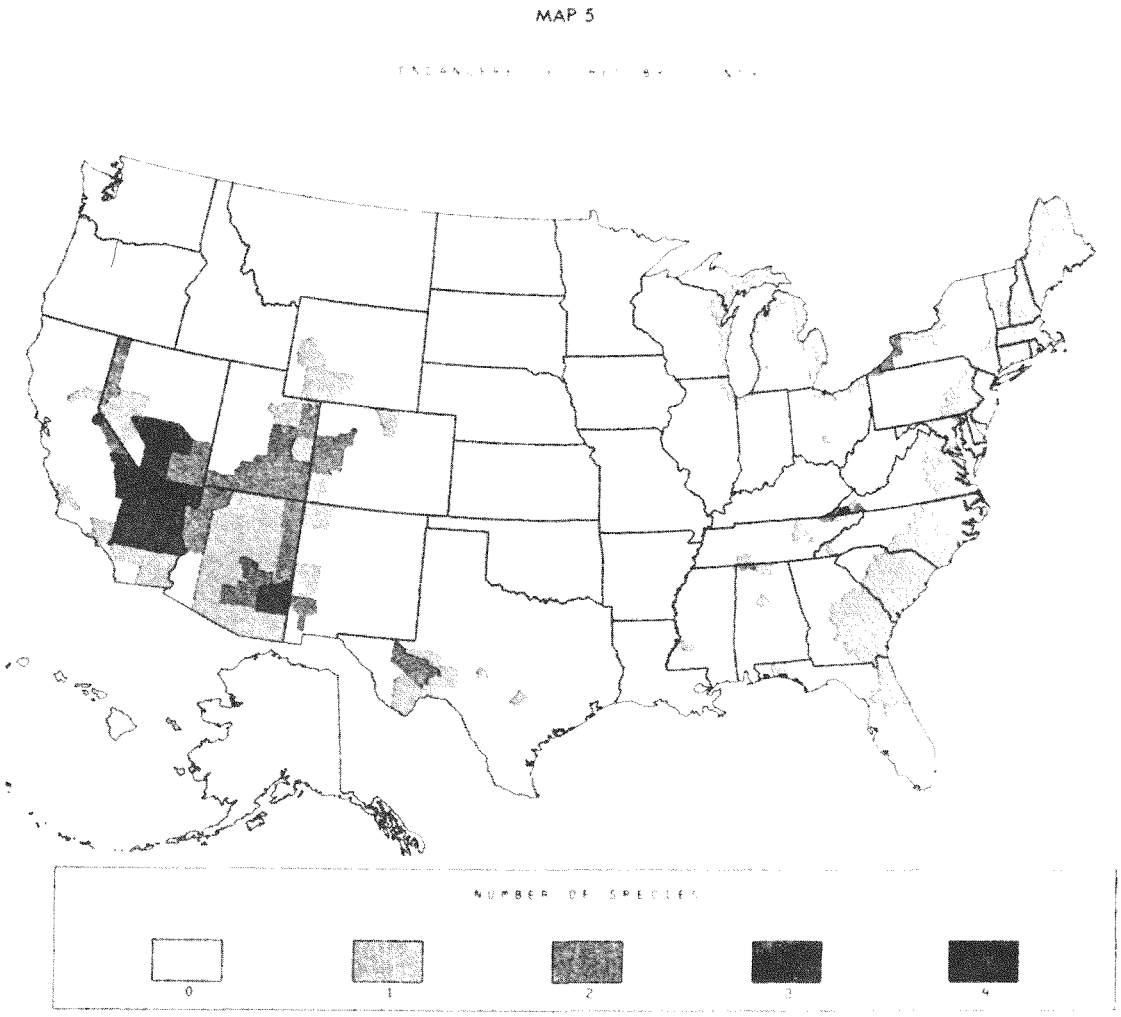


FIGURE II-F-172. Endangered Fishes by County

Data Source: Ref. 65, Endangered Species Act, p. 30.

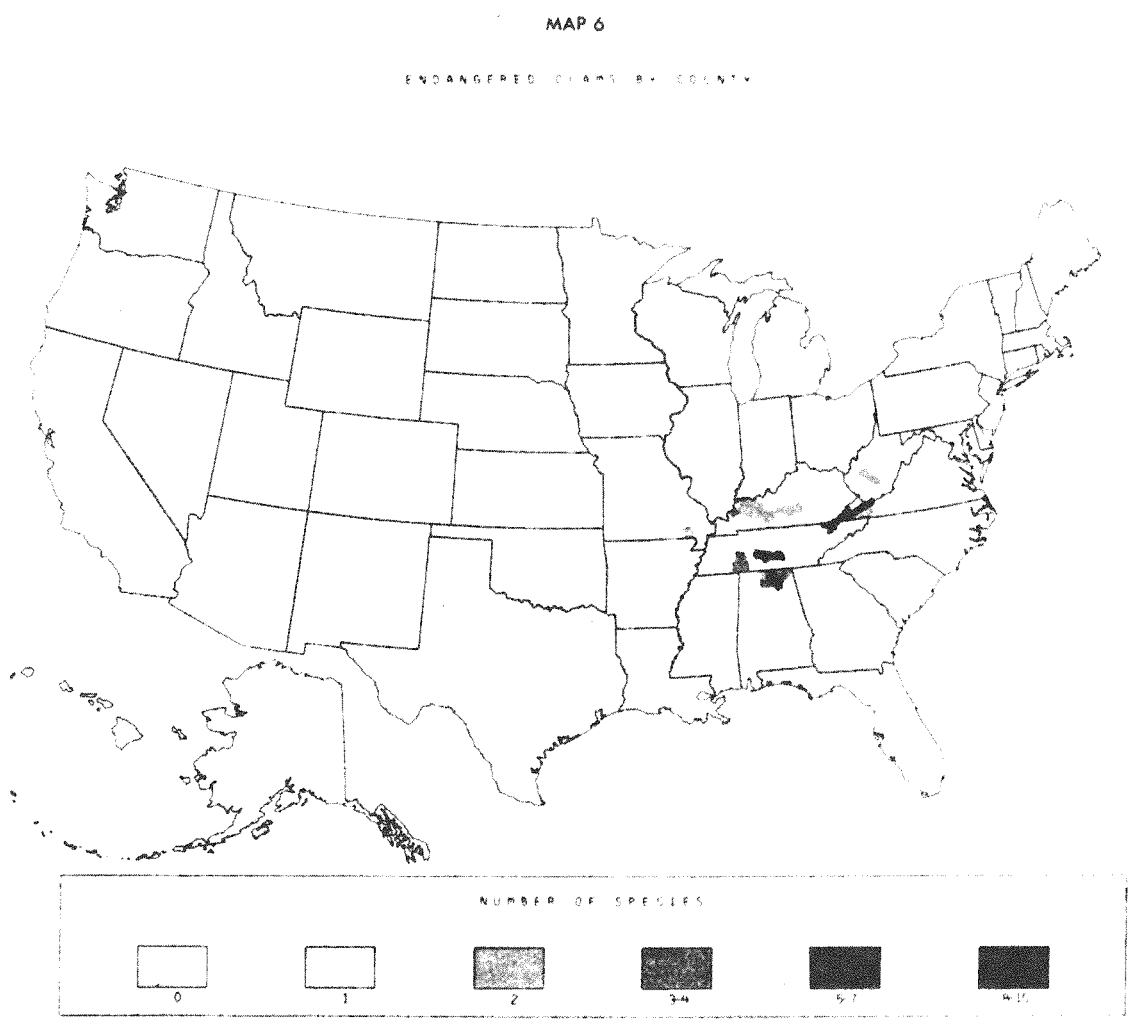


FIGURE II-F-173. Endangered Clams by County

Data Source: Ref. 65, Endangered Species Act, p. 31.

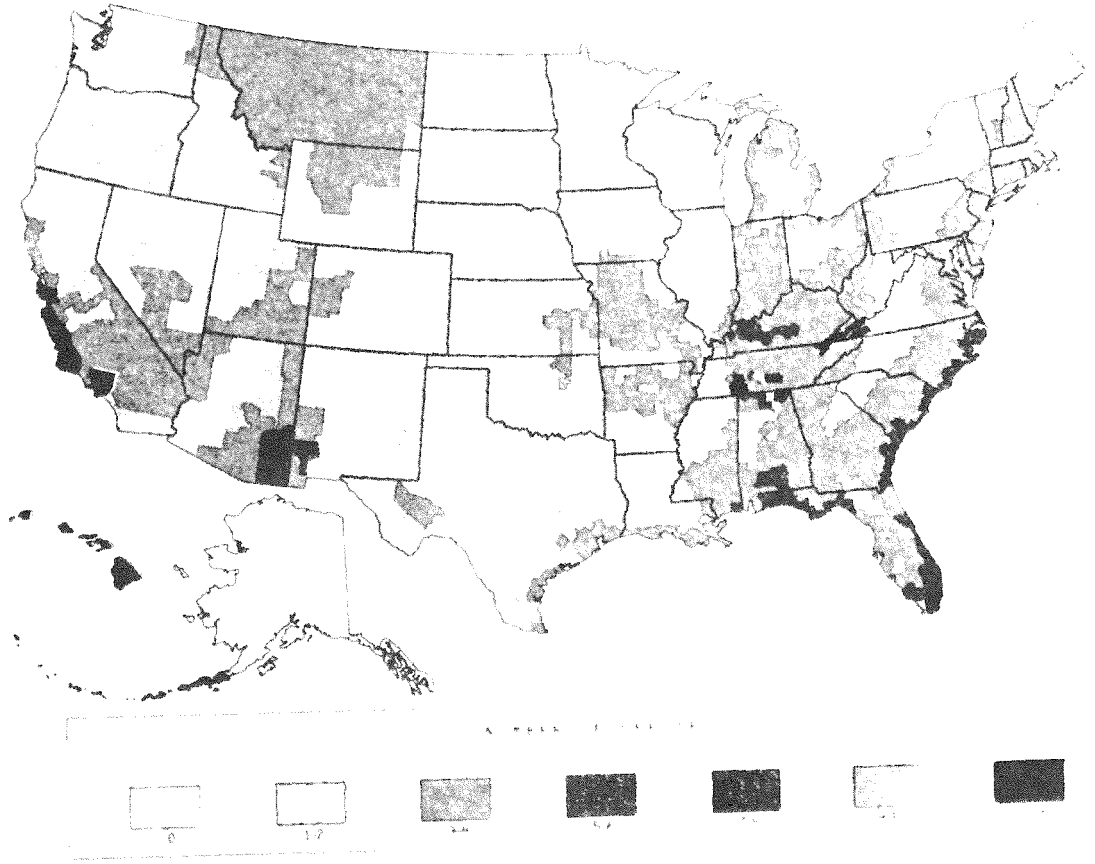


FIGURE II-F-174. Total Endangered Species by County

Data Source: Ref. 65, Endangered Species Act, p. 32.

MAP 10

ENDANGERED SPECIES - ENERGY DEVELOPMENT CONFLICTS

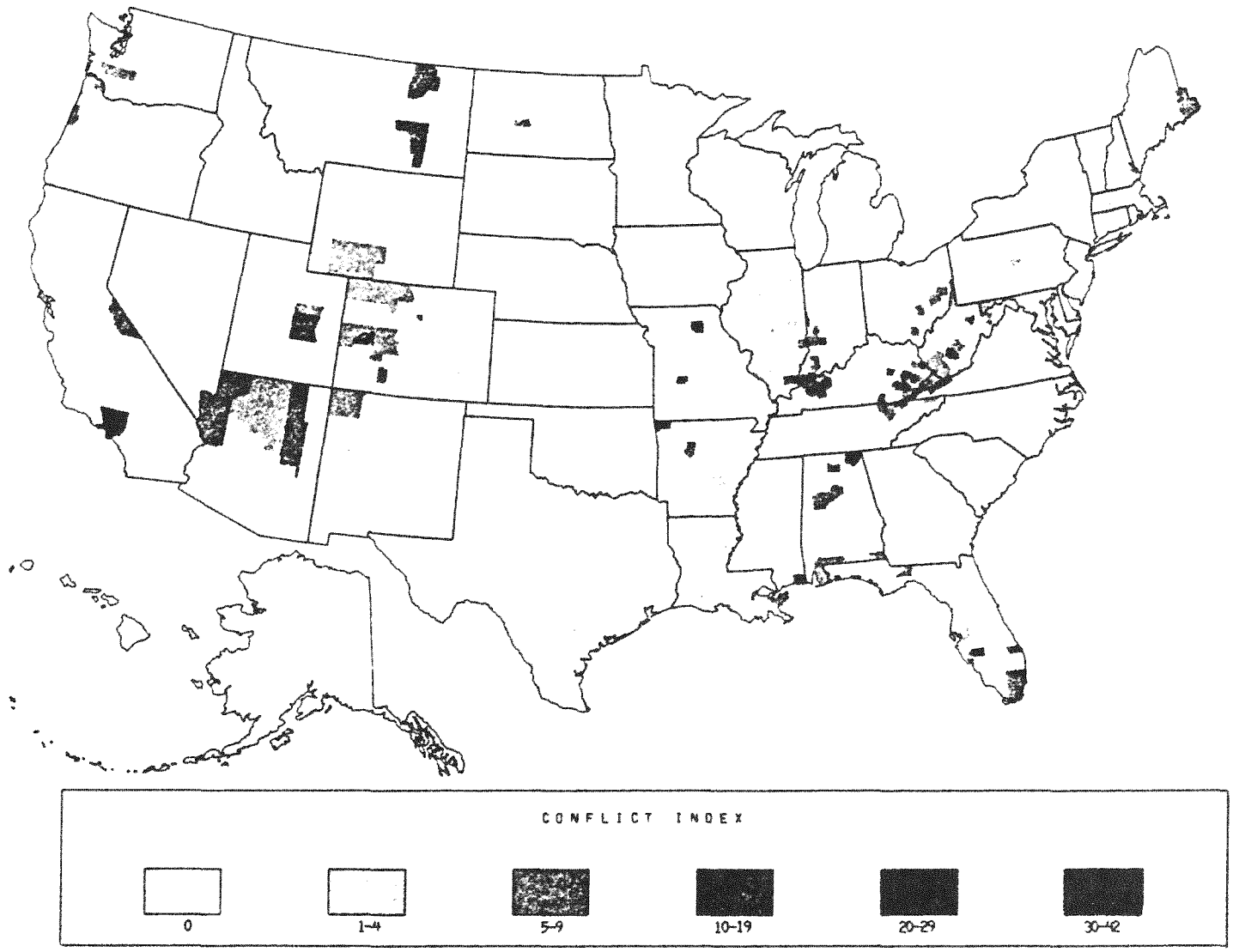


FIGURE II-F-175. Endangered Species - Energy Development Conflicts

Data Source: Ref. 65, Endangered Species Act, p. 35.

TABLE II-F-87

THREATENED AND ENDANGERED SPECIES BY STATE

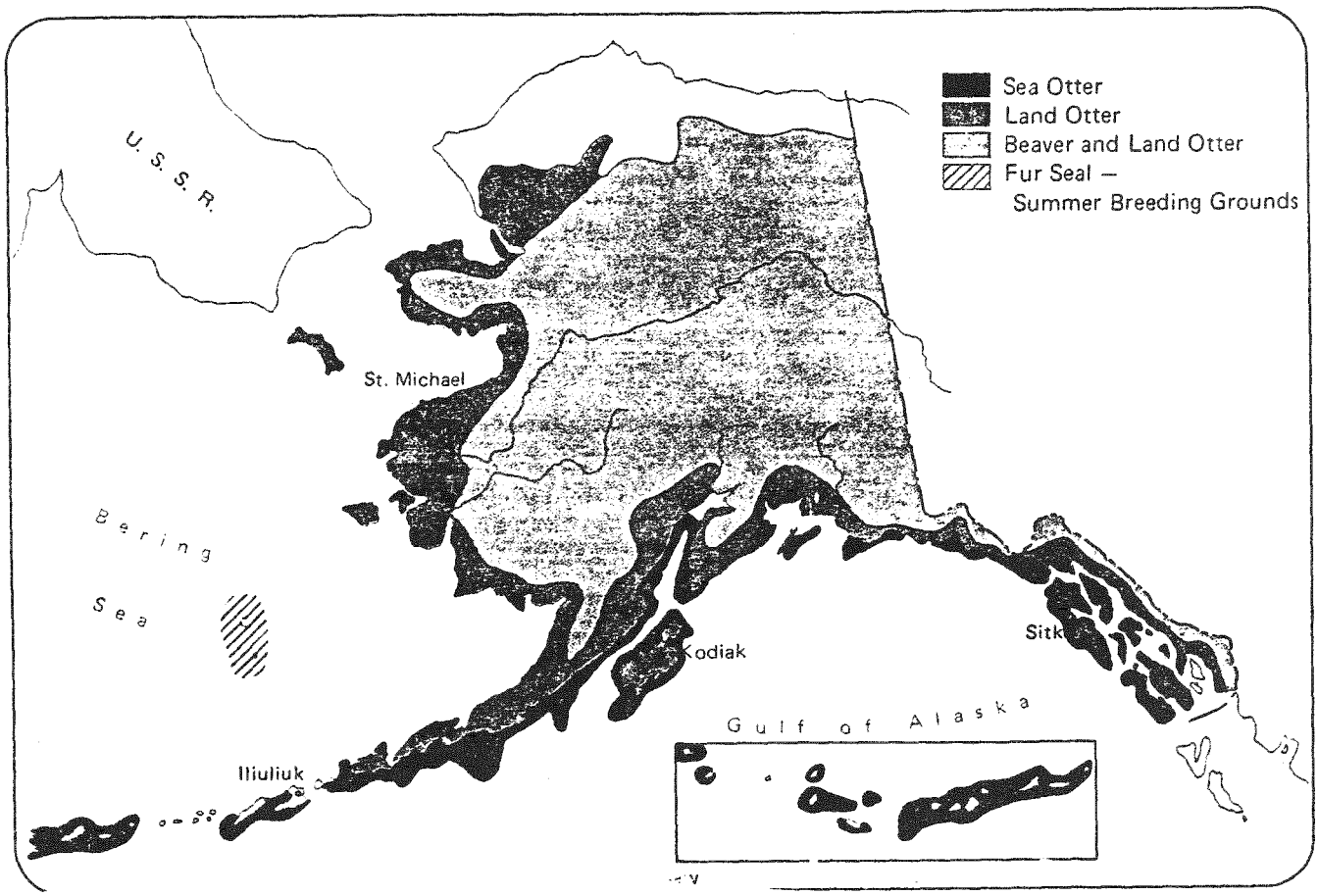
Common Name and State	Scientific Name	Group (a) and Family (b)	Additional Information
Alaska			
Glacier black bear	Ursus Americanus Emmonsii	(a) Mammals (b) Ursidae	Historic present distribution rejected (status)
River otter	Lutra Canadensis	(a) Mammals (b) Mustelidae	Historic review (status)
Eskimo curlew	Numenius Borealis	(a) Birds (b) Scolopacidae	Historic endangered (status)
Arctic peregrine falcon	Falco Peregrinus Tundrius	(a) Birds (b) Falconidae	Historic endangered (status)
Aleutian Canada goose	Branta Canadensis Leucopareia	(a) Birds (b) Anatidae	Historic endangered (status)
Idaho			
Grizzly (brown) bear	Ursus Arctos Horribilis	(a) Mammals (b) Urisidae	Historic critical habitat threatened (status)
Bobcat	Lynx Rufus	(a) Mammals (b) Felidae	Historic review (status)
Lynx	Lynx Canadensis	(a) Mammals (b) Felidae	Historic review (status)
River otter	Lutra Canadensis	(a) Mammals (b) Mustelidae	Historic review (status)
Gray wolf	Canis Lupus	(a) Mammals (b) Canidae	Historic threatened and endangered (status)
Northern Rocky Mountain wolf	Canis Lupus Irremotus	(a) Mammals (b) Canidae	Historic present distribution depleted (status)
Whooping crane	Grus Americana	(a) Birds (b) Gruidae	Historic critical habitat endangered (status)
Bald eagle	Haliaeetus Leucocephalus	(a) Birds (b) Accipitridae	Historic threatened and endangered (status)
American peregrine falcon	Falco Peregrinus Anatum	(a) Birds (b) Falconidae	Historic endangered
Arctic peregrine falcon	Falco Peregrinus Tundrius	(a) Birds (b) Falconidae	Historic endangered (status)
Oregon			
Bobcat	Lynx Rufus	(a) Mammals (b) Felidae	Historic review (status)
Columbian white-tailed deer	Odocoileus (Dama) Virginianus Leucurus	(a) Mammals (b) Cervidae	Historic endangered (status)
Lynx	Lynx Canadensis	(a) Mammals (b) Felidae	Historic review (status)
River otter	Lutra Canadensis	(a) Mammals (b) Musteliade	Historic review (status)
Gray wolf	Canis Lupus	(a) Mammals (b) Canidae	Historic threatened and endangered (status)
Northern Rocky Mountain wolf	Canis Lupus Irremotus	(a) Mammals (b) Canidae	Historic depleted (status)
Bald eagle	Haliaeetus Leucocephalus	(a) Birds (b) Accipitridae	Historic threatened and endangered (status)

Data Source: Ref. 66, Computer printout, Biomedical and Environmental Assessment Division.

TABLE II-F-87. (Contd)

Common Name and State	Scientific Name	Group (a) and Family (b)	Additional Information
American peregrine falcon	Falco Peregrinus Anatum	(a) Birds (b) Falconidae	Historic endangered (status)
Arctic peregrine falcon	Falco Peregrinus Tundrius	(a) Birds (b) Falconidae	Historic endangered (status)
Aleutian Canada goose	Branta Canadensis Leucopareia	(a) Birds (b) Anatidae	Historic endangered (status)
Larch mountain salamander	Plethodon Larselli	(a) Amphibians (b) Plethodontidae	Historic review (status)
Siskiyou mountain salamander	Plethodon Stormi	(a) Amphibians (b) Plethodontidae	Historic review (status)
Newcomb's littorine snail	Algamorda Newcombiana	(a) Snails	Historic proposed (status)
Oregon silverspot butterfly	Speyeria Zerene Hippolyta	(a) Insects (b) Nymphalidae	Historic critical habitat present distribution proposed (status)
Washington			
Grizzly (brown) bear	Ursus Arctos Horribilis	(a) Mammals (b) Ursidae	Historic critical habitat threatened (status)
Bobcat	Lynx Rufus	(a) Mammals (b) Felidae	Historic review (status)
Columbian white-tailed deer	Odocoileus (Dama) Virginianus Leucurus	(a) Mammals (b) Cervidae	Historic endangered (status)
Lynx	Lynx Canadensis	(a) Mammals (b) Felidae	Historic review (status)
River otter	Lutra Canadensis	(a) Mammals (b) Mustelidae	Historic review (status)
Gray wolf	Canis Lupus	(a) Mammals (b) Canidae	Historic threatened and endangered (status)
Northern Rocky Mountain wolf	Canis Lupus Irremotus	(a) Mammals (b) Canidae	Historic depleted (status)
Bald eagle	Haliafetus Leucocephalus	(a) Birds (b) Accipitridae	Historic threatened and endangered (status)
American peregrine falcon	Falco Peregrinus Anatum	(a) Birds (b) Falconidae	Historic endangered (status)
Arctic peregrine falcon	Falco Peregrinus Tundrius	(a) Birds (b) Falconidae	Historic endangered (status)
Aleutian Canada goose	Branta Canadensis Leucopareia	(a) Birds (b) Anatidae	Historic endangered (status)
Larch mountain salamander	Plethodon Larselli	(a) Amphibians (b) Plethodontidae	Historic review (status)
Newcomb's littorine snail	Algamorda Newcombiana	(a) Snails (b) Plethodontidae	Historic proposed (status)
Chryxus Arctic butterfly	Oeneis Chryxus Valerata	(a) Insects (b) Satyridae	Historic present distribution review (status)
Oregon silverspot butterfly	Speyeria Zerene Hippolyta	(a) Insects (b) Nymphalidae	Historic proposed (status) Historic propsoed (status)

Data Source: Ref. 66, Computer printout, Biomedical and Environmental Assessment Division.



Areal Decline of the Northern Sea Otter: 1750-1810

Area of Extinction or Near Extinction	Year	Source
Kamchatka Peninsula	1750	Berkh[a]
Kurile Islands	1780	Berkh
Aleutian Islands	1791	Sauer[b]
Shumagin Islands	1791	Sauer
Kodiak Island and Vicinity	1795	Berkh
Kenai Peninsula and Cook Inlet	1795	Berkh
Prince William Sound	1797	Berkh
Yakutat Bay	1799	Berkh
Cross Sound	1804	Lisiansky[c]
Alexander Archipelago	1810	Berkh

[a]Berkh, Chronological History of the Discovery of Aleutian Islands.
[b]Sauer, A Geographical and Astronomical Expedition.
[c]Lisiansky, A Voyage Round the World.

FIGURE II-F-176. Distribution of Alaskan Animals of Primary Interest to the Russians

Data Source: Ref. 11, Alaska Regional Profiles.

POPULATION

Regional settlement patterns and population migrations in the Northwest have been greatly influenced by resource availability and proximity to transportation systems and markets. Federal settlement acts between 1850 (the Donation Land Act) and the 1890s (the Cary Act for desert settlement and irrigation) initially served to boost the population, and by the early 1900s there were more than one million people in the Northwest.

Coastal towns from Coos Bay, Oregon to Grays Harbor, Washington were supported by farms, salmon, canneries, and sawmills. Northern Idaho and Southern Oregon developed as mining communities, while Spokane and Yakima, Washington, Boise, Idaho, and Pendleton and Salem, Oregon became Regional trading centers.

New towns continued to be developed in the Region even through the depression of the 1930s because of construction of government financed hydroelectric dams and irrigation projects. Population growth increased further when President Franklin D. Roosevelt signed legislation in 1937 creating the Bonneville Power Administration (BPA), which marketed federally generated hydroelectric power in the Region. Through special contracts with BPA the aluminum industry was attracted to the Region.(1)

The 1975 Regional population was estimated to be more than seven million. Slighty more than half of this population is situated in Washington State. Oregon's level of population is second to Washington's and is followed by Idaho and Alaska. Even though the oil discovered at Prudhoe Bay and the related pipeline construction created a population boom in the 1970s, Alaska is still the least populous state in the country. Population growth within the Region has been higher than the national average; however, the Region's population is still less than 4% of the U.S. total.(2)

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(1) Information Source: Reference 67, Energy Northwest.
(2) Information Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

The counties of the Region range in population size from 2,000 (Gilliam, Oregon) to 177,000 (Anchorage, Alaska); the mean size is 38,000. In general, counties with a population less than 25,000 are likely to be severely impacted by the population influx from a large construction project such as a generating plant. Moreover, if the project were especially large, counties with up to 50,000 might experience serious disruptions from rapid population growth. This would include all the remaining counties except Anchorage, Coos County in Oregon, and Grays Harbor and Whatcom Counties in Washington.

General population growth can be considered a serious problem when it exceeds a rate of 10%/yr. Even a single project can produce population growth exceeding this rate in rural areas. And more urbanized areas can also exceed that growth rate if they are already experiencing a rapid population increase from other sources. Thus, an energy development project would only aggravate what was already a critical condition for that area. This would definitely be the case in Anchorage, which has recently had an annual population growth rate of over 8%, adding approximately 10,000 people each year. Presumably, therefore, an area might welcome the population inflow generated by a large construction project, provided it had not already lost its capacity to absorb additional people.

Counties that are largely or wholly rural in nature (containing no towns with more than 10,000 people) will generally have a much more difficult time absorbing a sudden influx of growth than will counties containing one or more urban centers. Urbanized areas usually are much better prepared to manage socioeconomic impacts and to provide needed public services and facilities.

The nonwhite population range from 2 to 15% of the total. In contrast, Franklin and Grant Counties in Washington have relatively large nonwhite populations, as does Anchorage.

Information Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

With the exception of Coos County, Oregon, where the median education is only 11.5 yr, these counties show little variance in the educational attainments of their populations. Median figures for counties range only between 12.2 and 12.7 yr, indicating that these counties are relatively homogeneous in this characteristic.

Information Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

DATA QUALITY

FOR

CHAPTER II - PERSPECTIVES AND DATA ON ENVIRONMENTAL CONDITIONS

Outline	Resolution (temporal, spacial) of Data Available and Included	Finer Resolution Available to Laboratory but not Included
A. Socioeconomic		
1. Population		
a. Distribution	Total numbers by state and county	
b. Composition	Total numbers by state and county	
c. Population change components	Total numbers by state and county	
d. Density urbanization	Total numbers by state and county map showing percent urban	
2. Employment		
a. Income structure	Total numbers by state and county	
b. Employment structure	1975 state grouping by SIC code	Historical data available but too voluminous for data book
c. Public assistance	Total numbers by state	County level and SMSA data available but too voluminous for data book

3.	Housing	Data available by state	
4.	Health	Data available by state	Cancer data available by county but too voluminous for data book

POPULATION TRENDS 1970-1990

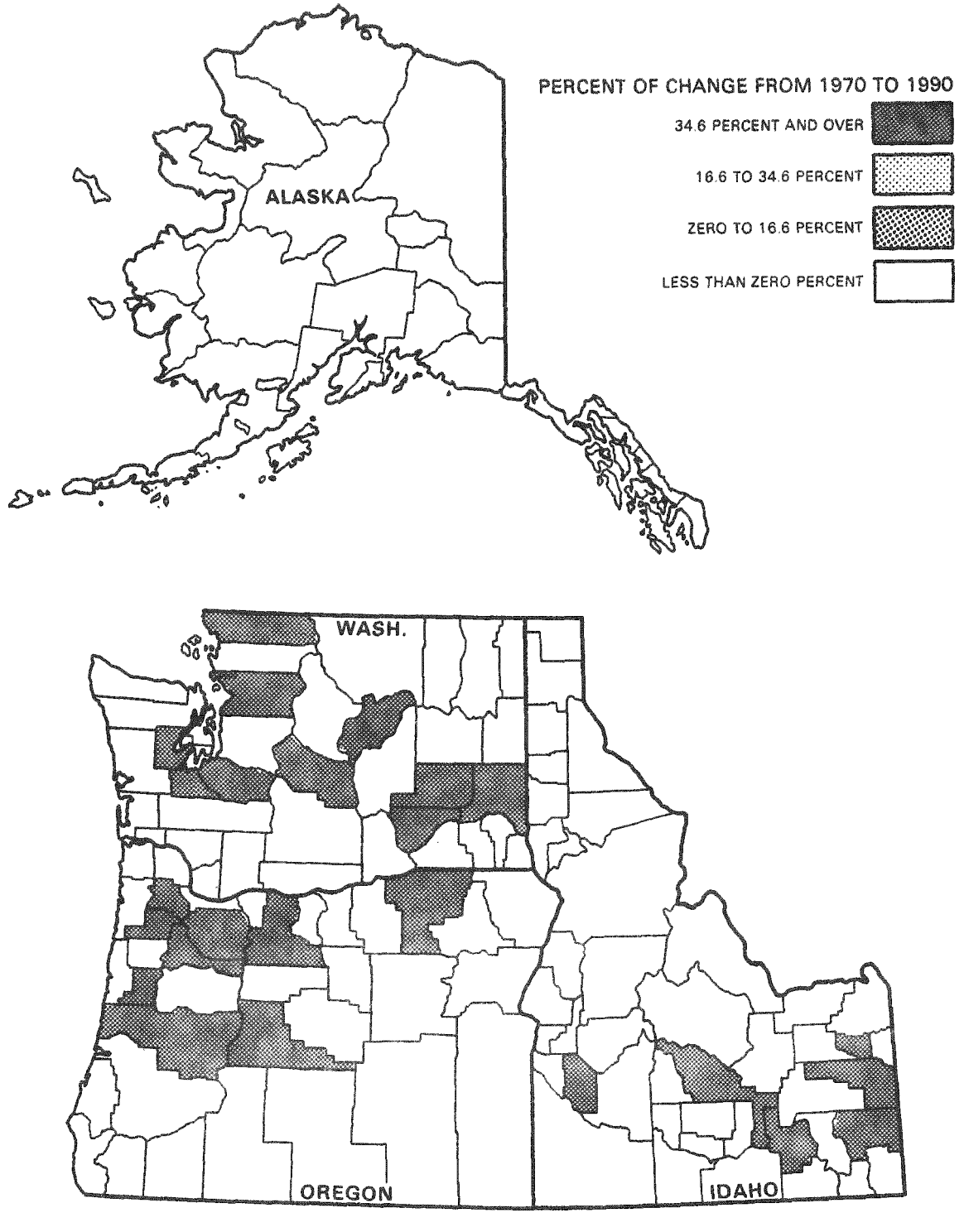

FIGURE II-G-177. Population Trends 1970-1990

Data Source: Ref. 20, BPA Role EIS, p. III-40.

TABLE II-G-88.

Population Distribution by State

Area	Population (in thousands) 1970	1975	Average Annual % Change 1960-1970	1970-1976	U.S. Rank
Alaska	304	365	2.9	3.9	50th
Idaho	718	813	.7	2.5	41st
Oregon	2,101	2,284	1.7	1.7	30th
Washington	3,413	3,559	1.8	.9	22nd
Total U.S.	203,806	213,032	1.3	.9	--

Data Source: Ref. 6, Statistical Abstract, 1977, Table 10, p. 11.

TABLE II-G-89.

Population Distribution by Sex, 1970

State	% Female	% Male
Alaska	45.7	54.3
Idaho	50.1	49.9
Oregon	51.0	49.0
Washington	50.3	49.7

Data Source: Ref. 68, County and City Data Book, 1972, Table 2.

TABLE II-G-90.

POPULATION COMPOSITION BY AGE - 1970

State	Under 5 Years (%)	18 Years and Over (%)	65 Years and Over (%)	Median Age (%)
Alaska	10.7	60.1	2.3	22.7
Idaho	9	62.8	9.5	26.5
Oregon	7.8	66.5	10.9	29.4
Washington	8.2	65.9	9.5	27.8

Data Source: Reference 68, County and City Data, 1972, Table 2.

TABLE II-G-91.

POPULATION COMPOSITION BY RACE

State	Population 1970	
	White	Black
Alaska	237,897	8,860
Idaho	700,514	2,037
Oregon	2,035,536	26,211
Washington	3,258,090	70,859

Data Source: Reference 68, County and City Data Book, 1972, Table 2.

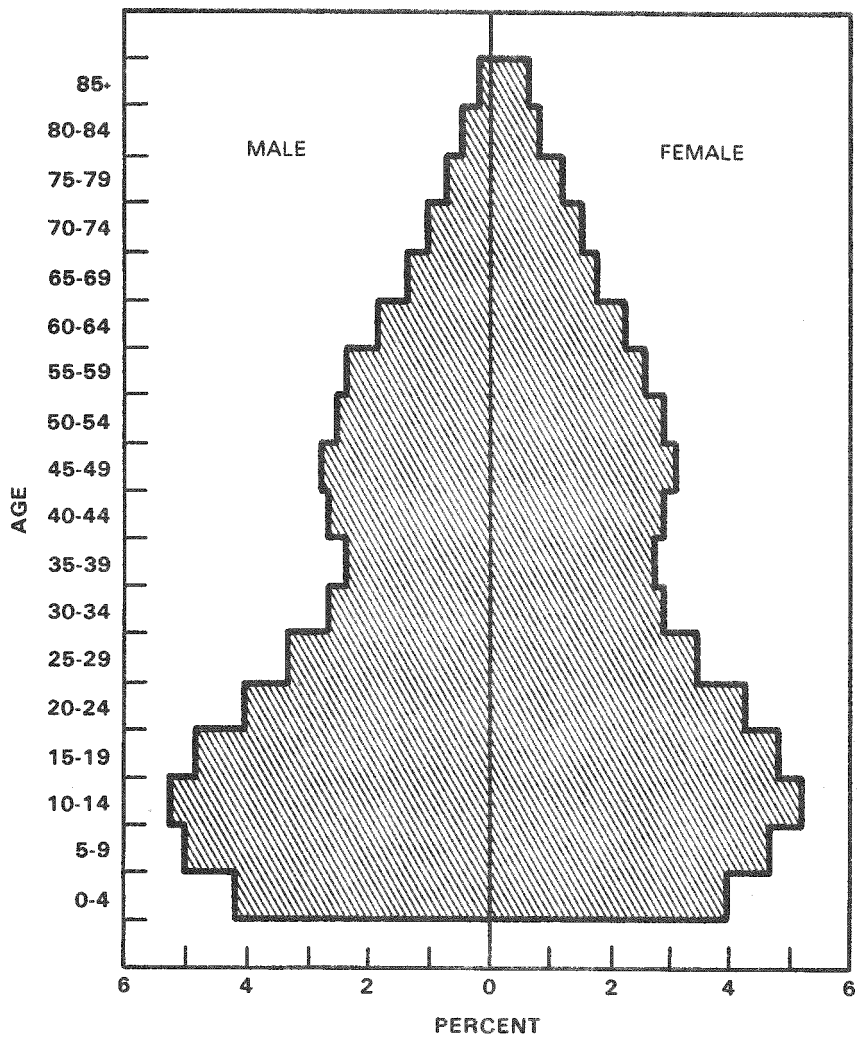

FIGURE II-G-178. 1970 Age Distribution for Pacific Northwest States

Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE II-G-92.

POPULATION BY RACE, 1970 and 1975

Area	1970 (1000s)			1975 (1000s)		
	White	Black	Other	White	Black	Other
Alaska	239	9	54	287	(a)	67
Idaho	700	2	11	799	(a)	(a)
Oregon	2,035	26	30	2,215	31	39
Washington	3,261	71	81	3,379	80	100
Total U.S.	178,158	22,589	2,558	185,141	24,435	3,456

(a) Estimated population less than 25,000.
Data Source: Ref. 6 , Statistical Abstract, 1977, Table 35, p. 31.

TABLE II-G-93.

POPULATION OF RACES OTHER THAN WHITE OR BLACK, 1970

Area	Indian	Japanese	Chinese	Filipino	All Other[a]
Alaska	16,276	916	228	1,498	35,786
Idaho	6,687	2,255	498	206	1,989
Oregon	13,510	6,843	4,814	1,633	6,198
Washington	33,386	20,335	9,201	11,462	12,422
Total U.S.	792,730	591,290	435,062	343,060	720,520

(a) Aleuts, Asian Indians, Eskimos, Hawaiians, Indonesians, Koreans, Polynesians, and other races not shown separately.
Data Source: Ref. 6 , Statistical Abstract, 1977, Table 38, p. 33.

TABLE II-G-93.

Population: Natural Increase and Net Racial Migration By Area, 1960-1970

Area	White			Black		
	Natural Increase (In thousands)	Net Migration Number (In thousands)	%	Natural Increase (In thousands)	Net Migration Number (In thousands)	%
Alaska	40	22	12.6	3	<500	B[a]
Idaho	85	-44	-6.6	1	<500	B[a]
Oregon	155	145	8.4	4	4	20.9
Washington	280	220	8.0	13	10	20.0
Total U.S.	16,496	2,284	1.4	3,886	-85	-.5

(a) B - Not shown; base less than 10,000

Data Source: Ref. 6 , Statistical Abstract, 1977, Table 27, p. 26.

TABLE II-G-94.

Components of Regional Population Change

State	1960-1970 Totals, (In thousands) Net Increase	Births	Deaths	Net Total Migration	1970-1976 Totals, (In thousands) Net Increase	Births	Deaths	Net Total Migration
Alaska	76	73	13	16	79	45	9	44
Idaho	46	146	58	-42	118	94	40	64
Oregon	323	346	182	159	237	205	127	159
Washington	556	591	284	249	199	323	189	64

Data Source: Ref.6 , Statistical Abstract, 1977, Table 12, p. 14.

TABLE II-G-95.

Live Births by Area: Total and Rate, 1970 and 1975

Area	Number (In thousands) 1970	1975	Rate Per 1,000 Population 1970	1975
Alaska	8	7	25.1	21.2
Idaho	14	16	20.3	19.8
Oregon	35	33	16.8	14.6
Washington	61	51	17.8	14.3
Total U.S.	3,731	3,144	18.4	14.8

Data Source: Ref. 6 , Statistical Abstract, 1977, p. 57.

TABLE II-G-96.

Deaths: Total and Rate, 1970 and 1975

Area	Deaths (In thousands) 1970	1975	Rate Per 1,000 Population[a] 1970	1975
Alaska	1	2	4.8	4.3
Idaho	6	7	8.6	7.9
Oregon	20	20	9.3	8.8
Washington	30	30	8.8	8.4
Total U.S.	1,921	1,893	9.5	8.9

(a) Based on a 50% sample of deaths.

Data Source: Ref. 6 , Statistical Abstract, 1977, Table 101, p. 69.

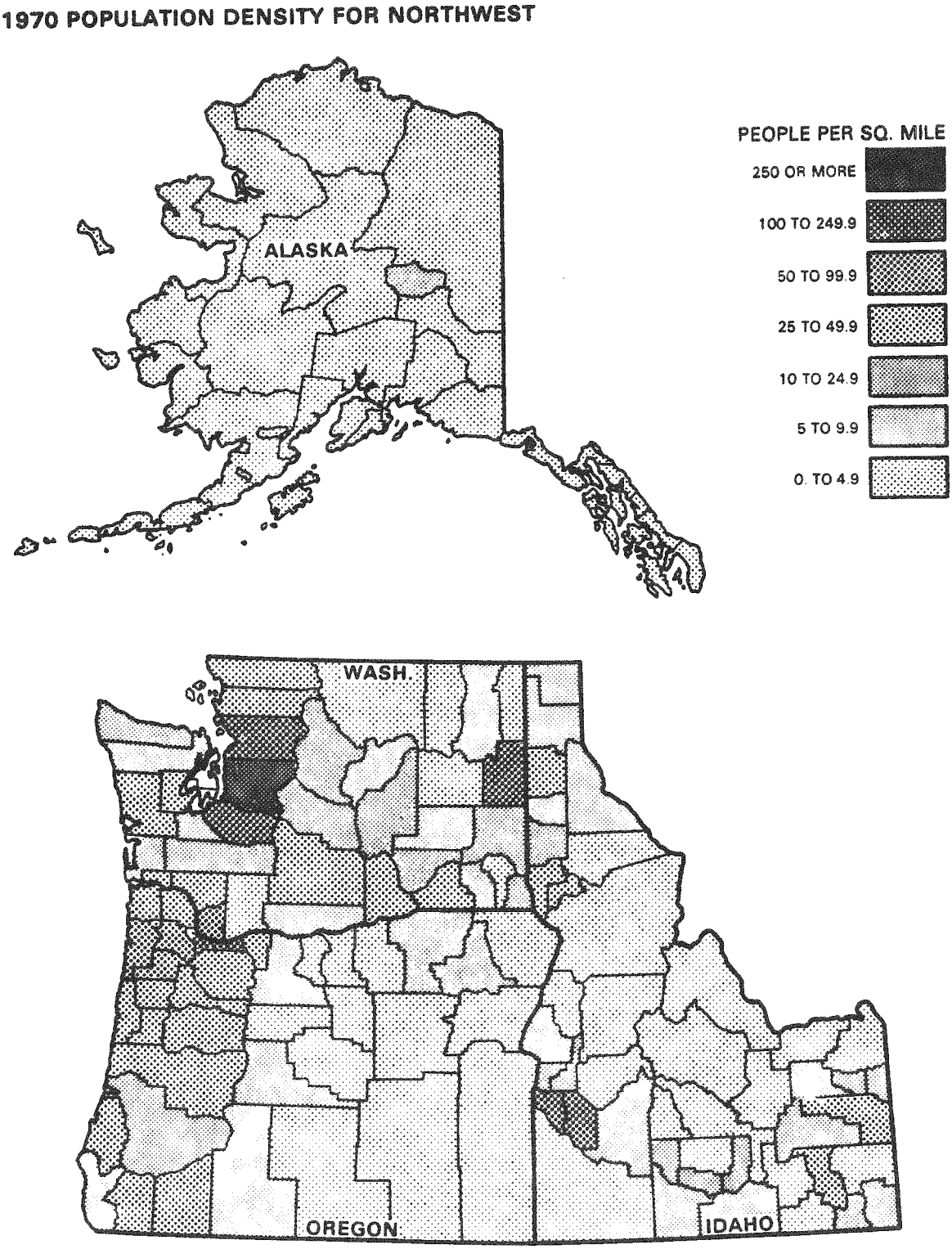

FIGURE II-G-179. 1970 Population Density for the Northwest

Data Source: Ref. 67, Energy Northwest.

TABLE II-G-97.

Population Change and Density by State

State	1960-1970 % Change	1970-1975 % Change	Population Per Square Mile of Land Area 1970	1976
Alaska	32.8	20.8	.5	.7
Idaho	6.8	14.9	8.6	10.1
Oregon	18.2	9.5	21.7	24.2
Washington	19.5	4.5	51.2	54.3

Data Source: Ref.6 , Statistical Abstract, 1977, Table 10, p. 11 and Ref. 72, 1975 Population Census.

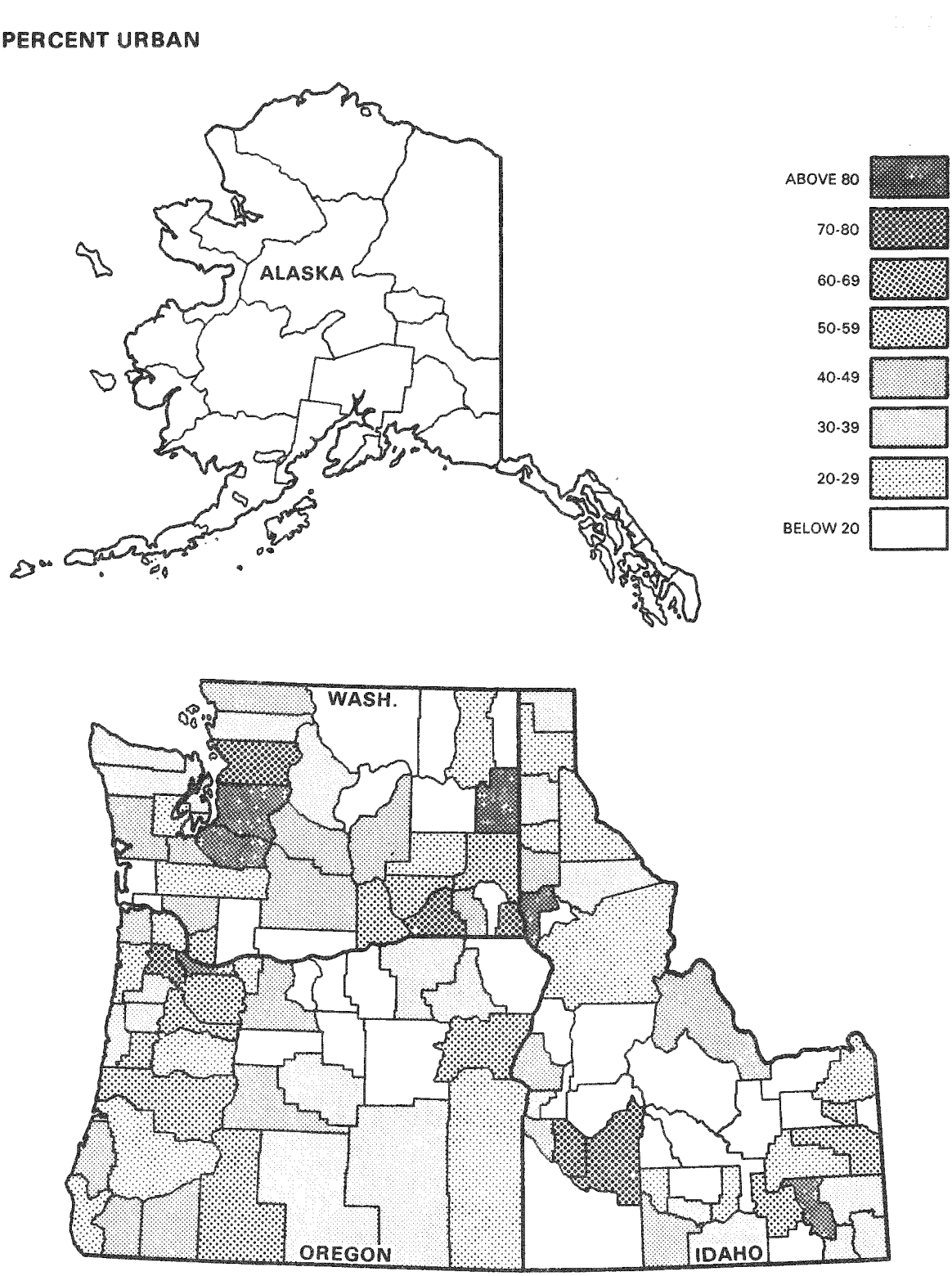

FIGURE II-G-180. Percent Urban Population

Data Source: Ref. 26, Engeretics, p. 87.

TABLE II-G-98.

Metropolitan and Nonmetropolitan Area Population

State	Metropolitan				Nonmetropolitan			
	1970		1975		1970		1975	
	Total (In thousands)	% of State	Total (In thousands)	% Change, 1970-1975	Total (In thousands)	% of State	Total (In thousands)	% Change, 1970-1975
Alaska	126	41.7	161	27.4	176	58.2	203	15.5
Idaho	112	15.7	135	20.0	601	84.3	679	13.0
Oregon	1,281	61.2	1,372	7.1	811	38.8	912	12.5
Washington	2,491	73.0	2,544	2.1	922	27.0	1,009	9.5

Data Source: Ref.6 , Statistical Abstract, 1977, Table 17, p. 17.

TABLE II-G-99

DEMOGRAPHIC INDICATORS FOR ENERGY SITING AREAS, CIRCA 1975

CURRENT COUNTY CHARACTERISTICS: DEMOGRAPHIC INDICATORS[a]

State/County	Population Size	Annual Population Change[a] Amount	%	% Urbanization[b]	Sex Ratio[c]	% Nonwhite[d]	Median Age	% Families with Children[e]	Median Education[f]
Alaska									
Anchorage	177,800	10,300	8.2	48	110	11	19	65	12.4
Idaho									
Bingham	32,300	620	2.1	0	100	8	23	62	12.4
Elmore	19,800	460	2.6	0	117	8	24	62	12.3
Oregon									
Clatsop	29,100	140	0.5	37	96	6	33	46	12.4
Coos	59,000	500	0.9	23	95	2	29	51	11.5
Gilliam	2,000	-70	-2.6	0	97	2	31	50	12.7
Malheur	24,000	240	1.0	0	96	5	28	54	12.2
Morrow	5,200	150	3.2	0	96	7	33	47	12.4
Washington									
Cowlitz	71,000	540	0.8	56	97	3	28	51	12.3
Douglas	19,000	260	1.6	0	97	2	30	53	12.5
Franklin	27,500	140	0.5	53	95	15	26	58	12.6
Grant	43,900	680	1.6	23	98	14	24	56	12.3
Grays Harbor	60,500	220	0.4	49	98	5	24	52	12.2
Lincoln	9,500	20	0.2	0	96	2	37	44	12.2
Whatcom	90,000	1,720	2.1	47	95	5	27	52	12.5

(a) Between 1970-1975
(b) In cities ± 10,000
(c) Males per 100 females
(d) Including Spanish surname people
(e) Under age 18 present in the home
(f) Persons age 25+

Data Source: Reference 1 , The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

TABLE II-G-100.

State Population Characteristics by County

Place Name	Area (mi^2)	Population	Change in Population 1970-1960	Percent of Change in Population 1960-1970	Population Density
Alaska					
Aleutian I	14,583	8,057	2,739	34.0	1
Anchorage	927	124,542	0	-0.0	134
Angoon	2,825	463	0	-0.0	0
Barrow	57,587	2,703	670	24.8	0
Bethel	19,642	7,579	3054	40.3	0
Bristol Ba	531	1,045	0	-0.0	2
Bristol Ba	36,565	3,587	0	-0.0	0
Cordova-Mc	15,481	1,774	99	5.6	0
Fairbanks	17,074	45,947	0	-0.0	7
Haines	2,128	3,095	0	-0.0	2
Juneau	1,286	13,520	0	-0.0	11
Kenai-Cook	12,474	14,250	190,521	133.7	1
Ketchikan	1,345	10,041	0	-0.0	8
Kodiak	5,375	9,409	0	-0.0	2
Kobuk	42,978	4,434	1,091	24.6	0
Kuskowim	56,562	2,263	5	0.2	0
Matanuska-	25,730	6,552	0	-0.0	0
Nome	24,968	5,749	-321	-5.6	0
Outer-Ketc	3,762	1,755	0	-0.0	1
Prince Od	3,485	2,027	381	18.8	1
Seward	3,727	2,021	-423	-21.0	1
Sitka	2,296	6,424	0	-0.0	3
Skagway-Ya	8,646	2,021	0	-0.0	0
Southeast	17,713	4,315	0	-0.0	0
Upper Yuko	84,142	1,666	67	4.0	0
Valdez-Chi	18,619	3,116	277	8.9	0
Wade Hampt	16,770	3,917	987	25.2	0
Wrangell-P	6,178	4,913	0	-0.0	1
Yukon-Koyu	73,053	4,752	0	-0.0	0
Total	566,452	301,937	27,677	10.1	0
Idaho					
Ada	1,043	112,230	22,558	20.1	108
Adams	1,371	2,877	-97	-3.4	2
Bannock	1,122	52,200	3,028	5.8	47
Bear Lake	984	5,801	-1,090	-18.8	6
Benewah	788	6,230	199	3.2	8
Bingham	2,084	29,167	992	3.4	14
Blaine	2,647	5,749	1,437	25.0	2
Boise	1,910	1,779	126	7.1	1

TABLE II-G-100. (contd)

Place Name	Area (mi^2)	Population	Change in Population 1970-1960	Percent of Change in Population 1960-1970	Population Density
Bonner	1,733	15,544	-30	-0.2	9
Bonneville	1,836	51,250	6,048	11.8	28
Boundary	1,275	6,371	-356	-5.6	5
Butte	2,239	2,925	-479	-16.4	1
Camas	1,054	740	-151	-20.6	1
Canyon	578	61,276	3,860	6.3	106
Caribou	1,746	6,534	608	9.3	4
Cassia	2,544	17,017	953	5.6	7
Clark	1,751	699	-132	-19.0	0
Clearwater	2,521	10,913	2,968	27.2	4
Custer	4,929	2,967	-29	-1.0	1
Elmore	3,048	17,479	787	4.5	6
Franklin	664	7,373	-943	-12.8	11
Fremont	1,864	8,710	35	0.4	5
Gem	555	9,387	263	2.8	17
Gooding	720	8,645	-812	-9.4	12
Idaho	8,516	12,891	-618	-4.8	2
Jefferson	1,096	11,619	70	0.6	11
Jerome	595	10,253	-1281	-12.5	17
Kootenai	1,249	35,332	6,890	19.5	28
Latah	1,090	24,891	4,381	17.6	23
Lemhi	4,580	5,566	-238	-4.3	1
Lewis	476	3,867	-486	-12.6	8
Lincoln	1,203	3,057	-522	-17.1	3
Madison	473	13,452	5,758	42.8	28
Minidoka	750	15,731	1,463	9.3	21
Nez Perce	844	30,376	3,706	12.2	36
Oneida	1,191	2,864	-986	-20.5	2
Owyhee	7,641	6,422	45	0.7	1
Payette	402	12,401	37	0.3	31
Power	1,413	4,864	890	18.3	3
Shoshone	2,609	19,718	-104	-5.5	8
Teton	457	2,284	-248	-10.9	5
Twin Falls	1,947	41,874	-41	-0.1	22
Valley	3,676	3,609	-53	-1.5	1
Washington	1,462	7,633	-678	-8.9	5
Total	82,676	712,567	57,128	8.7	8
Oregon					
Baker	3,048	14,919	-2043	-13.7	5
Benton	668	53,776	20,058	37.3	81
Clackamas	1,884	166,088	77,89[illegible]	46.9	88

TABLE II-G-100. (contd)

Place Name	Area (mi^2)	Population	Change in Population 1970-1960	Percent of Change in Population 1960-1970	Population Density
Clatsop	805	28,473	1,139	4.0	35
Columbia	639	38,790	3,234	28.6	45
Coos	1,604	56,515	1,582	2.8	35
Crook	2,975	9,985	589	5.9	3
Curry	1,627	13,006	-909	-7.0	8
Deschutes	3,031	30,442	9,681	31.8	10
Douglas	5,063	71,743	3,444	4.8	14
Gilliam	1,208	2,262	-835	-23.7	2
Grant	4,530	7,076	-664	-9.4	2
Harney	16,166	7,215	505	7.0	1
Hood River	523	13,187	-210	-1.6	25
Jackson	2,812	94,533	26,230	27.8	34
Jefferson	1,793	8,548	1701	19.9	5
Josephine	1,625	35,746	6,971	19.5	22
Klamath	3,970	50,021	2,701	5.4	8
Lake	8,231	6,343	-722	-11.4	1
Lane	4,552	213,358	68,701	32.2	47
Lincoln	986	25,755	1,159	4.5	26
Linn	2,283	71,914	15,965	22.2	32
Malheur	9,859	23,169	417	1.8	2
Marion	1,166	151,309	38,130	25.2	130
Morrow	2,060	4,465	-370	-8.3	2
Multnomah	423	556,667	33,957	6.1	1316
Polk	736	35,349	11,771	33.3	48
Sherman	830	2,147	-270	-12.6	3
Tillamook	1,115	17,922	-877	-4.9	16
Umatilla	3,227	44,923	584	1.3	14
Union	2,032	19,377	1279	6.6	10
Wallowa	3,178	6,247	-749	-12.0	2
Wasco	2,381	20,133	-80	-0.4	9
Washington	716	157,920	112,439	71.2	221
Wheeler	1,707	1,819	583	-32.1	1
Yamhill	711	40,243	9,572	23.8	57
Total	96,184	2,091,385	446,737	27.2	21
Washington					
Adams	1,894	12,014	2,523	21.0	6
Asotin	633	13,799	952	6.9	22
Benton	1,722	67,540	5,944	8.8	39
Chelan	2,918	41,355	372	0.9	14
Clallam	1,753	34,770	5,494	15.8	20
Clark	627	128,454	47,400	36.9	205
Columbia	853	4,439	-123	-2.8	5

TABLE II-G-100. (contd)

Place Name	Area (mi^2)	Population	Change in Population 1970-1960	Percent of Change in Population 1960-1970	Population Density
Cowlitz	1,144	68,616	12,831	18.7	60
Douglas	1,831	16,787	2,132	12.7	9
Ferry	2,202	3,655	-218	-6.0	2
Franklin	1,250	25,816	2,737	10.6	21
Garfield	709	2,911	-65	-2.2	4
Grant	2,675	41,881	-4,145	-9.9	16
Grays Harbor	1,910	59,553	5,538	9.3	31
Island	212	27,011	10,129	37.5	127
Jefferson	1,605	10,661	1,130	10.6	6
King	2,128	1,156,633	277,592	24.0	544
Kitsap	393	101,732	21,262	20.9	259
Kittitas	2,317	25,039	5,584	22.3	11
Klickitat	1,908	12,138	-1,189	-9.8	6
Lewis	2,423	45,467	3,910	8.6	19
Lincoln	2,306	9,572	-1,176	-12.3	4
Mason	962	20,918	6,004	28.7	22
Okanogan	5,301	25,867	362	1.4	5
Pacific	908	1,772	135	7.6	2
Pend Oreille	1,402	6,025	-776	-12.9	4
Pierce	1,675	411,027	114,266	27.8	245
San Juan	179	3856	1,328	34.3	22
Skagit	1,735	52,381	1,048	2.0	30
Skamania	1,672	5,845	719	12.3	4
Snohomish	2,098	265,236	143,227	54.0	126
Spokane	1,758	287,487	9,487	3.3	164
Stevens	2,481	17,405	-469	-2.7	7
Thurston	714	76,894	30,527	39.7	108
Wahkiakum	261	3,592	172	4.8	14
Walla Walla	1,262	42,176	0	-0.0	33
Whatcom	2,126	81,950	13,522	16.5	39
Whitman	2,153	37,900	8,035	21.2	18
Yakima	4,268	144,971	-144	-0.1	34
Total	94,572	3,395,145	726,041	27.2	50

Data Source: Ref. 26, The Energetics of the U.S.A., 1977.

TABLE II-G-101.

Transfer Payments, Total Personal Income, Population and Per Capita Income, by State, 1970 and 1975

State	Transfer Payments (in $ Million)								Total Personal Income ($ Million)		Per Capita Income ($ Million)	
	Total		Public Assistance		Unemployment Compensation		Retirement and Others					
	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975
Alaska	79	262	23	111	14	38	42	113	1,412	3,355	4,644	9,535
Idaho	239	526	17	41	11	38	210	447	2,362	4,248	3,290	5,177
Oregon	856	1,908	76	193	57	201	723	1,512	7,814	13,163	3,719	5,752
Washington	1,506	3,120	177	333	193	341	1,136	2,446	13,834	22,292	4,053	6,284

Data Source: Ref. 69, Transfer Payments: Regional Patterns, 1965-1975.

TABLE II-G-102.

Ratio of Transfer Payments to Total Personal Income and Percent Changes in Total Personal Income, Population, and Per Capita Income, and State, 1970 and 1975

(Index, U.S. = 100)

State	Ratio of Transfer Payments to Total Personal Income								Percent Change		
	Total		Public Assistance		Unemployment Compensation		Retirement and Other		Total Personal Income	Population 1965-1975	Per Capita Income
	1970	1975	1970	1975	1970	1975	1970	1975			
Alaska	57	50	134	194	194	79	37	31	218	294	180
Idaho	103	90	59	56	94	63	111	98	115	194	100
Oregon	112	105	79	86	143	108	115	108	110	179	98
Washington	111	101	105	87	273	108	102	103	115	193	100

Data Source: Ref. 69 , Transfer Payments: Regional Patterns, 1965-1975, p. .

TABLE II-G-103.

Family Annual Income Structure

State	Less Than $3000 (%)	$3000-$4999 (%)	$5000-$6999 (%)	$10,000-$14,999 (%)	$15,000-$24,999 (%)	$25,000 or More (%)
Alaska	18.5	14.4	15.1	20.0	8.9	2.3
Idaho	11.2	11.8	15.3	24.3	10.3	2.8
Oregon	9.2	9.9	11.8	28.2	14.2	3.8
Washington	8.0	8.5	10.0	30.1	18.3	4.5

Data Source: Ref.68 , County and City Data Book, Table 2.

TABLE II-G-104.

Percentage of Total Population and Family Units Living Below the Poverty Level

Area	Persons		Families	
	1969 (%)	1975 (%)	1969 (%)	1975 (%)
Alaska	12.6	6.7	9.3	5.2
Idaho	13.2	10.3	10.9	8.2
Oregon	11.5	8.9	8.6	6.7
Washington	10.2	8.5	7.6	6.6
Total U.S.	13.7	11.4	10.7	9.0

Data Source: Ref. 6, Statistical Abstract, 1977, Table 741.

TABLE II-G-105

Median Income of White and Black Families
By State, 1969

State	White (In dollars)	Black (In dollars)	Total (median) (In dollars)
Alaska	13,461	8,632	12,441
Idaho	8,404	6,133	8,380
Oregon	9,528	6,818	9,487
Washington	10,464	8,188	10,404

Data Source: Ref. 68, County and City Data Book, Table 2.

TABLE II-G-106

FARM INCOME: CASH RECEIPTS FROM FARMING AND VALUE OF HOME CONSUMPTION, BY AREA, 1974 (PRELIMINARY)

Area	Cash Receipts from Farming					Value of Home Consumption[a]			Cash Receipts from Farming and Value of Home Consumption
	Farm Marketings			Government Payments	Total	Livestock and Products	Crops	Total	
	Livestock and Products	Crops	Total						
	1,000 Dollars			1,000 Dollars		1,000 Dollars			1,000 Dollars
Alaska	3,642	2,324	5,966	59	6,025	260	65	325	6,350
Idaho	411,339	1,042,266	1,453,605	11,151	1,464,756	9,238	7,296	16,534	1,481,290
Oregon	328,081	774,947	1,103,028	4,137	1,107,165	11,825	3,726	15,551	1,122,716
Washington	457,852	1,525,506	1,983,358	9,829	1,993,187	18,392	4,698	23,090	2,016,277
Total U.S.	41,423,639	52,097,482	93,521,121	530,448	94,051,569	910,084	388,823	1,298,907	95,350.476

(a) Value of farm products consumed directly in farm households where produced.

Data Source: Ref. 54, Agricultural Statistics, 1975.

TABLE II-G-107

LABOR FORCE PARTICIPATION, 1970

State	Total	Civilian Labor Force (16 years old and over)			
		Total	Male	Female	Unemployed (%)
Alaska	129,721	98,296	60,293	38,003	9.2
Idaho	276,788	271,593	176,741	94,852	5.2
Oregon	841,196	837,069	526,256	310,813	7.0
Washington	1,398,998	1,338,513	845,810	492,703	7.9

Data Source: Reference 68, County and City Data Book, Table 2.

TABLE II-G-108

LABOR FORCE BY OCCUPATION, 1970

State	Total	Industry (Percent)						Percent of White Collar Workers		Percent of Craftsmen and Foremen
		Manufacturing	Wholesale and Trade	Services	Educational Services	Construction	Government	Professional, Managerial	Sales and Clerical	
Alaska	89,236	7.1	18.8	7.51	10.6	9.4	36.5	31.0	24.3	15.1
Idaho	257,451	14.7	22.7	8.2	8.7	6.5	17.2	23.3	19.8	12.7
Oregon	778,745	21.4	22.1	7.3	9.6	5.8	17.2	24.2	24.1	13.2
Washington	1,233,063	21.6	21.5	7.4	9.1	6.1	19.0	25.9	24.89	14.6

Data Source: Ref. 68, County and Ciy Data Book, 1972, Table 2.

TABLE II-G-109

NET MIGRATION OF THE WORK FORCE AND THE RELATIVE TREND IN EMPLOYMENT AND MEAN EARNINGS, 1970-1976

State	Net Migration Thousands of Workers		Relative Trend			
			Employment		Mean Earnings	
	1970-73	1973-76	1970-73	1970-73	1970-73	1970-73
Alaska	1.6	14.2	96.5	139.5	89.0	136.3
Idaho	6.0	6.5	112.2	107.8	99.5	103.9
Oregon	21.0	8.9	108.4	105.4	100.7	102.6
Washington	-11.9	18.8	98.3	106.0	97.4	103.1

(a) Index, U.S. percent change = 100.0.

Data Source: Ref. 69, Transfer Payments: Regional Patterns, 1965-1975.

TABLE II-G-110

FARM EMPLOYMENT: NUMBER OF PERSONS EMPLOYED BY AREA, 1972 AND 1974

Area	In Thousands					
	Total Employment(a)		Family Workers(b)		Hired Workers(c)	
	1972	1974	1972	1974	1972	1974
Idaho	45	43	33	30	12	13
Oregon	57	54	38	34	19	20
Washington	75	76	48	43	27	33
Total U.S.	4373.4	4312.8	3227.7	3110.4	1145.7	1202.4

(a) Average number of persons employed during one survey week each month. Survey weeks selected are the lastes calendar week that excludes the last day of the month.
(b) Includes farm operators doing one or more hours of farm work and members of their families working 15 hr or more during the survey week without cash wages.
(c) Includes all persons doing farm work for pay in survey weeks.
Data Source: Ref. 54, Agricultural Statistics, 1975, Table 605.

TABLE II-G-111

NORTHWEST EMPLOYMENT PROJECTIONS BY MAJOR ACTIVITY CATEGORIES, 1974

	Employment 1974 (1000)	% of Total
Manufacturing		
Durable Goods		
Lumber and Wood Products	141.8	5.0
Furniture and Fixtures	7.5	0.3
Stone, Clay, and Glass Products	10.9	0.4
Primary Metals	27.1	1.0
Fabricated Metals	18.9	0.7
Machinery (Except Electrical)	26.9	1.0
Electrical Equipment	21.1	0.8
Transportation Equipment	84.2	3.0
Nondurable Goods		
Food and Kindred Products	72.5	2.6
Textile, Apparel and Allied Products	12.9	0.5
Paper and Allied Products	28.8	1.0
Printing and Publishing	21.6	0.8
Chemicals and Allied Products	7.8	0.3
Other Nondurable Goods	11.1	0.4
Other Manufacturing	14.5	0.5
Nonmanufacturing		
Mining	10.5	0.4
Contract Construction	121.2	4.3
Transportation Communications and Utilities	155.6	5.5
Trade	553.1	19.7
Finance, Insurance and Real Estate	125.0	4.4
Services	410.6	14.6
Government	538.8	19.2
Agriculture and Self-employed	379.6	13.5
Total Employment	2803.0	100.0

Data Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, Chap. 2-(G) Socioec.

TABLE II-G-112

RECENT EMPLOYMENT TRENDS BY INDUSTRY
IN IDAHO, OREGON, AND WASHINGTON

Industry	1968 (1,000's)	1972 (1,000's)	1968-1972 Average Annual Rate of Growth, Percent
Agriculture	175.2	152.9	-3.3
Mining	8.4	10.5	2.8
Construction	103.9	106.4	0.6
Manufacturing	511.4	464.7	-2.4
Transportation, Communications, and Utilities	139.4	140.9	0.3
Wholesale and Retail Trade	446.8	500.0	2.3
Finance, Insurance and Real Estate	97.7	111.9	3.5
Services	498.9	646.8	1.9
Government	426.6	486.5	3.3
Total Employment	2,508.3	2,620.6	1.1

Data Source: Reference 5, Water Today and Tomorrow (Table 3-11).

TABLE II-G-113

COMMUNITY STRUCTURE INDICATORS FOR ENERGY SITING AREAS, CIRCA 1975

State/County	Percent High-Status Occupations[a]	Percent Housing Vacant[b]	Local Government Employees[c]	Percent Families Poor[d]
Alaska				
Anchorage	27	7	24	5
Idaho				
Bingham	22	8	27	12
Elmore	14	9	23	12
Oregon				
Clatsop	25	14	31	10
Coos	18	4	29	9
Gilliam	27	36	55	9
Malheur	23	7	35	16
Morrow	13	13	42	13
Washington				
Cowlitz	19	4	29	8
Douglas	21	6	24	10
Franklin	22	5	35	9
Grant	24	20	38	14
Grays Harbor	18	9	28	10
Lincoln	20	24	59	8
Whatcom	23	8	21	10

(a) Labor force in professional, technical, executive and managerial jobs
(b) Dwelling units currently unoccupied
(c) All local governments, per 1000 population
(d) Below the official poverty line

Data Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

TABLE II-G-114

STATISTICS FOR THE STATE, BY INDUSTRY GROUP AND INDUSTRY - 1975

Sic Code	State and Industry Group	Number of Employed (in 1000s)	Number of Production Workers (in 1000s)	Value Added by Manufacturer ($ Million)	Capital Expenditure ($ Million)
	Alaska	8.0	6.3	449.2	121.6
20	Food and kindred products	3.1	2.5	91.5	17.1
209	Miscellaneous foods, kindred products	2.7	2.5	64.8	16.1
24	Lumber and wood products	1.8	1.7	101.3	10.8
25	Furniture and fixtures	0.2	0.2	2.7	0.2
27	Printing and publishing	0.7	0.4	17.6	3.0
32	Stone, clay, glass products	0.5	0.5	16.8	9.4
35	Machinery, except electric	0.1	0.1	2.6	--
37	Transportion equipment	0.1	0.1	1.5	--
39	Miscellaneous manufacturing industries	0.1	0.1	2.3	0.2
	Idaho	47.3	36.4	1294.9	143.0
20	Food and kindred products	15.0	12.3	351.9	26.7
23	Apparel, other textile products	0.3	0.3	4.8	(D)
24	Lumber and wood products	12.7	11.3	268.3	32.9
242	Sawmills and planing mills	6.7	6.2	124.8	15.7
2421	Sawmills, planing mills, general	6.6	6.1	123.0	(D)
25	Furniture and fixtures	0.1	0.1	1.5	--
27	Printing and publishing	2.2	1.7	20.7	1.8
28	Chemicals, allied products	4.8	2.2	329.5	30.1
30	Rubber, miscellaneous plastics products	1.5	1.5	36.1	(D)
31	Leather, leather products	0.1	0.1	1.1	--
32	Stone, clay, glass products	1.0	0.7	69.5	4.1
34	Fabricated metal products	1.2	0.9	27.1	1.5
35	Machinery, except electric	2.3	2.0	47.2	22.1
	Administrative and auxiliary	1.7	--	--	--
	Oregon	181.0	137.8	4425.9	452.4
20	Food and kindred products	22.6	17.7	562.0	33.2
203	Preserved fruits and vegetables	10.2	9.2	178.4	20.6
2033	Canned fruits and vegetables	3.3	3.0	50.5	(D)
2037	Frozen fruits and vegetables	5.4	4.8	101.3	13.1
209	Miscellaneous foods, kindred products	2.7	2.3	34.7	2.0
24	Lumber and wood products	63.8	56.9	1513.3	212.8
2411	Logging camps, log contractors	10.0	9.1	409.6	79.6
242	Sawmills and planing mills	23.0	20.3	456.0	67.7
2421	sawmills, planing mills, general	22.7	20.1	453.0	67.2
243	Millwork, plywood, structural members	24.8	22.4	529.0	42.2
2431	Millwork	4.0	3.6	79.1	4.4
2436	Softwood veneer and plywood	18.1	16.5	402.9	34.1
249	Miscellaneous wood products	3.5	3.0	79.0	22.7
25	Furniture and fixtures	2.6	2.1	44.5	2.8
26	Paper and allied products	8.8	6.9	446.5	54.5

TABLE II-G-114 (contd)

Sic Code	State and Industry Group	Number of Employed (in 1000s)	Number of Production Workers (in 1000s)	Value Added by Manufacturer ($ Million)	Capital Expenditure ($ Million)
2621	Papermills, excluding building paper	3.7	2.9	209.5	39.1
27	Printing and publishing	7.9	5.2	177.9	13.7
2711	Newspapers	4.3	2.3	87.9	7.9
28	Chemicals, allied products	2.1	1.3	108.8	15.7
30	Rubber, miscellaneous plastics products	1.5	1.2	23.4	0.7
32	Stone, clay, glass products	4.0	3.3	103.2	7.5
327	Concrete, gypsum, plaster products	2.9	2.4	58.8	6.2
34	Fabricated metal products	9.3	6.9	240.7	11.0
342	Cutlery, handtools and hardware	2.7	2.0	56.7	5.0
344	Fabricated structural metal products	3.2	2.3	85.5	2.2
35	Machinery, except electric	11.4	7.4	257.5	16.8
353	Construction, related machinery	4.2	2.5	95.2	8.1
36	Electric, electronic equipment	3.4	2.4	82.0	4.6
38	Instruments, related products	11.5	6.7	266.2	14.1
39	Miscellaneous manufacturing industries	2.1	1.5	33.6	1.8
	Administrative and auxiliary	6.3	--	--	--
	Washington	242.3	163.2	7278.9	812.9
20	Food and kindred products	27.4	21.6	831.3	50.5
203	Preserved fruits and vegetables	10.2	9.2	296.0	17.7
2037	Frozen fruits and vegetables	6.1	5.5	169.7	8.2
208	Beverages	4.4	2.9	157.9	7.1
209	Miscellaneous foods, kindred products	3.2	2.7	88.7	3.5
22	Textile mill products	0.8	0.7	12.7	0.8
23	Apparel, other textile products	4.8	4.0	58.6	1.6
232	Men's and boys' furnishings	3.0	2.6	38.5	0.4
24	Lumber and wood products	44.9	41.4	1000.4	245.0
243	Millwork, plywood, structural members	8.9	8.4	195.9	10.7
25	Furniture and fixtures	1.6	1.3	47.7	1.3
26	Paper and allied products	15.6	12.3	623.8	242.5
2621	Papermills, excluding building paper	5.1	4.1	168.2	48.7
2631	Paperboard mills	3.0	2.4	147.5	100.7
264	Miscellaneous converted paper products	2.7	2.2	110.5	3.8
27	Printing and publishing	10.8	5.5	210.0	8.4
2711	Newspapers	6.4	2.3	132.2	5.1
275	Commercial printing	2.6	1.8	45.7	2.2
28	Chemicals, allied products	6.1	3.0	284.3	40.5
281	Industrial inorganic chemicals	3.7	1.8	181.2	31.9
29	Petroleum and coal products	1.9	1.2	133.8	17.7
30	Rubber, miscellaneous plastics products	1.8	1.3	52.2	2.5

TABLE II-G-114 (contd)

Sic Code	State and Industry Group	Number of Employed (in 1000s)	Number of Production Workers (in 1000s)	Value Added by Manufacturer ($ Million)	Capital Expenditure ($ Million)
31	Leather, leather products	0.3	0.3	4.4	--
32	Stone, clay, glass products	7.6	6.2	220.6	22.8
327	Concrete, gypsum, plaster products	4.7	3.8	115.0	12.5
33	Primary metal industries	13.7	10.9	706.6	100.1
333	Primary nonferrous metals	6.2	5.1	405.1	21.4
34	Fabricated metal products	10.7	8.8	339.4	13.2
35	Machinery, except electric	11.1	7.4	243.6	12.9
359	Miscellaneous machinery, except electric	3.1	2.5	69.2	4.2
36	Electric, Electronic Equipment	3.9	2.0	79.4	1.9
37	Transportation equipment	61.3	30.5	2303.1	43.0
3732	Boat building and repairing	2.5	1.9	42.6	2.8
38	Instruments, related products	1.3	0.8	33.1	1.9
39	Miscellaneous manufacturing industries	5.4	4.0	94.1	6.2
	Administrative and auxiliary	11.4	--	--	--

Data Source: Ref. 71, Annual Survey of Manufactures, 1975, Table 3.

TABLE II-G-115

STATE ECONOMIC CHARACTERISTICS BY COUNTY

Place Name	Personal Income ($ Thousand)	Value Added ($ Thousand)	Retail Sales ($ Thousand)	Mineral Sales ($ Thousand)	Agricultural Sales ($ Thousand)
Alaska					
Aleutian I	26,725	12,800	1,072	67,300	211
Anchorage	522,080	15,700	207,586	0	2,766
Angoon	238	1,700	0	0	0
Barrow	4,968	0	1,574	0	0
Bethel	10,125	0	2,875	0	0
Bristol Bay	3,804	5,200	774	0	0
Bristol Bay	5,871	1,500	1,196	0	0
Cordova-Mc	7,223	3,400	3,351	0	0
Fairbanks	182,960	2,400	65,590	0	311
Haines	5,639	0	0	0	0
Juneau	63,341	1,200	26,748	0	0
Kenai-Cook	54,235	6,600	14,298	0	60
Ketchikan	37,352	28,100	18,726	0	0
Kodiak	6,770	0	1,463	0	0
Kobuk	31,576	9,300	11,592	0	0
Kuskowim	3,779	0	557	0	0
Matanuska-	18,961	100	6,752	0	0
Nome	11,452	0	4,358	0	0
Outer-Ketc	4,647	0	0	0	0
Prince Od	8,221	700	1,442	0	0
Seward	7,089	400	3,005	0	0
Sitka	25,047	22,500	8,813	0	0
Skagway-Ya	6,869	4,600	3,933	0	0
Southeast	14,023	0	1,863	0	0
Upper Yukon	6,602	0	580	0	0
Valdez-Chi	12,641	0	3,045	0	0
Wade Hampt	4,187	0	1,357	0	0
Wrangell-P	16,586	13,000	7,108	0	0
Yukon-Koyu	16,009	0	1,983	0	0
Total	1,119,020	129,200	401,641	67,300	3,348
Idaho					
Ada	351,841	39,000	186,032	0	23,267
Adams	7,859	3,200	1,952	0	2,885
Bannock	139,478	13,400	85,066	0	10,016
Bear Lake	13,232	100	10,154	0	5,293
Benewah	17,151	7,900	7,750	0	3,419
Bingham	70,117	13,700	35,225	0	46,322
Blaine	19,253	600	10,101	0	5,758
Boise	4,216	2,300	791	0	831
Bonner	38,082	9,100	20,753	0	2,991

TABLE II-G-115 (contd)

Place Name	Personal Income ($ Thousand)	Value Added ($ Thousand)	Retail Sales ($ Thousand)	Mineral Sales ($ Thousand)	Agricultural Sales ($ Thousand)
Bonneville	149,445	23,200	114,938	0	27,149
Boundary	15,787	3,700	6,739	0	3,152
Butte	7,043	0	3,679	0	5,170
Camas	2,439	0	405	0	2,364
Canyon	152,148	47,800	108,624	0	75,563
Caribou	16,256	0	13,265	12,500	11,489
Cassia	40,126	14,500	34,249	0	35,050
Clark	1,671	0	1,151	0	2,297
Clearwater	32,018	19,600	12,135	0	1,566
Custer	6,847	0	2,695	0	4,117
Elmore	40,324	0	14,468	0	24,576
Franklin	13,846	0	11,122	0	10,896
Fremont	20,503	1,800	11,335	0	13,084
Gem	21,458	0	11,460	0	8,915
Gooding	21,768	0	10,660	0	17,438
Idaho	32,536	12,200	15,523	0	12,371
Jefferson	24,481	4,900	15,111	0	19,670
Jerome	22,207	0	12,655	0	28,664
Kootenai	95,573	16,300	48,306	0	5,577
Latah	65,961	8,300	40,272	0	11,317
Lemhi	13,714	2,300	8,593	0	5,547
Lewis	12,196	2,000	4,347	0	7,340
Lincoln	6,444	0	1,943	0	6,927
Madison	29,473	2,000	18,746	0	14,819
Minidoka	35,457	4,900	22,759	0	46,841
Nez Perce	89,936	67,600	71,687	0	11,213
Oneida	6,423	0	3,948	0	5,435
Owyhee	11,418	0	6,803	0	15,739
Payette	29,055	3,900	13,754	0	20,933
Power	12,573	33,200	7,365	0	19,921
Shoshone	54,993	0	24,712	39,600	143
Teton	4,367	0	2,677	0	4,597
Twin Falls	110,044	24,100	96,114	0	46,845
Valley	10,451	0	4,070	0	2,242
Washington	16,647	300	12,936	0	10,943
Total	1,883,857	381,900	1,147070	52,100	640,692
Oregon					
Baker	38,565	9,000	29,788	0	11,752
Benton	166,114	28,400	64370	0	7,890
Clackamas	565,529	109,900	167,131	0	31,469
Clatsop	89,689	136,100	48,580	0	1,980
Columbia	82,627	32,500	29,455	0	4,165

TABLE II-G-115 (contd)

Place Name	Personal Income ($ Thousand)	Value Added ($ Thousand)	Retail Sales ($ Thousand)	Mineral Sales ($ Thousand)	Agricultural Sales ($ Thousand)
Coos	168,075	79,800	84,837	0	7,292
Crook	27,448	15,300	11,876	0	9,060
Curry	38,224	22,200	17,303	0	2,489
Deschutes	90,869	20,100	53,275	0	6,367
Douglas	198,082	103,500	92,035	11,100	7,649
Gilliam	5,937	0	5,324	0	6,378
Grant	18,397	2,700	10,612	0	6,520
Harney	20,606	0	12,913	0	8,122
Hood River	38,070	13,000	22,891	0	12,699
Jackson	271,876	77,600	152,786	0	17,329
Jefferson	22,378	0	16,611	0	19,267
Josephine	93,368	30,000	55,439	0	3,946
Klamath	145,661	36,100	83,549	0	27,049
Lake	16,669	5,500	13,601	0	8,262
Lane	648,181	208,200	316,281	6,100	20,777
Lincoln	74,612	17,700	39,485	0	1,592
Linn	195,606	111,900	99,389	0	30,662
Malheur	55,072	22,700	42,556	0	42,786
Marion	430,776	89,700	254,054	0	46,313
Morrow	13,712	2,200	6,803	0	9,420
Multnomah	1,953,901	650,800	1,161,226	3,000	12,888
Polk	101,098	31,600	29,718	0	13,926
Sherman	5,663	0	2,465	0	4,705
Tillamook	50,952	19,800	23,209	0	8,671
Umatilla	125,559	35,800	83,149	0	53,867
Union	54,119	14,600	29,881	0	11,478
Wallowa	16,267	2,500	8,554	0	8,098
Wasco	57,922	23,400	42,927	0	10,895
Washington	587,304	168,200	187,338	0	22,554
Wheeler	4,689	0	1,584	0	2,326
Yamhill	110,426	25,900	45,906	0	17,983
Total	6,584,043	2,046,700	3,346,901	20,200	518,626
Washington					
Adams	32,389	4,700	27,871	0	30,129
Asotin	37,229	1,200	10,388	0	3,641
Benton	216,398	113,600	90,072	0	22,308
Chelan	121,790	57,400	91,461	0	23,834
Clallam	107,126	44,400	51,952	0	2,927
Clark	409,896	186,500	133,374	0	14,467
Columbia	12,673	0	7,893	0	9,648
Cowlitz	210,651	149,700	112,445	0	3,894
Douglas	50,444	0	12,145	0	19,112

TABLE II-G-115 (contd)

Place Name	Personal Income ($ Thousand)	Value Added ($ Thousand)	Retail Sales ($ Thousand)	Mineral Sales ($ Thousand)	Agricultural Sales ($ Thousand)
Ferry	8,633	1,600	2,198	0	1,397
Franklin	74,479	5,700	60,941	0	32,272
Garfield	7,620	0	5,363	0	6,589
Grant	109,267	17,700	76,222	0	80,467
Grays Harbor	177,229	109,900	98,957	0	5,353
Island	80,627	800	22,844	0	3,637
Jefferson	31,631	0	13,176	0	671
King	4,583,736	1,932,400	2,178,432	6,200	21,897
Kitsap	337,648	11,200	132,697	0	1,890
Kittitas	66,829	9,200	39,759	0	19,296
Klickitat	34,059	11,800	13,573	0	10,331
Lewis	126,580	41,700	70,607	0	13,068
Lincoln	30,687	0	17,245	0	22,138
Mason	64,427	0	22,887	0	1,168
Okanogan	67,383	13,800	36,709	0	26,031
Pacific	46,618	11,300	21,237	0	3,102
Pend Oreille	14,267	2,400	6,697	0	1,559
Pierce	1,302,544	282,600	585,441	3,200	22,173
San Juan	13,214	300	4,287	0	360
Skagit	159,290	101,900	91,917	0	25,838
Skamania	14,659	7,700	2,755	0	750
Snohomish	873,156	106,100	327,215	0	20,763
Spokane	866,773	197,600	473,000	4,100	28,814
Stevens	41,789	9,100	20,594	2,400	10,320
Thurston	257,594	56,000	108,133	0	13,645
Wahkiakum	10,398	0	2,079	0	2,049
Walla Walla	128,215	28,800	73,481	0	35,267
Whatcom	242,572	107,500	130,899	0	33,207
Whitman	105,551	1,800	48,313	0	47,805
Yakima	369,531	91,400	240,292	0	136,410
Total	11,444,602	3,717,800	5,465,551	15,900	758,227

Data Source: Ref. 26, The Energetics of the U.S.A., 1977.

TABLE II-G-116

PAID CIVILIAN EMPLOYMENT IN THE FEDERAL GOVERNMENT

Area	Total Employment (In thousands) 1970	1975	Employment in Selected Agencies, 1976 (In thousands) Department of Defense	Postal Service	Veterans Administration	HEW
Alaska	14.5	15.1	5.0	1.3	.1	7.7
Idaho	8.2	9.8	.8	2.0	.5	6.1
Oregon	24.1	25.6	3.3	5.9	2.6	11.8
Washington	52.6	57.8	23.4	9.8	3.8	19.5
Total U.S.	2,875	2,870	995.4	671.8	222.6	945.2

Data Source: Ref. 6, Statistical Abstract 1977, Table 444, p. 269.

TABLE II-G-117

ANNUAL AVERAGE EMPLOYMENT IN THE FOREST PRODUCTS INDUSTRY IN ALASKA

Year	Statewide	Southeast
1964	2,100	1,800
1965	2,300	2,000
1966	2,300	2,000
1967	2,600	2,300
1968	2,500	2,200
1969	2,500	2,200
1970	2,800	2,500
1971	2,800	2,400
1972	2,800	2,400
1973	3,200	2,600
1974	3,600	2,800

Data Source: Reference 11, Alaska Regional Profiles.

TABLE II-G-118

EMPLOYMENT AND WAGES IN ALASKA'S TOURIST INDUSTRY

	1970	1973	1974	1975
Number of Tourists	129,000	215,300	236,000	265,000
Tourist Impact	$45,000,000	$72,000,000	$69,000,000	$88,000,000
Primary Employment[a]	2,500	4,050	4,450	5,000
Primary Wages	$15,500,000	$26,819,500	$29,500,000	$34,000,000
Secondary Employment[a]	1,200	2,050	2,250	2,500
Secondary Wages	$ 7,440,000	$13,513,500	$14,800,000	$16,500,000
Total Employment[a]	3,700	6,100	6,700	7,500
Total Wages	$22,940,000	$40,333,000	$44,300,000	$50,500,000

(a) Nongovernment employment

Data Source: Reference 11, Alaska Regional Profiles.

TABLE II-G-119

TOTAL UNEMPLOYED AND INSURED UNEMPLOYED, 1975
(IN THOUSANDS OF PERSONS 16 YEARS OLD AND OVER)

State	Total Unemployed		Insured Unemployed	
	Number (in thousands)	% (a)	Number (in thousands)	% (b)
Alaska	10	6.7	7.0	8.0
Idaho	21	6.2	11.6	5.4
Oregon	110	10.6	54.7	7.1
Washington	147	9.5	83.8	8.6

(a) Total unemployment as percent of civilian labor force.

(b) Insured unemployment as percent of average covered employment.

Data Source: Ref. 6, Statistical Abstract, 1977, Table 643, p. 396.

TABLE II-G-120

ECONOMIC INDICATORS FOR ENERGY SITING AREAS, CIRCA 1975

State/County	Annual Gross Sales Receipts Per Capita	Annual Gross Sales Receipts Percent Growth[a]	Job Openings Per 1000 Workers[b]	Employment Rate[c]	Businesses Per 1000 People	Personal Income Per Capita[d]	Property Value Per Capita[e]	Governmental Income Per Capita[f]
Alaska								
Anchorage	$ 6,140	8.3	210	93	20	$ 7,160	$ 18,180	$ 2,980
Idaho								
Bingham	7,700	3.2	150	94	15	4,910	6,100	610
Elmore	4,530	14.2	170	93	13	4,280	2,620	570
Oregon								
Clatsop	5,570	-3.1	80	90	26	5,050	16,550	650
Coos	8,000	4.2	100	88	23	4,560	11,030	780
Gilliam	12,390	9.6	200	92	23	8,820	34,380	540
Malheur	10,660	3.9	510	93	25	5,300	10,590	790
Morrow	8,510	6.1	250	93	22	9,530	30,550	730
Washington								
Cowlitz	11,510	7.5	90	93	19	5,430	19,830	680
Douglas	3,350	4.9	120	91	12	5,260	11,480	490
Franklin	9,980	8.9	80	93	25	7,520	14,430	810
Grant	14,950	17.9	150	91	22	6,930	12,480	690
Grays Harbor	8,510	2.8	160	92	25	5,110	12,170	1,100
Lincoln	11,640	4.7	150	98	26	6,540	24,880	1,120
Whatcom	9,510	7.5	90	90	24	5,020	13,740	816

(a) Between 1967-1975, in constant dollars
(b) Reported to the Public Employment Office
(c) Of the labor force
(d) In 1974 dollars
(e) Full actual value
(f) Received annually by all local governmental units from all sources (excluding local transfers)

Data Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, RAP-21.

TABLE II-G-121

REGIONAL PUBLIC ASSISTANCE BY STATE

State	Social Security Monthly Benefits, December 1971			Recipients of			Public Assistance Payments, February 1972		
	Recipient	Payment, $1,000	Average Retiree Benefits Dollars	Old Age Assistance	Aid to Families With Dependent Children	Total, $1,000	Old Age Assistance, Percent	Families with Dependent Children, Total Percent	Average Per Family, Dollars
Alaska	13,241	1,337	129	1,948	11,028	1,261	19.8	59.7	206
Idaho	97,597	10,745	128	3,319	21,812	1,885	13.2	69.4	204
Oregon	309,954	36,699	134	7,528	95,814	6,077	7.6	77.3	169
Washington	433,074	51,844	137	19,189	154,060	14,430	9.6	69.0	219

Data Source: Ref. 68, County and City Data Book, Table 2.

TABLE II-G-122

OUTLAYS FOR THE FIVE LARGEST WELFARE PROGRAMS, 1976

Area	All Outlays ($ million)	Federal ($ million)	Monthly Benefits Per Recipient, By Program (dollars)				
			Medicaid	AFDC	SSI	Food Stamps	General Assistance
Alaska	37	22	397	103	158	38	55
Idaho	72	55	134	83	103	22	--
Oregon	299	203	111	85	102	23	83
Washington	491	308	119	84	124	24	103
Total U.S.	35,937	22,261	134	73	116	24	103

Data Source: Ref. 6, Statistical Abstract 1977, Table 548, p. 349.

TABLE II-G-123

FEDERAL FOOD STAMP PROGRAM-
PARTICIPATION AND VALUE

State	Persons Participating (1,000)		Value of Coupons Issued' (mil.dol.) 1973		1975	
	1973	1975	Total	Federal Bonus	Total	Federal Bonus
Alaska	22	12	9.3	7.4	8.6	6.6
Idaho	15	39	4.2	2.4	16.0	10.4
Oregon	110	208	34.4	21.6	86.0	56.1
Washington	224	239	82.3	47.6	112.2	69.0

Data Source: Ref. 6, Statistical Abstracts, 1977, Table 197.

TABLE II-G-124

STATE UNEMPLOYMENT INSURANCE, 1976[a]

State or Other Area	Statutory Coverage Provisions[b] (effective January 1976)	Covered Employment: Average Monthly Number of Workers (1,000)	Covered Employment: Wages ($ millions) Total	Covered Employment: Wages ($ millions) Taxable[c]	Average Weekly: Insured Unemployment: Number (1,000)	Average Weekly: Insured Unemployment: Percent[d]	Average Weekly: Unemployment Benefits: Current Dollars	Average Weekly: Unemployment Benefits: Percent of Weekly Wage	Weeks Compensated for all Unemployment (1,000)
Alaska	At any time	129	3,246	1,660	10	8.1	81.82	20.2	655
Idaho	20 wks. or $300 in qtr.	234	2,228	3,352	10	4.6	70.13	42.4	361
Oregon	18 wks. or $225 in qtr.	804	8,487	4,124	43	5.6	69.06	37.0	1,675
Washington	At any time	1,053[e]	11,929[e]	6,296[e]	74	7.4	76.28	37.5	2,710
Total U.S.	--	67,890	716,066	303,222	2,991	4.6	75.16	39.8	127,425

(a) Includes unemployment compensation for state and local government and for ex-servicemen, except as noted.

(b) Employer subject to state unemployment insurance law when he has employed at least one worker on at least 1 day in each of specified number of weeks within current or preceding calendar year and/or specified wages as indicated.

(c) Wages subject to unemployment insurance tax. Includes state and local government coverage as well as private industry coverage.

(d) Percent of workers covered by insurance.

(e) For one quarter.

Data Source: Ref. 6, Statistical Abstracts, 1977, Table 537, p. 340.

TABLE II-G-125

Hospital and Medical Insurance (Medicare) Under Social Security - Enrollment and Payments, 1975[a]

Area	Hospital		Medical	
	Enrollment[b] (1,000)	Benefit Payments[c] ($ million)	Enrollment (1,000)	Benefit Payments ($ million)
Alaska	9	3	8	1
Idaho	87	26	85	10
Oregon	282	118	270	48
Washington	394	157	385	68
Total U.S.	24,172[d]	11,291	23,740[d]	4,208

(a) Enrollment as of July 1; payments for calendar year. Payments reflect locations of hospitals and physicians.

(b) Mailing address of beneficiary.

(c) Estimates based on payment vouchers drawn by intermediaries and carriers, some of whom serve more than one state; amounts represent obligations rather than trust fund outlays.

(d) Includes enrollees with residence unknown.

Data Source: Ref. 6, Statistical Abstracts, 1977, Table 531.

TABLE II-G-126

FEDERAL AID TO STATE AND LOCAL GOVERNMENTS, 1976
(IN MILLIONS OF DOLLARS)

State	Total Federal Aid[a]	Federal Aid Per Capita[b] (dollars)	Department of: Social and Rehab. Service, Public Assistance	Department of: Treasury, General Revenue Sharing	Department of: Transportation, Highway Fund	Department of: Agriculture, Food Stamps	HUD[c] Low Rent Public Housing	HUD[c] Urban Renewal	EPA[d] Waste Treatment Facilities Construction
Alaska	407	1,065	27	11	172	.9	4.0	1.8	12.4
Idaho	335	403	60	31	76	1.0	2.0	1.5	13.7
Oregon	1,038	446	218	83	187	5.3	16.7	12.6	39.7
Washington	1,237	342	318	114	169	3.9	24.9	16.1	58.7

(a) Includes amounts not shown separately.

(b) Based on Bureau of the Census estimated resident population as of July 1, 1976, including Armed Forces stationed in area.

(c) Dept. of Housing and Urban Development.

(d) Environmental Protection Agency.

Data Source: Ref. 6, Statistical Abstract , 1977, Table 465, p. 285.

TABLE II-G-127

PUBLIC SERVICE INDICATORS FOR ENERGY SITING AREAS[a]

State/County	Annual Local Governmental Expenditures Per Capita: Public Services[b]	Annual Local Governmental Expenditures Per Capita: Public Facilities[c]	School Student-Teacher Ratio[d]	Hospital Beds Per 1000 People	Police Personnel Per 10,000 People[e]	Fire Personnel Per 10,000 People[f]
Alaska						
Anchorage	$ 1,160	$ 720	21	6	15	12
Idaho						
Bingham	420	67	21	3	23	16
Elmore	410	58	18	3	18	1
Oregon						
Clatsop	430	53	18	5	22	26
Coos	590	72	20	4	29	7
Gilliam	610	44	14	0	10	0
Malheur	700	140	18	6	15	5
Morrow	610	69	15	4	21	10
Washington						
Cowlitz	370	92	21	4	21	11
Douglas	310	230	23	0	22	7
Franklin	540	230	21	3	28	16
Grant	680	120	21	4	18	14
Grays Harbor	400	110	21	4	27	15
Lincoln	750	170	20	15	15	10
Whatcom	480	160	21	3	17	12

(a) Circa 1975
(b) Annual operational expenditures for all human services
(c) Annual expenditures for streets, utilities, and sanitation
(d) All public schools
(e) All police employees
(f) All fire employees

Data Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest.

TABLE II-G-128

REGION, DIVISION, AND STATE--NEW HOUSING UNITS AUTHORIZED IN PERMIT-ISSUING PLACES: 1970

Area	Number of Housing Units: Total[(a)]	Privately Owned (Permit-authorized), In structures With--: 1 Unit	2 Units	3 and 4 Units	5 Units Or More	Publicly Owned (Contract Awards)	Number of Privately Owned Structures With 5 Units Or More
Alaska	1,673	853	233	253	334	0	26
Idaho	3,565	1,952	190	291	1,090	42	46
Oregon	16,980	8,723	1,150	1,497	5,220	390	421
Washington	28,262	16,705	1,320	1,341	8,494	402	466
U.S.	1,384,028	646,767	43,006	45,090	616,671	32,494	35,016

(a) All housing units authorized in permit-issuing places are treated as nonfarm even though a negligible number are located on farm properties.

Data Source: Ref. 72, 1975 Population Census.

TABLE II-G-129

REGION, DIVISION, AND STATE--NEW HOUSING UNITS AUTHORIZED IN PERMIT-ISSUING PLACES: 1975

Area	Number of Housing Units: Total	Publicly Owned (Contract Awards)	Privately Owned (Permit-authorized), In structures With--: 1 Unit	2 Units	3 and 4 Units	5 Units or More	Number of Privately Owned Structures With 5 Units or More
Alaska	2,903	0	1,295	222	283	1,103	78
Idaho	8,172	0	6,447	356	463	906	85
Oregon	20,091	0	14,300	1,512	1,172	3,107	300
Washington	35,209	40	22,490	1,582	1,536	9,561	661
U.S.	949,234	10,075	675,480	34,092	29,752	199,835	13,158

Data Source: Ref. 72, 1975 Population Census.

TABLE II-G-130

HOUSEHOLDS

Area	Total Households (in thousands)			Percent of Change		Average Annual Percent of Increase	
	1960	1970	1975	1960-1970	1970-1975	1960-1970	1970-1975
Alaska	57	79	97	38.6	23.0	3.3	3.9
Idaho	194	219	266	12.9	21.6	1.2	3.7
Oregon	558	692	819	24.0	18.4	2.2	3.2
Washington	894	1,106	1,248	23.7	12.9	2.1	2.3
Total U.S.	53,021	63,450	71,537	19.7	12.7	1.8	2.3

Data Source: Ref. 6, Statistical Abstract, 1977, Table 62, p. 44.

TABLE II-G-131

NEW HOUSING UNITS AUTHORIZED
NUMBER AND VALUATION

Area	Housing Units (in 1000s)		Valuation ($ Million)	
	1970	1975	1970	1975
Alaska	1.7	2.9	39	90
Idaho	3.6	8.2	43	179
Oregon	17.0	20.1	230	500
Washington	28.3	35.2	416	855
Total U.S.	1,384.0	949.2	19,664	24,107

Data Source: Ref. 6, Statistical Abstract, 1977, Table 1328, p.775.

TABLE II-G-132

HOUSING UNITS - SELECTED CHARACTERISTICS: 1970

Area	Total Year-Round Units (1000s)	Occupied Units (1000s)	Percent Owner Occupied	Percent with Complete Plumbing[a]	Percent with 1.01 or More Persons per Room[b]
Alaska	88	79	50.3	86.2	12.2
Idaho	238	219	70.1	96.2	8.6
Oregon	735	692	66.1	97.0	5.3
Washington	1,204	1,106	66.8	97.4	5.2
Total U.S.	67,657	63,450	62.9	94.0	7.0

(a) Includes hot and cold piped water as well as a flush toilet and a bathtub or shower inside the structure for exclusive use of the people in the unit.
(b) For units with all plumbing facilities.
Data Source: Ref. 6, Statistical Abstract, 1977, Table 1333, p. 778.

TABLE II-G-133

HOUSING: YEAR-ROUND UNITS

State	Percent Change 1960-1970	Percent of Structures Built Prior to 1950	Percent of Structures Built in 1960 or Later
Alaska	38.1	24.8	43.9
Idaho	13.5	57.3	22.4
Oregon	21.4	52.4	27.0
Washington	23.9	51.2	28.6

Data Source: Ref. 68, County and City Data Book, 1972, Table 2.

TABLE II-G-134

CHARACTERISTICS OF OCCUPIED UNITS, 1970

State	Average Person Per Unit	Median Gross Rent, Renter Occupied, $	Lacking Some or all Plumbing Facilities, %	Moved Into During 1965-1970, %	With Air Condi-tioning %	With Home Food Freezer %	With Telephone Available %	With One or More Automobiles %
Alaska	3.7	189	13.2	76.7	1.0	41.3	73.4	80.4
Idaho	3.2	92	3.2	52.8	17.8	52.4	85.2	89.9
Oregon	3.0	109	2.6	56.8	10.7	46.4	89.5	88.0
Washington	3.0	115	2.3	56.8	9.3	41.7	90.0	87.6

Data Source: Ref. 68, County and City Data Book, 1972, Table 2.

TABLE II-G-135

CONSTRUCTION CONTRACT VALUES BY STATES

State	1970 Total ($ million)	1975 Total ($ million)	1976 ($ million)			
			Total	Non-residential	Resi-dential	Non-building
Alaska	238	4,826	880	395	235	251
Idaho	197	399	400	119	186	95
Oregon	634	1,036	1,238	341	680	217
Washington	1,478	2,019	3,478	599	1,300	1,581

Data Source: Ref. 6, Statistical Abstract, 1977, Table 1323.

TABLE II-G-136

COMMUNITY STRUCTURE INDICATORS FOR ENERGY SITING AREAS[a]

State/County	Percent Housing Vacant[b]
Alaska	
Anchorage	7
Idaho	
Bingham	8
Elmore	9
Oregon	
Clatsop	14
Coos	4
Gilliam	36
Malheur	7
Morrow	13
Washington	
Cowlitz	4
Douglas	6
Franklin	5
Grant	20
Grays Harbor	9
Lincoln	24
Whatcom	8

(a) Circa 1975

(b) Dwelling units currently unoccupied

Data Source: Ref. 1, The Impact of Increased Coal Consumption in the Pacific Northwest.

TABLE II-G-137

AGE ADJUSTED MORTALITY, 1968-1972

Area	Sex and Race	Death Rates Per Million Population					
		Tuberculosis All Forms	Cancer of Stomach	Cancer of Respiratory System	Influenza and Pneumonia	Chronic Respiratory Disease	Congenital Heart and Circulation
Alaska	White Female	5.5	52.3	132.0	250.1	133.9	36.6
	Black Female	0.0	0.0	0.0	669.1	0.0	0.0
	White Male	65.3	161.4	579.9	428.2	378.2	31.9
	Black Male	0.0	85.6	342.8	1487.1	85.6	70.9
Idaho	White Female	3.5	47.8	89.2	214.7	82.0	32.0
	Black Female	0.0	0.0	0.0	0.0	566.6	0.0
	White Male	20.7	110.9	404.0	341.0	519.2	41.0
	Black Male	0.0	0.0	376.4	0.0	376.4	0.0
Oregon	White Female	4.6	41.4	115.0	217.3	101.8	27.5
	Black Female	0.0	38.4	128.3	252.7	129.4	27.2
	White Male	18.6	98.1	562.6	328.0	448.8	37.5
	Black Male	48.6	81.9	763.9	331.3	379.4	24.2
Washington	White Female	7.0	49.7	120.3	221.6	118.0	31.5
	Black Female	18.3	93.9	185.1	201.8	168.6	50.6
	White Male	20.6	104.0	605.9	390.3	446.2	41.9
	Black Male	55.1	236.0	908.4	621.2	498.6	30.4
Total U.S.	White Female	9.1	51.3	117.1	234.8	89.9	33.5
	Black Female	42.7	78.9	121.9	366.2	87.8	39.2
	White Male	32.2	104.2	609.8	393.9	381.7	41.0
	Black Male	128.6	196.0	700.9	656.0	286.9	45.5

TABLE II-G-137. (contd)

Area	Sex and Race	Death Rates Per Million Population: Other Congenital	Other Early Infancy	Motor Vehicle Accidents	Other Accidents	Major CV Diseases	Cancer All Sites All Forms
Alaska	White Female	30.0	117.9	211.9	442.0	1210.6	3172.3
	Black Female	32.8	328.5	38.6	38.6	587.3	4382.9
	White Male	27.2	181.5	350.3	1256.0	1841.5	6066.0
	Black Male	0.0	173.2	326.0	983.9	2434.6	4019.3
Idaho	White Female	34.8	145.9	213.6	199.0	1138.2	3367.6
	Black Female	0.0	190.5	266.9	527.2	566.6	6061.7
	White Male	37.5	197.4	600.6	658.6	1623.3	5625.2
	Black Male	0.0	190.5	620.5	446.0	2467.5	5751.9
Oregon	White Female	43.1	134.6	189.9	156.6	1227.7	3436.8
	Black Female	63.8	305.9	93.9	187.2	1503.5	3991.8
	White Male	43.0	174.6	482.9	450.3	1845.8	5891.3
	Black Male	171.1	182.0	489.4	666.3	2873.7	7570.4
Washington	White Female	35.1	126.7	152.1	171.5	1260.9	3596.1
	Black Female	38.9	307.7	158.7	311.9	1689.0	4333.8
	White Male	39.8	187.4	367.5	468.8	1944.6	6212.7
	Black Male	27.0	335.6	393.3	598.4	2469.5	6641.1
Total U.S.	White Female	40.2	148.2	145.6	166.8	1318.3	3836.4
	Black Female	37.3	306.7	138.2	245.4	1478.4	5237.0
	White Male	42.4	207.2	395.0	393.3	1993.7	6442.8
	Black Male	44.4	395.2	490.6	673.9	2428.1	7039.3

Data Source: Ref. 73, U.S. National Institute of Health, Computer Printout.

TABLE II-G-138

REPORTED CASES OF NOTIFIABLE DISEASES, 1976

Area	Amebiasis	Aseptic Meningitis	Brucellosis	Chickenpox	Diphtheria	Hepatitis, Viral A	Hepatitis, Viral B	Hepatitis, Viral Unspecified	Malaria	Measles	Meningococcal Infections	Mumps	Pertussis	Rheumatic Fever Acute
ALASKA	-	19	1	467	8	1,398	30	4	-	13	21	39	-	30
IDAHO	4	4	3	784	-	112	18	82	-	2,024	7	475	10	27
OREGON	12	44	1	46	-	740	351	140	8	185	24	422	14	1
WASHINGTON	30	40	3	6,948	101	477	241	247	5	298	35	946	26	-

Area	Rubella Cases	Rubella Congenital Syndrome	Salmonellosis Excluding Typhoid Fever	Shigellosis	Tetanus	Trichinosis	Tularemia	Typhoid Fever	Typhus-Fever Tick-borne (Rky Mt Spotted)
ALASKA	2	-	61	61	-	8	-	-	-
IDAHO	17	-	75	42	-	-	3	1	1
OREGON	143	-	140	114	1	-	1	1	-
WASHINGTON	228	-	370	223	1	1	1	5	3

Data Source: Reference 74, "Morbidity and Mortality Annual Summary 1976." Table 5.

TABLE II-G-139

TUBERCULOSIS CASES AND CASE RATE PER 100,000 POPULATION BY AREA, 1975-1976

Area	1975		1976	
	Cases	Case Rate	Cases	Case Rate
Alaska	74	21.0	88	23.0
Idaho	36	4.4	37	4.5
Oregon	194	8.5	197	8.5
Washington	427	12.0	378	10.5
Total U.S.	33,989	15.9	32,105	15.0

Data Source: Ref. 74, "Morbidity and Mortality Annual Summary, 1976."

TABLE II-G-140

REPORTED CASES OF NOTIFIABLE DISEASES OF LOW FREQUENCY, 1976

Area	Anthrax	Botulism	Leprosy	Lepto-spirosis	Poliomyletis		Psittacosis	Typhus Fever Flea-borne (Endemic, Murine)
					Total	Paralytic		
Alaska	-	14	-	-	-	-	-	-
Idaho	-	-	-	-	1	-	-	-
Oregon	-	-	1	1	-	-	3	-
Washington	-	5	1	-	1	1	5	-

Data Source: Reference 74, "Morbidity and Mortality Annual Summary 1976." Table 6.

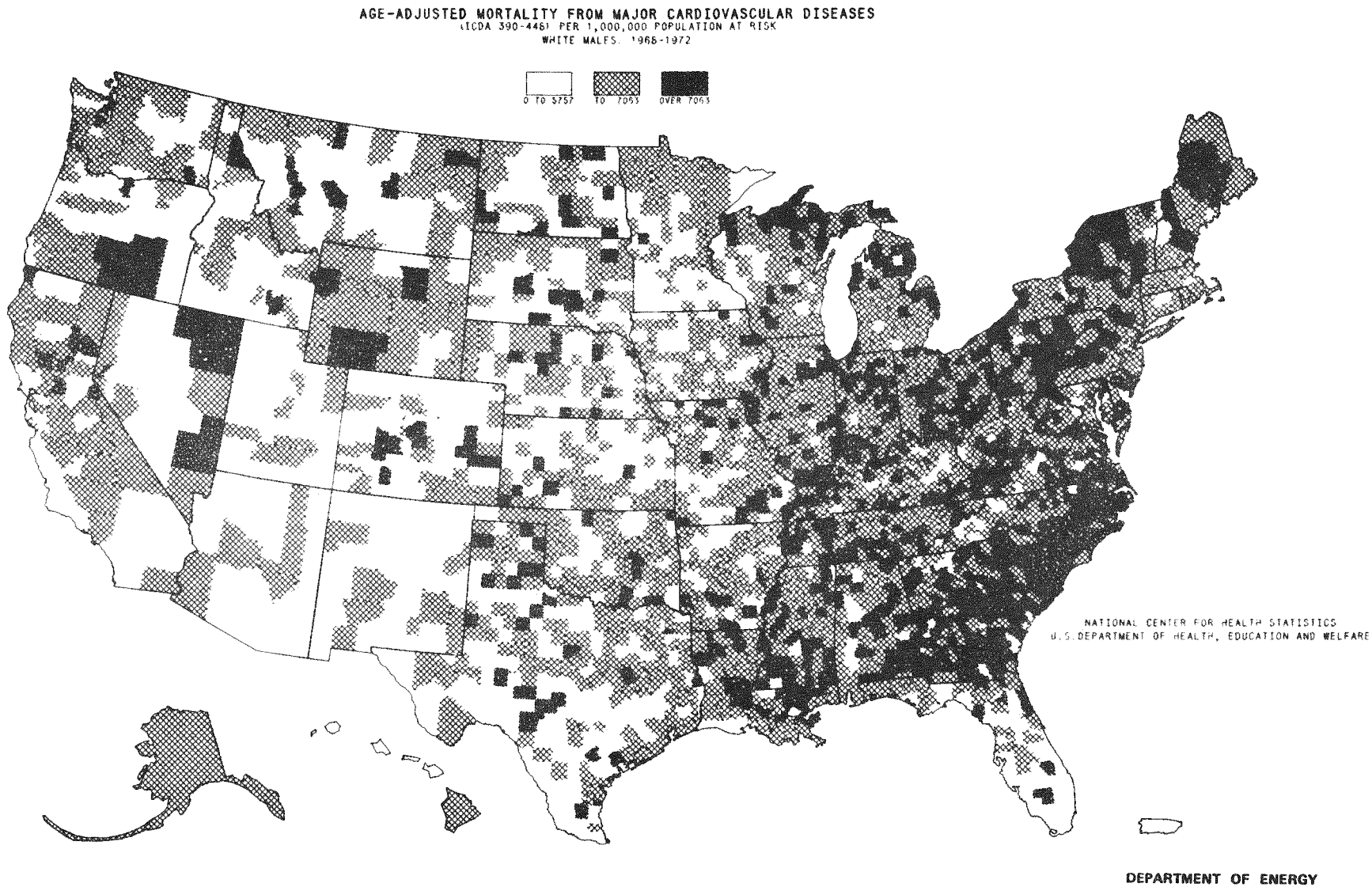

FIGURE II-G-181. Age-Adjusted Mortality from Major Cardiovascular Diseases

Data Source: Ref. 12, Council on Environmental Quality, 1977.

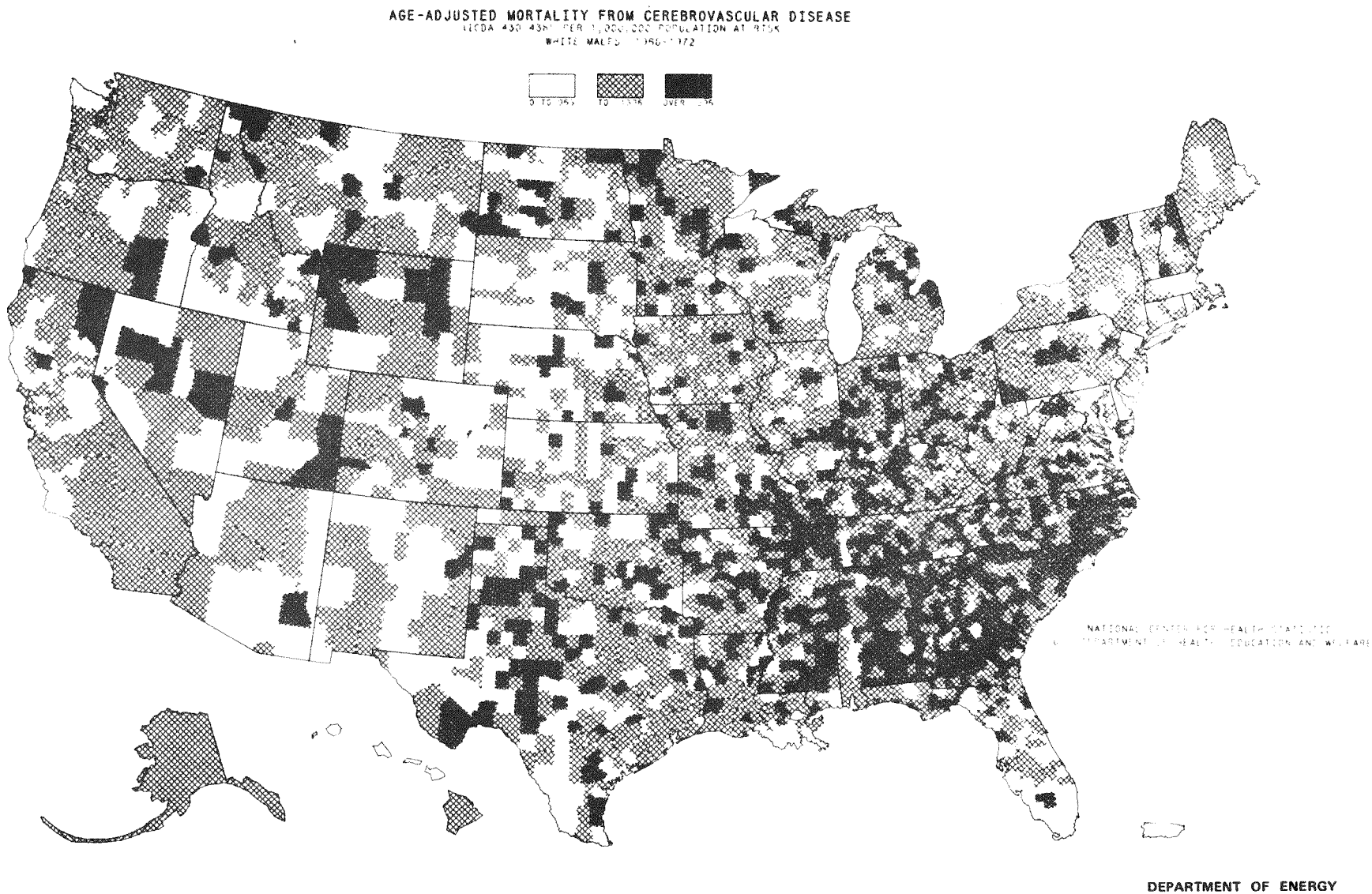

FIGURE II-G-182. Age-Adjusted Mortality from Cerebrovascular Diseases

Data Source: Ref. 12, Council on Environmental Quality, 1977.

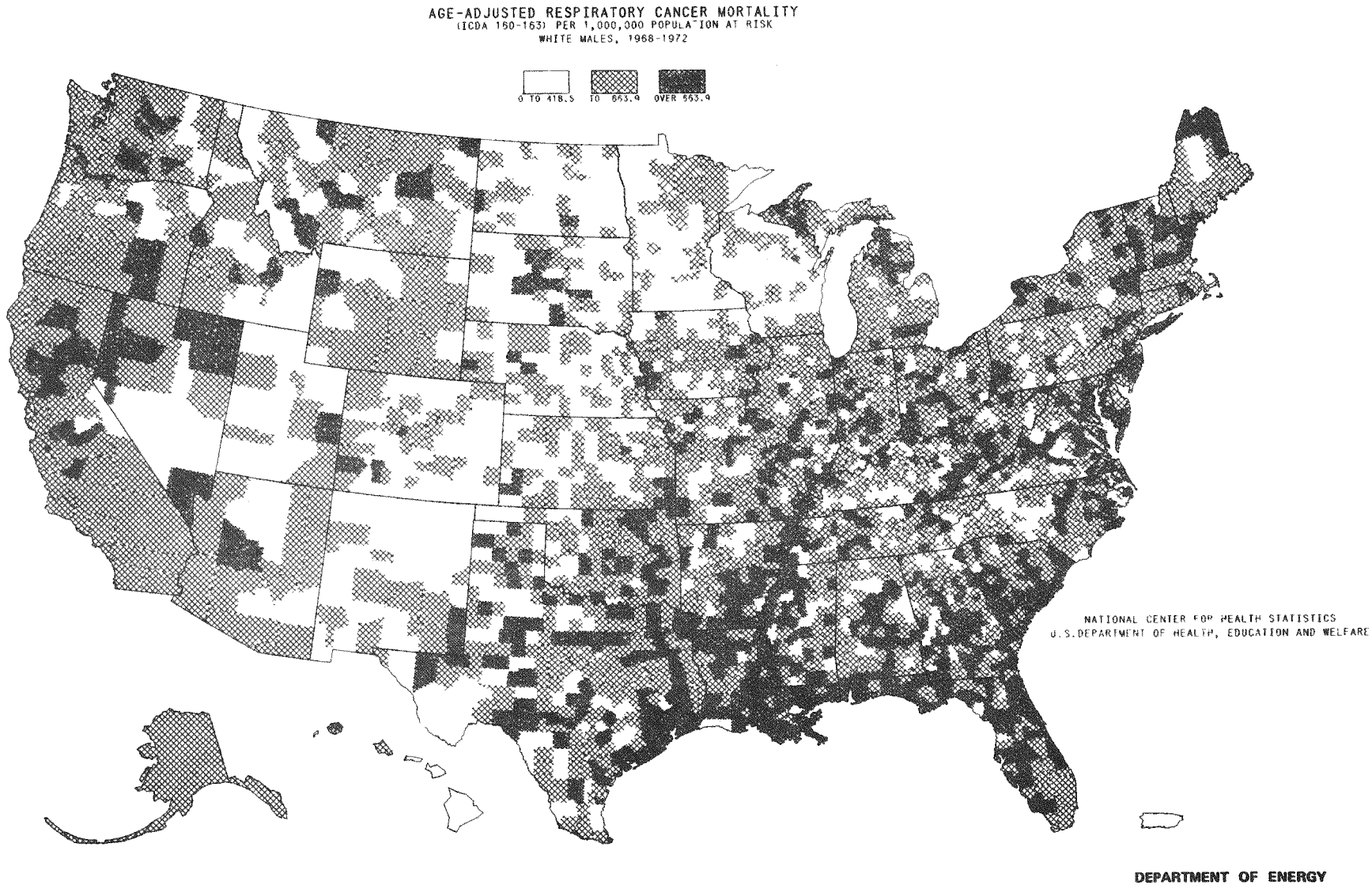

FIGURE II-G-183. Age-Adjusted Respiratory Cancer Mortality

Data Source: Ref. 12, Council on Environmental Quality, 1977.

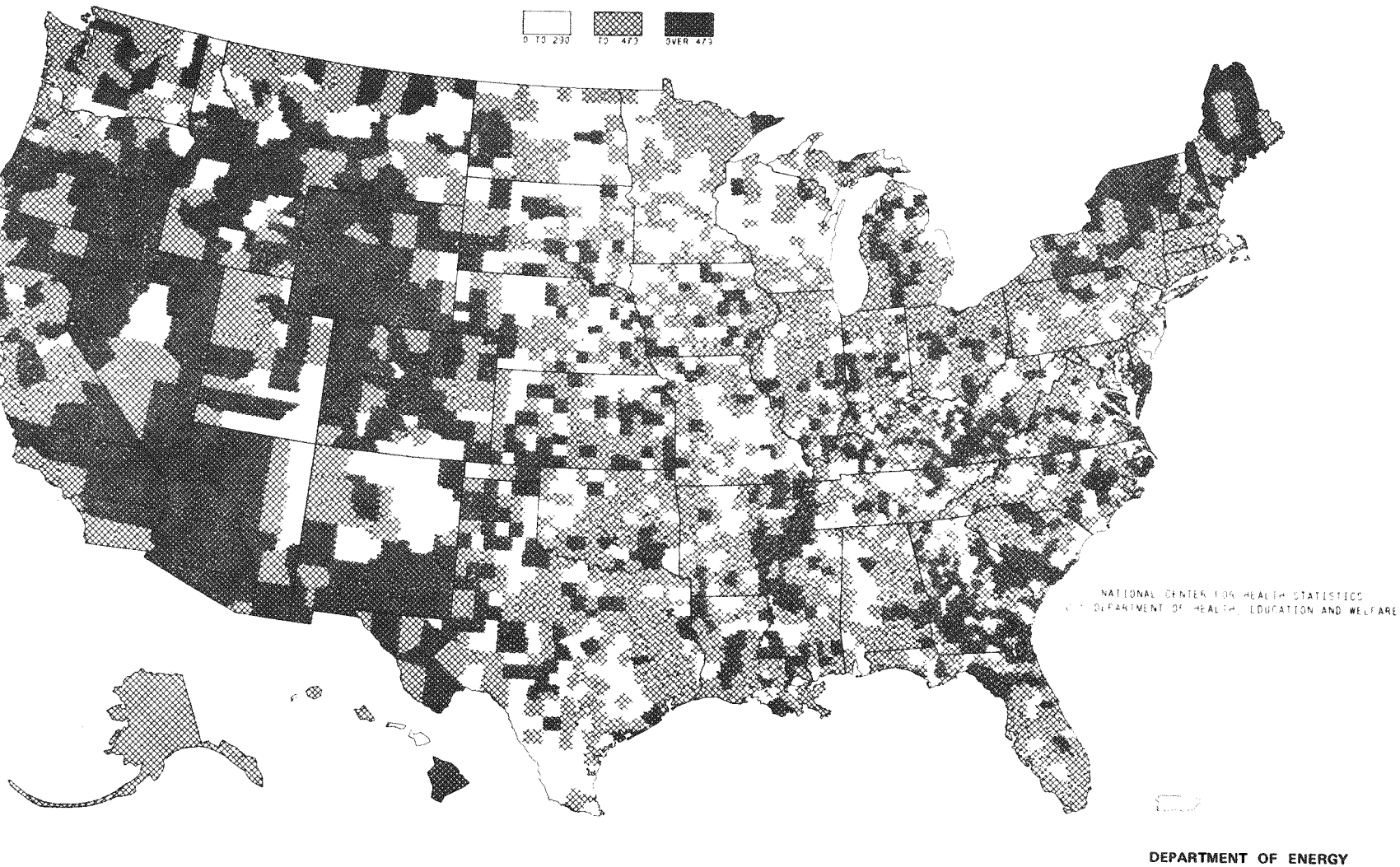

FIGURE II-G-184. Age-Adjusted Mortality from Chronic Ischemic Heart Disease

Data Source: Ref. 12, Council on Environmental Quality, 1977.

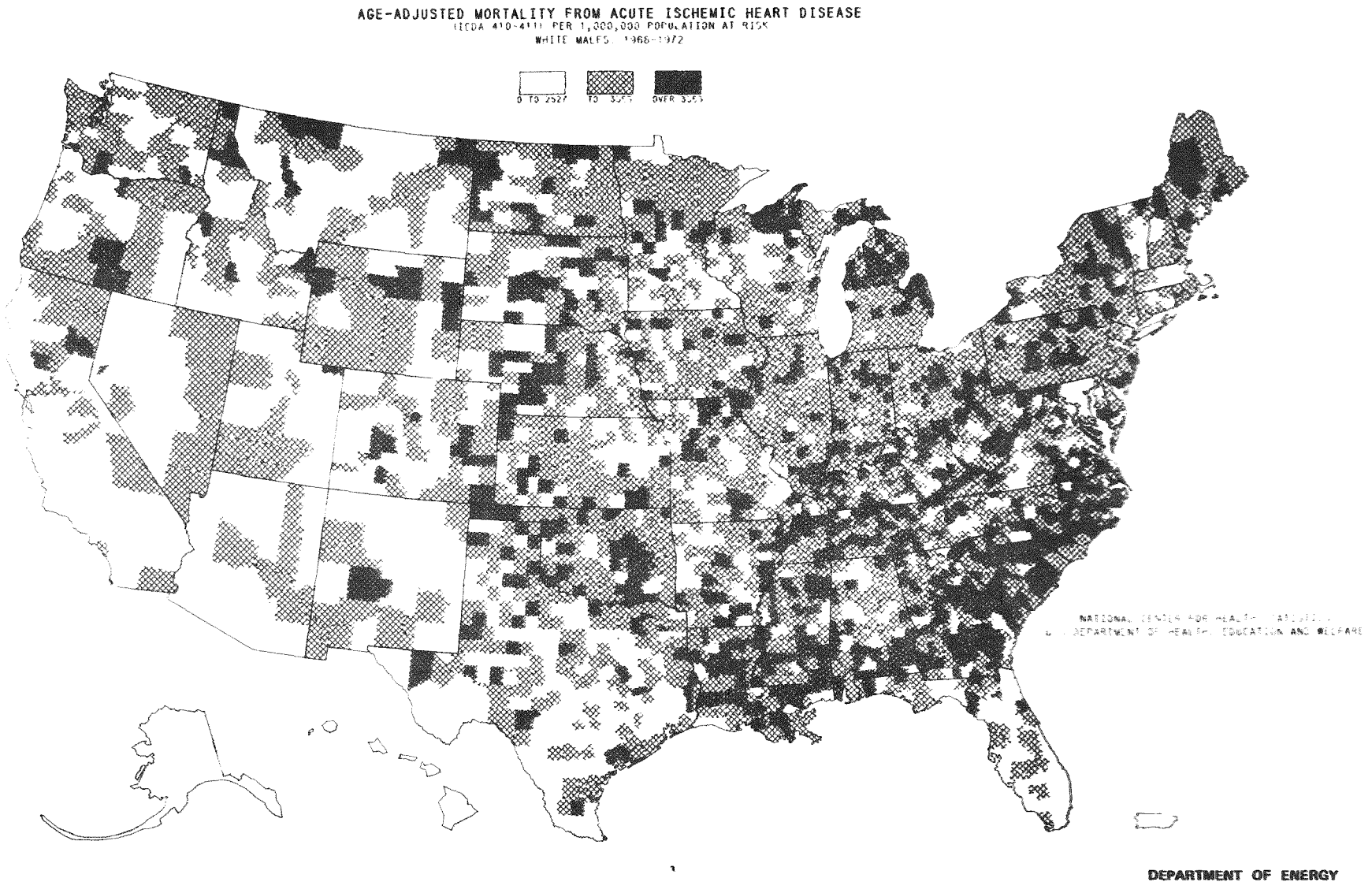

FIGURE II-G-185. Age-Adjusted Mortality from Acute Ischemic Heart Disease

Data Source: Ref. 12, Council on Environmental Quality, 1977.

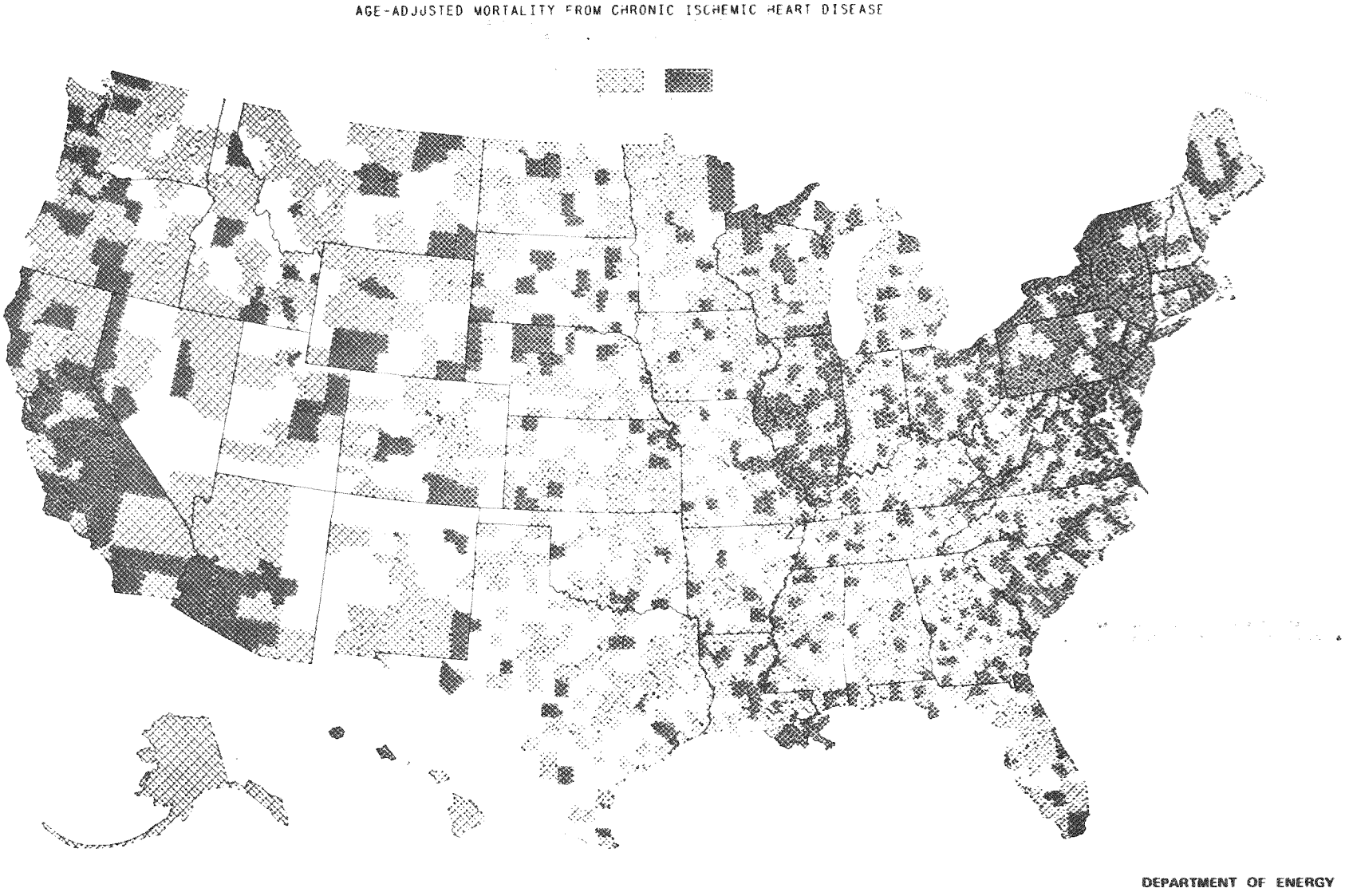

FIGURE II-G-186. Age Adjusted Mortality from Chronic Ischemic Heart Disease

Data Source: Ref. 12, Council on Environmental Quality, 1977.

TABLE II-G-141

Annual Deaths and Injuries by Energy Source for the U.S. (per Unit Energy)(a)

	Coal		Crude Oil			Natural Gas
	Deep	Surface	Onshore	Offshore	Import	Total
Fatalities	4.00	2.64	0.35	0.35	0.06	0.02
Injuries	112.30	41.20	32.30	32.30	5.70	18.30

(a) For a 1000-MW power plant with a load factor of 0.75.

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-G-142

LNG Risk Analysis-Fatalities
Million per year (for the United States)

Model	Los Angeles		Oxnard		Point Conception	
	Marine	Terminal	Marine	Terminal	Marine	Terminal
Federal Power Commission	--	100	1	--	10	--
Science Applications, Inc.	0.1	0.1	0.01	0.1	0.001	0.1
El Paso-Alaska Company	--	--	--	--	0.01	--

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-G-143

Coal Mining Accident Rates for the U.S.

Type of Accident	Disabling Injuries/ Million Employee-hours
Underground Coal Mining	35.0
Surface Coal Mining	10.0
Overall Industry Average (All member companies of National Safety Council)	9.8

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-G-144

Coal Mining Accidents for the U.S., by Type

Type	Accident	% of Total	Total %
Underground (total)			80
	Roof, rib, and face falls	50	
	Fires and explosions	10-12	
	Transportation (coal haulage)	10-15	
Surface (total)			20
	Fall of highwall, equipment misoperation, electrical system malfunctions	20	

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-G-145

Oil Industry Accident Data for the U.S.

Type	Accidents/yr	Fatalities/yr	Injuries/yr
Shipping	636	76	37
Blow-outs	11	N/A	N/A
Offshore Rigs	5	6	N/A
Pipelines	135	1	1
Refineries	N/A	3	5915

Data Source: Ref. 23, Energy/Environment Fact Book.

TABLE II-G-146

ANNUAL HEALTH EFFECT ESTIMATES FOR REFERENCE 500 MWe COAL-FIRED POWER PLANT BY LOCATION AND FUEL CYCLE COMPONENT

Fuel Cycle Component	Idaho, Oregon, Washington	Alaska
Surface Mining		
Accidental deaths	0.15 (0.14-0.18)[a]	0.18 (0.16-0.22)[a]
Accidental injuries	7.8 (6.8-9.0)	9.4 (8.1-10.8)
Processing		
Accidental deaths	0.03 (0.02-0.04)	0.04 (0.03-0.05)
Accidental injuries	2.0 (1.5-2.4)	2.3 (1.8-2.9)
Rail Transportation		
Accidental deaths	3.0	0
Accidental injuries	14.4	0
Combustion		
Excess deaths/10^5 population	0.1 (0.0-1.1)[b]	--

(a) Interval is an approximate 95% confidence interval.
(b) Interval is an approximate 80% confidence interval.

Data Source: Reference 1, The Impact of Increased Coal Consumption in the Pacific Northwest, Table 9.1.

CHAPTER II

REFERENCES

1. The Impact of Increased Coal Consumption in the Pacific Northwest, Regional Assessment Program - Report 21, Battelle, Pacific Northwest Laboratories, Richland, WA 99352, March 1978.

2. Northwest Energy Policy Project, Energy Futures Northwest, Pacific Northwest Regional Commission, Vancouver, WA, May 1978.

3. Highsmith, R. M. (ed.) Atlas of the Pacific Northwest, 4th ed., Oregon State University Press, Corvallis, OR, 1978.

4. Pacific Northwest River Basins Commission, Columbia-North Pacific Region Comprehensive Framework Study of Water and Related Lands, Appendix II The Region, Pacific-Northwest River Basins Commission, Vancouver, WA, June 1969.

5. Pacific Northwest Regional Commission, Water Today and Tomorrow, Draft, Pacific Northwest Regional Commission, Vancouver, WA, 1978.

6. Bureau of the Census, The Statistical Abstract of the United States, 1977, (98th ed), U.S. Department of Commerce, U.S. Government Printing Office, Washington, DC, 1977.

7. U.S. Forest Service, The Nation's Renewable Resources - An Assessment 1975, Forest Service, U.S. Department of Agriculture, Forest Resource Report No. 21, Washington, DC, 1977.

8. Luken, Ralph A. and Edward H. Pechan, Water Pollution Control Assessing the Impacts and Costs of Environmental Standards, Praeger Publishers, New York, 1977.

9. Ceraghty, J. J. et al., Water Atlas of the United States, Water Information Center, Inc., Port Washington, New York, 1973.

10. U.S. Geological Survey, Large Rivers of the United States, USGS Circular No. 686, U.S. Government Printing Office, Washington, DC, 1974, p. 9.

11. Office of the Governor, Alaska Regional Profiles, State of Alaska, Arctic Environmental and Information Data Center, Six volumes, 1974.

12. U.S. Council on Environmental Quality, Environmental Quality, Annual Report, 1977, U.S. Government Printing Office, Washington, DC, December 1977.

13. U.S. Geological Survey, The National Atlas of the United States of America, Washington, DC, 1970.

14. Shepherd, Alf., "Critical Water Supply Estimates for ASR's, Used in the Nationwide Assessment of Water Quantity Impacts of the National Energy Plan," Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1978.

15. U.S. Water Resources Council, Preliminary Water Resources Problem Statements, 1977 National Conference on Water, St. Louis, MO, May 1977.

16. U. S. Bureau of the Census, Nineteen-Seventy-Seven U.S. Fact Book, The American Almanac (The Statistical Abstract of the U.S.), Grosset and Dunlop, New York, 1977.

17. Environmental Improvement Agency, Draft Environment Impact Statement Proposed Regulations Criteria for Classification of Solid Waste Disposal Facilities, U.S. Government Printing Office, Washington, DC. April 1978.

18. Ficke, John F. and Richard O. Hawkinson, CEQ Water Quality Information, The National Stream Quality Accounting Network (NASQAN)-Some Questions and Answers, Geological Survey Circular, 79, Reston, VA, 1975.

19. U.S. Environmental Protection Agency, National Water Quality Inventory,. Vol. 1, U.S. Government Printing Office, Washington, DC. pp.279-305, 1974.

20. Bonneville Power Administration, The Role of the BPA in the Pacific Northwest Power Supply System; Part 1, "The Regional Electric Power Supply System," Bonneville Power Administration, U.S. Department of the Interior, 1977.

21. U.S. Department of the Interior, Bureau of Reclamation, Critical Water Problems Facing the Eleven Western States, Westside Study Report, 1975.

22. Battelle, An Approach to Valuing Visual Pollution from Western Electricity Production, BNWL-2103, U.S. Government Printing Office, February 1977.

23. DOE/EPA Energy/Environmental Fact Book-EPA-600/9-77-041, U.S. Governmental Printing Office, March 1978.

24. Goldsmith and Mahoney, "Implications of the 1977 Clean Air Act Amendments for Stationary Sources," Environmental Science and Technology, Vol. 12, No. 2, Feb. 1978.

25. Department of Energy, Upgrade Ambient Air Quality Data Base, EPA/Sardad Database, EPA/National Air Data Branch, Aeros User's Manual, (Research Triangle Park, N.C., December 1976), EPA-450/2-76-029.

26. F. Drysdale and C. Caley, Energetics of the U.S.A.: An Atlas, Brookhaven National Laboratory, BNL-50501-R, (revised October 1977).

27. U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Service, Climatic Atlas of the United States, U.S. Government Printing Office, June 1968.

28. NOAA, Climatography of the United States, No. 81 (By State), Monthly Normals of Temperature Precipitation, and Heating and Cooling Degree Days 1941-70. U.S. Department of Commerce, NOAA, 1973. Via ORNL Climatological Computer Printout.

29. D. M. Hershfield, Rainfall Frequency Atlas of the United States, USDA Technical Paper Pb. 40, 1961.

30. U.S. Weather Bureau, Local Storm Occurrences, pg. 77.

31. Maurice E. Pautz, Severe Local Storm Occurrences, 1955-1967, U.S. Department of Commerce, National Bureau of Standards, Washington, DC, September 1969.

32. Holzworth, G. C., Mixing Heights, Wind Speeds, and Potential for Air Pollution Throughout the Contiguous United States, U.S. Environmental Protection Agency, Office of Air Programs, Research Triangle Pool, North Carolina, January 1972.

33. A. M. McRae and J. L. Dudis, The Energy Source Book, Center for Compliance Information, Aspen Systems Corporation, Germantown, MD, 1977.

34. G. E. Lineks, "Acid Precipitation," Chemical and Engineering News, 11/22/76.

35. National Academy of Sciences, Mineral Resources and the Environment, U.S. Governmental Printing Office, Washington, DC, 1975. Galloway, James N. and Ellis B. Cowling, "The Effects of Precipitation on Aquatic and Terrestrial Ecosystems," 70th Annual Meeting of the Air Pollution Control Association, Toronto, Canada, June 1977.

36. Mineral Resources and the Environment, National Academy of Science, Washington, DC. 1975.

37. EPA, Air Quality Data 1975, Annual Statistics, EPA 450/2-77-002, May 1977, utilized to map data, Bill Sandusky, Battelle.

38. EPA, "Noise Regulation in State and Local Noise Ordinance," 2/1975.

39. ERDA, "Alternatives for Managing Wastes from Reactors and Post-fission Operations in the LWR Fuel Cycle," Vol. 4, Alternatives for Waste Isolation and Disposal, ERDA-76-43. U.S. Energy Reserach and Development Agency, Washington, DC, 1976.

40. U.S. Department of Energy. "Report of Task Force for Review of Nuclear Waste Management," (Deutch Report), draft copy, U.S. Department of Energy, Washington, DC, February 1978.

41. Waste Control Act of 1975, Hearings before the subcommittee of Transportation and Commerce, House of Representatives, 94th Congress, 1st Session, 4/8-17/75.

42. U.S. Environmental Protection Agency, Resource Recovery and Source Reduction, Second Report to Congress, U.S. Government Printing Office, Washington, DC 1974.

43. Hearings before the Subcommittee on Environmental Pollution of the Committee on Public Works, U.S. Senate, 93rd Congress, 2nd Session, 7/17-18/74.

44. Bond, et al., Handbook of Environmental Control, Vol. II, Solid Waste, CRC Press, 1973.

45. "Survey of U.S. Resource Recovery Energy Conversion Practices," Waste Age, March 1977, p. 70-73.

46. "U.S. Hazardous Waste Control Practices," Waste Age, April 1977, p 18-23.

47. "1977 Survey of Collection Practices," Waste Age, February 1977, p. 6-9.

48. "Exclusive Waste Age Survey of U.S. Disposal Practices," Waste Age, January 1977, p. 24-28.

49. Data from: Wetlands of the United States, U.S. Department of the Interior, Fish and Game, Wildlife Circular 39, 1956.

50. Nuclear Energy Center Site Survey-1975: Resource Availability and Site Screening.

51. U.S. Department of Agriculture, Agriculture Economic Report, No. 247, U.S. Government Printing Office, Washington, DC, pp. 37-38.

52. U.S. Department of Agriculture, Conservation Needs Inventory 1967, Statistical Bulletin Vol. 461.

53. U.S. Bureau of the Census, 1974 Census of Agriculture, Vol. 1, Part 51, United States Summary and State Data, U.S. Government Printing Office, Washington, DC, December 1977.

54. Statistical Reporting Service, Agriculture Statistics 1975, U.S. Department of Agriculture, Washington DC.

55. U.S. Forest Service, Land Management Planning Unit, Fort Collins, Colorado.

56. Alaska Wilderness Proposals, Alaska Geographic Society, Anchorage, Alaska, Northwest Publishing Co., 1977.

57. U.S. Department of Interior, National Park Service, National Parks and Land Marks, U.S. Government Printing Office, Washington, DC, 1976.

58. U.S. Department of Agriculture, Forest Service, Wilderness Monitoring System, August 1, 1977.

59. U.S. Department of the Interior, Bureau of Outdoor Recreation, River Mileage Classifications for Components of the National Wild and Scenic Rivers System, 1977.

60. Power Planning Committee, Review of Power Planning in the Pacific Northwest, Pacific Northwest River Basins Commission, May 1977.

61. Council on Environmental Quality, Environmental Quality Annual Report, 1976, p. 68-69.

62. U.S. Department of Commerce, Fisheries of the United States, 1977, National Oceanic and Atmospheric Administration, Washington, DC, 1978.

63. U.S. Department of Agriculture Forest Service, "Ecoregions of the United States," Compiled by Robert G. Bailey in cooperation with the U.S. Fish and Wildlife Service, Ogden, Utah, March 1977.

64. Council on Environmental Quality, Computer Printout of compiled data.

65. Brookhaven National Laboratory, The Endangered Species Act and Energy Facility Planning: Compliance and Conflict, Daniel Shreeve, Charles Calef, and John Nagg, BNL-50841, Upton, New York, May 1978, p. 26-35.

66. Threatened and Endangered Species, Computer Printout from the Biomedical and Environmental Assessment Division, Brookhaven National Laboratory.

67. Energy Northwest, Battelle, Pacific Northwest Laboratories, Richland, WA 99352, (1977).

68. U.S. Bureau of Census, County and City Data Book 1972, U.S. Government Printing Office, Washington, DC, March 1973.

69. Benshaw, V., and A. L. Friedenburg, Transfer Payments: Regional Patterns, 1965-1975, Reprint from Survey of Current Business, May 1977.

70. U.S. Department of Commerce, Bureau of Economic Analysis Work Force Migration Patterns, 1970-1976, Reprinted in Survey of Current Business, February 1978.

71. U.S. Bureau of the Census, Annual Survey of Manufactures, 1976, U.S. Government Printing Office, Washington, DC, 1978.

72. U.S. Bureau of the Census, 1975 Population Census: Characteristics of the Population, State Summaries, U.S. Government Printing Office, Washington, DC.

73. U.S. National Institute of Health, Division of Computer Research and Technology, Bethesda, Maryland, June 1978.

74. "Annual Summary 1976," Morbidity and Mortality Weekly Report.

GOVERNMENT INVOLVEMENT IN NORTHWEST ENERGY RESOURCES

Among the various levels of government (federal, state and local) a number of agencies are actively and passively involved in mining, transport and utlimate use of energy resources. Their direct participation in resource utilization decisions may result from 1) outright ownership of the mineral resources or rights-of-way, 2) economic, environmental, health or safety considerations, or 3) directly related energy projects and programs. Historically, government has treated mineral resources as an ordinary marketable commodity, with private industry being responsible for resource development and commodity marketing. Overall energy policies and priorities, however, are set by government. The fact that no clear policy exists creates its own set of problems: first, because the various levels of government may not be in agreement, and secondly, because industry may get mixed signals from within a level of government as it pursues specific energy objectives.

Governmental arrangements that influence energy resource development and utilization are still evolving. Efforts are being made to define the role of government at both the federal and state levels. Recently the state governors of Idaho, Oregon and Washington, through the Pacific Northwest Regional Commission, initiated the Northwest Energy Policy Project (NEPP) - a two-year study to identify and evaluate a number of energy policy options for the region. A recently published NEPP report suggests that significant changes will occur in the region's energy entities and institutions. These changes will affect all levels of regional government. The report goes on to say, however, that even with changes in government institutions, private industry will continue to play a principal role in resource development and utilization.

Just how federal and state institutions are currently involved in Regional energy development and utilization is summarized below. Much of this information has been drawn from a report entitled Energy Northwest and from NEPP information, as well as from discussions with federal and state personnel.[1]

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

FEDERAL

An important factor currently influencing federal authority over energy resource development is management of the vast resources found on land owned by the federal government. Management of these government-owned lands also influences resource transport and utilization by means of right-of-way permits, eminent domain legislation, and air and water quality standards.

Land use permits offer the most direct control. They are issued for development of mineral reserves and rights-of-way on federal lands. The permit process may vary depending on how the government acquired the land and on the administrative process adopted by the agency responsible for land management. Federal land is essentially divided into two categories: public domain and acquired lands.

Unlike acquired lands, public domain lands have never passed from federal to private ownership. Except for Indian trust lands and other minor exceptions, the Bureau of Land Management (BLM) of the Department of the Interior has primary land management and leasing responsibilities for public domain lands. Responsibility for managing and leasing Indian trust lands and for issuing rights-of-way over these lands falls to the Department of the Interior's Bureau of Indian Affairs (BIA). The separate leasing and land management responsibilities for Indian lands was designed to ensure that Indian interests would not be compromised.

The U.S. Forest Service (FS) of the Department of Agriculture has land management responsibility over some public domain forest lands. However, leasing and issuance of rights-of-way for these lands are conducted by the BLM.

Similarly, the National Park Service (NPS), the Bureau of Outdoor Recreation, and the Bureau of Reclamation (BR) of the Department of the Interior have land management responsibilities over public domain lands in national parks and recreation lands. In these cases the BLM retains leasing responsibility.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

The General Services Administration (GSA) can handle, under limited circumstances, the disposition of public domain lands. GSA is authorized to to sell property to utilities on an administrative basis. Recent litigation involving a nuclear power plant, while upholding GSA's authority to dispose of public domain lands, now prohibits such disposal before completion of an Environmental Impact Statement (EIS) and an economic feasibility study.

Mineral development rights on public domain lands are obtainable through several mechanisms that may include either the actual leasing for mineral deposits with a royalty provision or other fee payments to the federal government.

Acquired lands may be lands for which the federal government obtained surface rights, subsurface rights, or both. For example, the Forest Service may purchase or otherwise receive rights to subsurface lands and mineral resources to develop and preserve forest resources. While the BLM may or may not have land management control over acquired lands, BLM is responsible for leasing these lands.

Permit procedures for land use on acquired lands vary somewhat from those on public domain lands. All development of minerals require prior leases and royalty payments, unlike the development of minerals on public domain lands. Procedures for obtaining right-of-way and facility siting permits for energy facilities on public and acquired lands are the same in most cases.

Over 82% of the Region's 523 million acres are federally owned. Allocation on federal lands among the states of Alaska, Idaho, Oregon and Washington is presented in Table III-A-1. Besides being the largest state, Alaska leads all states in the percentage of land that is classified under federal ownership (96.4%). The smallest state in the Region, Washington, has the lowest percentage of federal lands (29.5%).

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE III-A-1

FEDERALLY OWNED LANDS COMPARISON FOR THE STATES, REGION, AND UNITED STATES AS OF JUNE 30, 1975 (IN THOUSANDS OF ACRES)

	Total Land Area (Acres)	Federally Owned Land (Acres)	Percent of Respective Total Area	Percent of Region	Percent of United States
Alaska	365,482	352,408	96.4	81.8	46.3
Idaho	52,933	33,742	63.7	7.8	4.4
Oregon	61,599	32,370	52.6	7.5	4.2
Washington	42,694	12,588	29.5	2.9	1.7
Region	522,708	431,108	82.5	100.0	56.7
United States	2,271,343	760,414	33.5	--	100.0

Data Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

In addition to direct management responsibilities over federal lands, the federal government establishes environmental regulations that influence development of energy resources and their utilization. No attempt is made here at a legal interpretation of federal legislation. The following legislation is, however, presented, because it indirectly influences resource utilization within the Region:

1) National Environmental Policy Act of 1969 (42 U.S.C.A. 4321 et seq.) requires extensive formal consideration of the environmental impact of major federal actions--a category likely to cover all federal activities related to energy development at the regional level. The act is implemented by the writing of an environmental impact statement (EIS) by the agency, to be submitted for review by other agencies and the public, with rather permissive rules of challenge. NEPA requirements in at least two significant Department of Interior actions, outer continental shelf leasing and coal leasing on federal lands, may be modified by special purpose federal legislation. Congress appears to be taking the position that both actions are too vital to national interests to leave them subject to "open session" legislation. As in the case of the Alaskan pipeline, EIS's would be prepared, but cutoff dates on other limits may be placed on the challenges anticipated.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

2) Clean Air Act, as amended (42 U.S.C.A. 1957 et seq.) is administered by the U.S. Environmental Protection Agency. The regulation of air quality, particularly in presently unpolluted areas, poses important constraints on fossil energy development. In 1977, the act was amended to include best available control technology (BACT) and visibility requirements.

3) Federal Water Pollution Control Act, as amended (42 U.S.C.A. 1251 et seq.), prescribes major water pollution control efforts, partially subsidized by federal grants-in-aid. Thermal pollution from power plants is a specific target of control. More generally, the planning responsibilities required of watershed regions by the act could affect both energy-related land use and energy demand over the long term.

4) Wild and Scenic Rivers Act (16 U.S.C.A. 1271 et seq.) permits Congressional oversight over rivers of special wilderness value. For example, the inclusion of selected reaches of the Skagit River in northwest Washington has affected licensing of a nuclear plant that would draw upon its waters. Similar cases may develop for coal-fired plants.

5) Coastal Zone Management Act (16 U.S.C.A. 1451 et seq.) requires extensive state planning for land use in shoreline areas. Recently Congress has authorized a coastal zone energy impact fund, recognizing the impact of energy development on the coastal zone.

6) Alaska Native Claims Settlement Act (43 U.S.C.A. 160) gives Congress the responsibility to determine which public lands shall receive special protection as national parks, wildlife refuges, scenic rivers and national forests. Section 17(d)(2) authorizes the Secretary of Interior to withdraw "national interest" lands to be closed to development. Congress is to establish these areas officially by December 1978. Several legislative proposals to locate and provide permanent protection for d-2 lands have been introduced in Congress. The final form of this

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Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

legislation and its impact on mineral development and transportation is uncertain. Beyond the basic question of which areas to designate as d-2 lands is the issue of how much land should be given formal wilderness protection. It is clear, though, that this Act will affect both the energy resources that can be developed and the potential location of generating plants.

Federal institutions are also beginning to move toward the development of unconventional energy uses, such as energy conversion to synthetic natural gas (SNG) or to liquid, energy-based fuels. This involvement may include the utilization of public funds to perform engineering research, to subsidize new plants, and to provide industry loans.

Other areas where federal policy may significantly influence energy development and utilization include:

- Strip mine standards--requirements for surface land restoration, recovery techniques for subsurface drainage and acidity control, leasing and monitoring of operations on federal or state lands.
- Transportation--rate setting for rail shipments, and the (potential) granting of eminent domain power for coal slurry pipelines across railroad rights-of-way.
- Pricing of competitive fuels--the pricing of interstate natural gas and oil, which has been historically competitive with coal.

Specific federal agencies responsible for administering the federal government's role in energy resource utilization are identified below. These federal agencies influence energy resource utilization in five important ways: land management, regulation, setting safety standards, coal technology research and development, and identification of policy options. A brief summary of these principal agencies and their activities under each of the five categories follows.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

Land Management

Within the Region nine federal agencies hold management responsibility over most of the federal lands: BPA, BIA, BLM, BR, Department of Defense, Department of Energy, Fish and Wildlife Service, Forest Service, and National Park Service.

1) Bonneville Power Administration (BPA), Department of Energy. The BPA requires a joint-use permit for those portions of energy facilities that cross or are directly adjacent to its electric power line rights-of-way.

2) Bureau of Indian Affairs (BIA), Department of the Interior. Separate applications must be made to the superintendent of the appropriate Indian Agency for rights-of-way over tribal trust lands. These rights-of-way must be acquired by negotiation or by authority given in an appropriate special Act of Congress. Negotiations for easements across tribal lands presently require payment of an annual fee.

3) Bureau of Land Management (BLM), Department of the Interior. The BLM issues right-of-way grants and permits to cross lands under its jurisdiction, including submerged lands of the outer continental shelf. The BLM also issues prospecting permits; however, prospecting for energy resources is currently suspended.

4) Bureau of Reclamation (BR), Department of the Interior. The BR requires an individual contract for each crossing of land and facilities within an existing irrigation project developed by the BR.

5) Department of Defense (DOD). The Army and Air Force require information on the proposed land use and an environmental impact statement. This information is reviewed by the DOD. Evaluation findings are turned over to the Corps of Engineers, who issue the permit. The Navy requires the same information but issues right-of-way permits directly.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

6) Department of Energy (DOE). DOE negotiates an easement deed over DOE lands. In specific situations, limited land use permits will also be issued but can be revoked if the user fails to meet the requirements called for in the permit.

7) Fish and Wildlife Service (FWS), Department of the Interior. The FWS issues right-of-way permits over the land it administers. These primarily include lands administered by the National Wildlife Refuge Service and some areas over which it has easements for waterfowl management rights. The FWS also reviews any Corps of Engineers permits for their effect on wildlife habitat.

8) Forest Service (FS), Department of Agriculture. A special use permit is required from the FS for rights-of-way on national forest land. Application must be made to each national forest separately.

9) National Park Service (NPS), Department of the Interior. Any construction or easement necessary across national park lands will require a right-of-way permit. Environment impacts are also of concern to the NPS, and thus actions that affect the environment of existing or planned units of the NPS or properties listed or eligible for the National Register of Historic Places or the National Registry of National Landmarks should be prefaced by an environment statement or review addressing these areas.

Regulatory

A number of federal agencies serve as regulatory agencies. Those related to the energy resources but not limited to it are: Coast Guard, Corps of Engineers, Environmental Protection Agency, Federal Aviation Administration, Department of Energy, Federal Communications Commission, Federal Railroad Administration, Interstate Commerce Commission, Geological Survey, and the Security and Exchange Commission.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

- Coast Guard (CG), Department of Transportation. The CG issues permits for all bridges constructed across navigable waters of the United States. The permits require specific clearances from the Environmental Protection Agency, Fish and Wildlife Service, and National Marine Fisheries Service.
- Corps of Engineers (CE), Department of Army. The CE is responsible for processing applications and issuing permits for placement of structures and work on navigable waters of the United States, for the discharge of dredged or fill material in navigable waters, and for the transportation of dredged material to be dumped into ocean waters. The CE review process includes comments by Environmental Protection Agency, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Department of Interior, Fish and Wildlife Service, and affected state and local governments.
- Environmental Protection Agency (EPA). The EPA has primary responsibility for issuing National Pollution Discharge Elimination System (NPDES) permits. This permit regulates the quantity and quality of liquid effluents discharged into rivers and waterways. EPA also has regulations to prevent significant deterioration of air quality. These regulations require preconstruction review and approval for certain types of industrial sources of air emissions.
- Federal Aviation Administration (FAA). The FAA determines the effects of proposed structures on safety in air commerce. Thus, the FAA requires prior notice of any obstruction more than 200 ft high, of obstructions near airports and seaplane bases, and of any construction near or on airports.
- Economic Regulatory Administration (ERA), Department of Energy. The ERA assures that in the case of energy shortages, priority needs for energy are met and the burden of the shortages is borne with equity. ERA also administers a program to encourage utilities to utilize coal.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

- Federal Communications Commission (FCC). Entities that maintain pipelines often operate microwave relay stations for monitoring purposes. Notification of station operation must be filed with the FCC. Construction contractors who use radio communication equipment must also have a license from the FCC.

- Federal Railroad Administration (FRA), Department of Transportation. The FRA administers and enforces the federal laws and related regulations designed to promote safety on railroads.

- Interstate Commerce Commission (ICC). The ICC regulates pipelines. The ICC regulation is concerned primarily with the reasonableness of rates. Prior to operating a pipeline, the ICC must approve a tariff for the pipeline.

- Geologic Survey (GS), Department of the Interior. The USGS approves mining plans and develops assessments of energy resources.

- Security and Exchange Commission (SEC). The SEC's interests are primarily in protecting the investor. The SEC monitors activities that raise public money and approves mergers and acquisitions of oil, gas or electric companies.

Safety Standards

The design and construction of energy facilities must conform to certain federally-set safety standards. Federal agencies responsible for setting standards affecting energy facilities are the Office of Pipeline Safety and the Occupational Safety and Health Administration.

1) Office of Pipeline Safety (OPS), Department of Transportation. The design and construction of pipelines must conform to the standards established by the OPS.

2) Occupational Safety and Health Administration (OSHA), Department of Labor. OSHA develops and promulgates occupational safety and health standards and develops and issues regulations.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

Research and Development

The offices and functions dealing with energy research and development under the jurisdiction of the Department of Interior, the Atomic Energy Commission, the National Science Foundation, the Federal Energy Administration, and the Environmental Protection Agency were consolidated in 1975 and now reside within the Department of Energy (DOE). The mission of DOE research and development is to develop all available domestic energy sources, to assist the nation in becoming self-sufficient in energy, and to protect the environment, public health and welfare.

Policy Evaluation

Federal agencies responsible for identifying and recommending policy are the Council on Environmental Quality, which formulates and recommends national policies to improve the quality of the environment, and the Department of Energy, which establishes policy to ensure that the supply of energy available to the United States will continue to be sufficient to meet our total energy demand.

Council on Environmental Quality (CEQ)

The CEQ advises the President on energy-related environmental issues. The CEQ also monitors and coordinates environmental assessments and regulatory authorities on energy-related activities in the federal government. This includes evaluating and determining priorities of energy requirements in the United States, as opposed to certain environmental regulations that restrict complete energy resource development.

Department of Energy (DOE)

The DOE's responsibilities include developing, recommending, coordinating and implementing national energy policies designed to identify and resolve existing and prospective United States energy problems. The Assistant Secretary for Policy and Evaluation is responsible for assuring that adequate consideration is given competition, antitrust policies and consumer impact in department-decision making.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

A summary of activities of the federal agencies discussed above is provided in Table III-A-2. Federal agencies directly or indirectly influence production, transportation, and conversion components of the energy cycle. Their input may be provided through a variety of mechanisms, from issuing final project approval to funding technological advances. Table III-A-3 summarizes the type of involvement each of the federal agencies may have in the energy resource development.

STATE

Until recently states in the Northwest have not been active in shaping energy policy. In general, planning and implementation of energy facilities and distribution systems have been initiated and carried out by the private sector or by federal agencies. Local levels of government, through public and municipal utility districts, were more active than the state in energy planning and implementation. The state's primary role in energy planning was limited to the regulating powers held by the various state public utility commissions. The commissioners represented the state's position on utility rates and other aspects of private utility operation; they did not have a significant role in energy planning or implementation.

In recent years the Region has been faced with several energy crises that have moved state governments toward more active roles in energy planning. The oil embargo by the OPEC nations in the fall and winter of 1973 had been preceded in late 1972 through the fall of 1973 by below-average waterflow in Northwest rivers and streams. Thus, the Region faced an electrical shortage, then a gasoline shortage. The states came away from these crises with a heightened interest in establishing a direct role in energy planning.

One of the first steps was the creation of state energy offices to assist the governors on energy matters. These offices are also responsible for setting up state conservation programs. However, NEPP, in reviewing the state energy offices, noted that the various state energy offices are likely to differ widely in the scope and degree of their planning activities.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE III-A-2

SUMMARY OF FEDERAL AGENCIES IMPACTING NORTHWEST ENERGY RESOURCES

Federal Agency		Principal Area of Operation: Land Management	Regulation	Safety Standards	Research and Development	Policy
Bonneville Power Administration	(BPA)	x	--	--	--	--
Bureau of Indian Affairs	(BIA)	x	--	--	--	--
Bureau of Land Management	(BLM)	x	--	--	--	--
Bureau of Reclamation	(BR)	x	--	--	--	--
Coast Guard	(CG)	--	x	--	--	--
Corps of Engineers	(CE)	--	x	--	--	--
Council on Environmental Quality	(CEQ)	--	--	--	--	x
Department of Defense	(DOD)	x	--	--	--	--
Department of Energy	(DOE)	x	--	--	x	x
Economic Regulatory Administration	(ERA)	--	x	--	--	--
Environmental Protection Administration	(EPA)	--	x	--	--	--
Federal Aviation Administration	(FAA)	--	x	--	--	--
Federal Communications Commission	(FCC)	--	x	--	--	--
Federal Railroad Administration	(FRA)	--	x	--	--	--
Fish and Wildlife Service	(FWS)	x	--	--	--	--
Forest Service	(FS)	x	--	--	--	--
Geologic Survey	(GS)	--	x	--	--	--
Interstate Commerce Commission	(ICC)	--	x	--	--	--
National Park Service	(NPS)	x	--	--	--	--
Occupational Safety and Health Administration	(OSHA)	--	--	x	--	--
Office of Pipeline Safety	(OPS)	--	--	x	--	--
Securities and Exchange Commission	(SEC)	--	x	--	--	--

Data Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE III-A-3

SUMMARY OF FEDERAL AGENCY INVOLVEMENT IN NORTHWEST ENERGY RESOURCES

Federal Agency	Production			Transportation				Conversion				
	Exploration	Extraction	Local Processing	Railroad	Barge	Truck	Pipeline	Direct Heat	Process Steam	Electric Generation	Gasification	Liquefaction
BPA	--	--	--	--	--	--	P	--	--	--	--	--
BIA	F	--	F	F	--	--	F	--	--	--	--	--
BLM	F	--	F	F	--	--	F	--	--	--	--	--
BR	F	--	F	F	--	--	F	--	--	--	--	--
CG	--	--	--	--	--	--	P	--	--	--	--	--
CE	P	--	P	--	--	--	P	--	--	--	--	--
CEQ	E	E	E	E	E	E	E	--	--	--	E	E
DOD	--	--	--	P	--	--	P	--	--	--	--	--
DOE	--	--	--	F	--	--	P	R&D	R&D	R&D	R&D	R&D
EPA	P	--	P	--	--	--	P	--	--	--	--	--
FAA	--	--	--	--	--	--	--	--	--	P	--	--
FCC	--	--	--	--	--	--	--	--	--	--	--	--
FRA	--	--	--	P	--	--	--	--	--	--	--	--
FWS	A	--	A	--	--	--	A	--	--	--	--	--
FS	F	--	F	F	--	--	F	--	--	--	--	--
GS	--	M	--	--	--	--	--	--	--	--	--	--
ICC	--	--	--	P	P	P	P	--	--	--	--	--
NPS	F	--	F	F	--	--	F	--	--	--	--	--
OSHA	S	S	S	S	S	S	S	S	S	S	S	S
OPS	--	--	--	--	--	--	S	--	--	--	--	--
SEC	S	S	S	S	S	S	S	--	--	S	S	S

A - Major approval or clearance of facility
D - Funds technology development
E - Distributes and/or coordinates environmental impact statements
F - Grants permits, leases, or rights-of-way for federal land administered by that agency
M - Manages leases of federal lands
P - Requires permit
R - Funds research
S - Enforces standards and laws which may relate to energy facilities

Data Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

Besides the state energy offices and public utility commissions, state agencies have jurisdiction regarding economic development, program planning, ecology, and other areas that vary in scope, title and authority from state to state. With this authority the states have substantial capability to influence energy planning.

While state power planning activities have been limited, considerable potential for involvement does exist:

> One point that emerges clearly from a study of the statutes and from state programs under them over the past few years is that the state government is not undertaking something new when it engages in planning and regulation of development and of land use. It is already profoundly in that business. The state resource and development management programs ... reflect an ongoing and extensive involvement by state government in this area. What is missing is an explicit recognition of this fact, and a more concerted effort to develop a coherent, coordinated approach to the execution of these responsibilities.(1)

The greatest potential for state influence exists in the cases of plants that have not received licenses. By being involved in land use planning decisions, the states could have considerable authority. The licensing procedures that are partly responsible for the present frustrations of the electrical utilities could be modified to speed up or slow down construction schedules.

The possibility also exists that states could individually or collectively influence the Region's energy picture by modifying their environmental protection standards and policies. Key environmental constraints now affect the Region's electric power program, and similar constraints exist with oil transportation and industrial utilization of coal.(2)

Air and water pollution and waste heat are subject to various state jurisdictions that could conceivably be modified by legislative or administrative action to establish either more or less severe restrictions on power plant operation and support. Licensed power plants could be affected by

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(1) Information Source: Reference 2, Review and Analysis of State Statutes Pertaining to Statewide Development Planning and Land, Water and Air Resource Management, p. 95.

(2) Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

such changes with a resulting effect on the Region's electrical power supplies. For example, effluent limitations can have an important impact on project location, design and cost.

One important consideration is the possibility of federal pre-emption in the name of national energy goals. If state air standards were relaxed, for instance, federal jurisdictions such as those under the Clean Air Act or other statutes could reduce or eliminate the impact of state action.

Existing constraints at least partly under state and local government control include:

- air quality standards enforcement. On a statewide (or better, Region-wide) basis designate point emission levels and particulate emission standards.
- facility and plant siting. Government regulates the flexibility of facility siting through siting councils.
- dedicated "public" bulk storage sites and transportation facilities. These could be provided from state or county land inventories or through the exercise of powers of eminent domain. In addition, state-chartered port districts (including inland ports) could be given encouragement to install energy handling and transfer components, and bulk storage areas.
- public utility status. Gas and electricity utilities are able to raise capital through utility-type security issues and to petition for exercise of eminent domain.

States can also influence energy projects through leases and right-of-way easements on state-owned lands. Some reserve deposits occur on state lands and thus require direct state participation in exploration and extraction. State-owned lands may also play an important role in providing rights-of-way for transportation.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

Coal-fired steam generation plants are strong candidates for increasing the electric generating capacity in each of the Northwest states. One coal-fired power plant is now operating at Centralia, Washington; another is under construction at Boardman, Oregon. Recently a coal-fired plant was proposed but rejected on the basis of air quality considerations for an area near Boise, Idaho. Coal-fired steam generation plants in Alaska are being considered to meet the state's rapidly expanding electricity demand.

Each of the four states is establishing some authority in the areas of energy conservation and energy facility siting. The public utility commissioners of each state have been regulating the rate structure of private utilities and natural gas companies for some time. Conservation programs have been operated out of the state energy offices. However, only in Oregon have the functions of the energy office and energy facility siting been administered under one office. Recently the Oregon Department of Energy published a report, Future Energy Options for Oregon; an energy demand forecasting model for the state was developed for this report. This was a unique step among the four states, in that it helps the state determine the future need for energy--an area previously attended to only by the utilities, BPA, and some specialized consultants.

A listing of the state agencies responsible for each state's conservation program, siting of energy facilities, and utility regulation is provided in Table III-A-4.

Local government agencies interface with energy utilization primarily in the areas of energy facility siting, local infrastructure impacts, and building codes. Basically, local agencies may be involved in two ways in the facility siting process. The first is as temporary members of the state siting council. The second is as agencies of local government which identify, characterize and mitigate anticipated local impacts. It is important that local government adequately plan for minimizing adverse social and economic impacts.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE III-A-4

STATE AGENCIES RESPONSIBLE FOR ENERGY CONSERVATION, FACILITY SITING AND UTILITY REGULATION PROGRAMS[a]

State	Conservation	Energy Facility Siting	Public Utility Regulation
Alaska	Alaska Department of Power and Energy Management	Alaska Coastal Zone Management Council Alaska Department of Natural Resources Alaska Power Authority Alaska Department of Fish and Game	Alaska Public Utilities Commission
Idaho	Idaho State Office of Energy	Idaho Public Utilities Commission	Idaho Public Utilities Commission
Oregon	Oregon Department of Energy	Oregon Department of Energy	Oregon Public Utility Commissioner
Washington	Washington State Energy Office	Washington Energy Facility Site Evaluation Council	Washington Utilities and Transportation Commission

(a) Data Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21.

The precise nature of local government involvement in siting decisions varies from state to state. In Oregon and Washington, representatives of county legislative authorities from the affected counties sit on or are advisors to the respective siting councils for the duration of the siting decision affecting them. Just how the local representative is to represent all local government (including cities and towns) is not clear. In some counties the local governments and county governments do not communicate regularly.

In addition to the question of how local governments are to be involved in the decision process is the issue of how much consideration should be given to the local government perspective in siting. These issues have not yet been fully resolved.

The following information discusses state and local agency involvement in energy planning.

Information Source: Ref. 1, The Impact of Increased Coal Consumption, RAP-21.

Alaska

Discussions with state officials indicate that the State of Alaska owns lands containing significant energy resources. The primary responsibility for managing these lands falls within the purview of the Department of National Resources (DNR). The DNR handles all requests for energy exploration and mining on state lands and right-of-way permits over state lands for access to the mine or for transport of resources to market. The DNR is also responsible for water right permits.

The DNR coordinates the state response and state approval of bulk energy supply facilities. To facilitate state review, the DNR requests a Plan of Operation from the applicant and reviews the Plan of Operation for compliance with DNR regulations and standards. The DNR also requests review by the Department of Environmental Conservation for air and water quality regulations, the Department of Fish and Game for ecological considerations, and the Department of Policy Development and Planning for overall state policy. Other state agencies review the Plan of Operation when they have a vested interest. The DNR will also request comment from the borough and hold hearings for public impact.

The DNR routinely circulates requests for energy exploration, mining, right-of-way and water rights permits; it is noted, however, that the Department of Fish and Game is responsible under Alaska statute for designated anadromous streams throughout the state. The Department of Fish and Game can require the submission and review of developer and user plans directly for review and approval of any work affecting anadromous fish waters.

Idaho

In Idaho the state agencies primarily governing energy policy and planning are the Office of Energy and the Public Utility Commission (PUC). The PUC represents the state in evaluating the needs of privately owned utility service areas for electric power, physical siting of power plants and

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Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

pipelines, and environmental assessments. The state does not have its own environmental policy act, and does not specifically require an environmental impact statement. When available, the state will use and supplement the federal environmental impact statement.

The PUC, after deliberation of need, environmental considerations and other related factors, issues a Certificate of Convenience and Necessity. It has the authority to preempt other state, county and local jurisdictions, with the exception of the Department of Health and Welfare, which has authority over administering air and water quality standards. However, the federal Environmental Protection Agency has not (at the time of this writing) delegated authority to the State of Idaho to issue National Pollution Discharge Elimination System (NPDES) permits.

State agencies directly involved in issuing the required site certificates and necessary permits include:

- Public Utility Commission--Certificate of Public Convenience and Necessity
- Department of Health and Welfare--Permit to Construct and Permit to Operate
- Department of Water Resources--Water Use Permit.

Oregon

In July of 1975 the Oregon State Legislature created the Department of Energy; its duties include engaging in research projects related to energy, collecting data on energy, and informing the public. The Department annually provides a preliminary and final forecast of energy supply and demand that defines the state's needs for power. The same legislation created the Energy Facility Siting Council (EFSC) along with the Department of Energy. The Council is a seven-member group comprised of private citizens appointed by the Governor for four-year terms with one renewal. While the Council is not a true one-stop siting authority, it is a one-step coordinating authority.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

At the conclusion of the siting process and the issuance of a Site Agreement by the Governor, the Agreement becomes binding in all state, county and local jurisdictions. Each state agency must, however, issue and enforce its own permits as separate actions apart from the Site Agreement.

Energy facilities falling under the State Energy Facility Siting Council's certification process include:

1) conversion facilities that have a generating capacity of 25,000 kW or more
2) pipelines 6 in. or more in diameter and at least 5 miles long.

The applicant for an energy facility site certificate for a specific site must file with the EFSC a notice of intent at least 1 yr before application for site certification. The Council then distributes copies of the notice of intent to interested parties and solicits comments from the following 11 state government bodies:

- Department of Environmental Quality
- Water Policy Review Board
- State Fish and Wildlife Commission
- Health Division
- State Geologist
- State Forestry Department
- Public Utility Commissioner of Oregon
- State Department of Agriculture
- Department of Transportation
- Department of Land Conservation and Development
- Economic Development Department.

Copies are also distributed to any city or county affected by the construction or operation of the facility.

Besides the Site Certificate Agreement, state agencies require their own permits. The Mined Land Reclamation Division of the Department of

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Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

Geology and Mineral Industries requires a Surface Mining Operation Permit and Bond if more than one acre per year is to be disturbed. No permits are required from the Department for underground mining. If Oregon's coal deposits were to be mined, underground mining would be the primary type of extraction.

The Division of State Lands manages, among other lands, the state's submerged and submergible lands. Permits are required for alteration or use of these tidelands, such as may be the case when introducing coal transportation by barge into an area not previously used for barge transportation. State permits cover fill, removal and riprap on state lands. However, the construction of a simple wharf for unloading coal would not require a permit. Permits for wharfs and other facilities in navigable waters are obtained from the Corps of Engineers with review and comment solicited from the Division of State Lands, which then coordinates input from other state agencies in their reply to the Corps.

The Department of Transportation (DOT) has jurisdiction over state highway right-of-way lands. These lands are important in that they provide right-of-way access for more than just highways. For a pipeline to use a state highway right-of-way would require a permit. Construction of an approach to a state highway also requires a DOT permit.

The Department of Environmental Quality (DEQ) discharges the state's interest in air and water quality matters. State air quality and waste quality concerns apply to all three activities of the energy cycle (production, transportation and conversion). DEQ requires the following notices and permits:

- Notice of Construction and Approval of Plans for Air Contaminant Sources
- Air Contaminant Discharge Permit
- Water Pollution Control Facility Permit
- Waste Discharge Permit (NPDES).

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

The Department of Water Resources handles water appropriations. Among the permits obtained through the Department are:

- Water Rights
- Permit to Construct Reservoir
- Permit to Appropriate Ground Water
- Permit to Appropriate Public Water.

The Department of Fish and Wildlife has approved authority over activities that cross waterways, such as pipelines and railroad spurs, and provides permits for blasting in water.

The Railroad Division of the Public Utility Commissioner provides permits for track clearances, railroad-highway crossings, and variances.

State and local governmental agencies are bound by the EFSC decision when issuing their permits. The Governor may refuse to execute a site certificate approved by the Council. He cannot, however, execute a site certificate application rejected by the Council. The Governor must sign the certificate within 30 days after receipt; if not, the certificate is void.

Washington

The Washington State Energy Office responsibilities include identifying state energy policy options, collecting and compiling data necessary to develop and implement an overall management and conservation program for the state government, and advising the Governor on energy matters. The office does not get into the business of energy demand forecasting but does collect available information (from utilities, etc.) and critiques these attempts to forecast demand.

The Washington State Legislature in March 1976 established the Energy Facility Site Evaluation Council (EFSEC), a one-stop energy facility siting authority. EFSEC is an outgrowth of the original Thermal Power Plant Site Evaluation Council, established in 1970. EFSEC is basically a reactive body,

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Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

in that its purpose is to react to specific proposals for siting energy facilities in the state. Its scope covers all new energy facility siting and major modifications of existing facilities, and includes associated facilities.

The Council consists of representatives of 14 state entities, plus a representative from the city or county where the site is located. If more than one incorporated area or county is involved, a representative of each sits on the council during hearing proceedings for that entity only. When an application for a proposed port facility is filed, a port district member or designee may be appointed to the council as a nonvoting member. Membership is restricted to those times the council considers the proposed site for the port district represented. Agencies represented on the Council include:

- Department of Ecology
- Department of Fisheries
- Department of Parks and Recreation
- Interagency Committee for Outdoor Recreation
- Utilities and Transportation Commission
- Department of Natural Resources
- Department of Emergency Services
- Department of Game
- Department of Social and Health Services
- Department of Commerce and Economic Development
- Office of Program Planning and Fiscal Management
- Planning and Community Affairs Agency
- Department of Highways
- Department of Agriculture.

The Council's authority in siting approval supersedes that of any of the state's departments, agencies, divisions, bureaus, commissions or boards, whether a member or not. The Site Certification Agreement, when signed

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Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

by the Governor and the applicant, is binding upon each party. The Governor must act on the certification recommendation within 60 days of its receipt.

The Department of Natural Resources manages a large holding of land owned by the State of Washington. There are significant energy deposits on state-owned lands; however, the extent of these resources has not been determined. Currently a moratorium has been placed upon leasing by the Department of Natural Resources so that rental rates, royalties and lease terms can be worked out. The moratorium is expected to be lifted soon.

The Department of Natural Resources also administers the state's surface mining reclamation permits. Presently four Surface Mining Permits are active. One is for the mine supporting the Centralia coal-fired generation plant, and the others are for much smaller operations in the state. The Department also issues permits for pipeline, transmission line, and other right-of-way easements over state lands.

Other agency permits that apply to the various energy cycle activities include air and water permits from the Department of Ecology and from the Regional Air Pollution Control Agency (considered a local government agency, as it administers permits over a county or multi-county area), hydraulic permits for in-stream work from the Department of Fisheries and the Department of Game, and Shoreline Management Substantial Development Permits from the county. The county also administers zoning, rezoning, conditional use, and building permits.

State agency involvement in energy utilization is summarized in Table III-A-5. The table lists the primary state agencies involved in energy matters and identifies the mechanism used by the agency to participate in or provide input into the narrow components of the energy cycle.

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

TABLE III-A-5

SUMMARY OF STATE AGENCY INVOLVEMENT IN ENERGY RESOURCES

State Agency	Production			Transportation				Conversion		
	Exploration	Extraction	Local Processing	Railroad	Barge	Truck	Pipeline	Direct Heat	Process Steam	Electric Generation
Alaska										
Department of Natural Resources	P	P	P	P	P	P	P	--	--	P
Department of Environmental Conservation	--	--	--	--	--	--	--	P	P	--
Department of Fish and Game	A	A	A	A	A	A	A	--	--	A
Department of Highways	--	--	--	--	--	P	--	--	--	--
Department of Policy Development and Planning	--	Z	Z	Z	Z	Z	Z	--	--	Z
Idaho										
Public Utility Commission	--	--	--	--	--	--	--	--	--	C
Department of Health and Welfare	--	P	P	--	--	--	--	P	P	P
Department of Water Resources	--	--	P	--	--	--	P	--	--	--
Department of Lands	--	--	--	--	--	--	P	--	--	--
Oregon										
Energy Facility Siting Council	--	--	--	--	--	--	S	--	--	S
Department of Environmental Quality	--	P	P	--	--	--	--	P	P	P
Public Utility Commissioner	--	--	--	P	--	--	--	--	--	--
Division of State Lands	--	--	--	--	P	--	P	--	--	--
Department of Water Resources	--	--	P	--	--	--	P	--	P	P
Department of Geology	--	P	--	--	--	--	--	--	--	--
Department of Fish and Wildlife	--	A	--	--	--	--	A	--	--	A
Department of Transportation	--	--	--	--	--	P	--	--	--	--
County	--	Z	ZB	Z	Z	Z	Z	ZB	ZB	ZB
Washington										
Energy Facility Site Evaluation Council	--	S	--	--	--	--	--	--	--	S
Department of Natural Resources	L	L	--	--	--	--	P	--	--	--
Department of Ecology	--	--	P	--	--	--	--	P	P	--
Department of Fisheries	--	--	--	--	P	--	--	--	--	--
Department of Game	--	--	--	--	P	--	--	--	--	--
Department of Social and Health Services	--	--	--	--	--	--	--	P	P	--
Regional Air Pollution Control Agency(a)	--	--	P	--	--	--	--	P	P	--
County(a)	--	Z	B	--	--	--	--	ZB	ZB	Z

(a) Local government
A - Approval
B - Building Permit
C - Certificate of Convenience and Necessity
L - Lease
P - Permit
S - Site Certification Agreement
Z - Zoning, Rezoning, Conditional Use

Information Source: Reference 1, The Impact of Increased Coal Consumption, RAP-21.

REGIONAL ENERGY-RELATED ORGANIZATIONS

Regional organizations as described here serve more than one state and operate from one of the four Northwest states (Alaska, Idaho, Oregon, and Washington). Some of these organizations address a specific subject, such as water resources management or economic development, but energy is a major factor in their efforts and has received special attention.

FEDERAL GOVERNMENT ENTITIES

Alaska Power Administration

The Alaska Power Administration functions include planning for water, power, and related resource development and utilization in Alaska in cooperation with other state, local and federal entities. Included within its functions is power marketing for federal hydroelectric projects. Marketing of power from the Eklatna and Snettisham hydroelectric projects, and the related transmission systems serving Anchorage and Juneau areas, come under the Administration's responsibility. The Administration also assesses the long-range potential of the state's hydroelectric power resources.

Alaska Power Administration
Federal Building
P.O. Box 50
Juneau, Alaska 99801

Telephone: (907) 586-7405

Bonneville Power Administration

Through a region-wide interconnecting transmission system, the Bonneville Power Administration markets electric power and energy from federal hydroelectric projects in the Pacific Northwest. BPA sells power surplus to the needs of the Pacific Northwest outside the region and participates in other interregional exchanges of power.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

BPA conducts power marketing programs to provide the basis for a sound regional economy. The Administration also participates with other governmental agencies and nonfederal groups in planning for the orderly development of the region's potential electric energy resources--hydro and thermal--to meet long-term power needs, and in the development and implementation of operating agreements concerning power generation and transmission facilities. In addition BPA plays a key role in the joint Power Planning Council, comprised of all interested public and private power systems in the region, and in formulating cooperative plans for efficient development of the region's future hydrothermal power facilities.

Through its interconnections with the principal generating utilities of the Northwest Power Pool, the BPA transmission network provides the capacity and wheeling capacity necessary for operation of the power pool and for carrying out the requirements of the Pacific Northwest Coordination Agreement.

Bonneville Power Administration
1002 N.E. Holliday Street
P.O. Box 3621
Portland, OR 97208

Telephone: (503) 234-3361

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

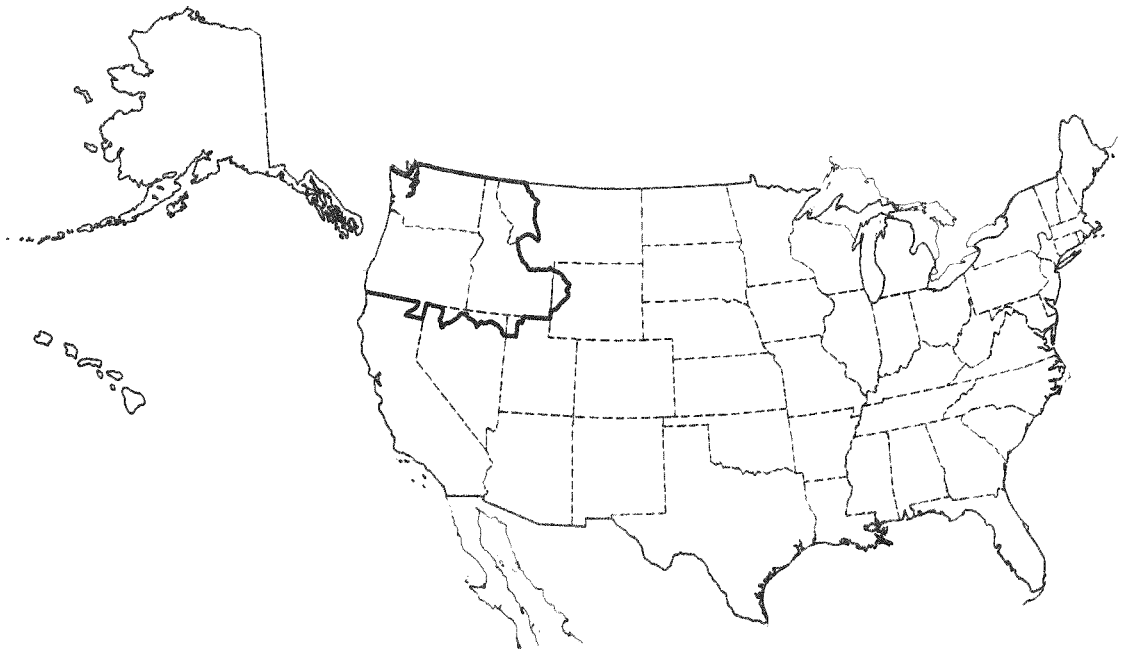

FIGURE III-A-1. Bonneville Power Administration Power Marketing Area

Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

JOINT FEDERAL STATE OF GOVERNMENT ENTITIES

Federal Regional Council

Council activities include: improving working relationships between the major federal domestic agencies and state and local governments. The Council assists state and local governments in analyzing and planning for energy development problems causing major Regional changes such as the Alaska pipeline. There is a council for each of the ten standard federal regions composed of the principal regional officials from the eleven agencies represented: the Departments of Health, Education, and Welfare; Commerce; Labor; Housing and Urban Development; Agriculture; Interior; Transportation: the Community Services Administration (OEO); the Environmental Protection Agency; Law Enforcement Assistance Administration; and the Federal Energy Administration.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Federal Regional Council
Region X
Arcade Plaza Building
1321 Second Avenue
Seattle, WN 98101
Telephone (206) 442-1593

Pacific Northwest Regional Commission

The Regional Commission develops and implements comprehensive long-range economic development programs. (See accompanying Figure III-A-2, Regional Commission Areas.) There are presently eight regional commissions. Each has authority to grant funds to the states, area-wide districts or local governments within its jurisdiction for planning and technical assistance purposes, including research studies, and planning and demonstration projects. The Pacific Northwest Regional Commission has completed a two year project to identify legislative opportunities available to the states in dealing with energy issues.

Pacific Northwest Regional Commission
2435 Virginia Avenue
Washington, D.C. 20037
Telephone (202) 633-7458

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

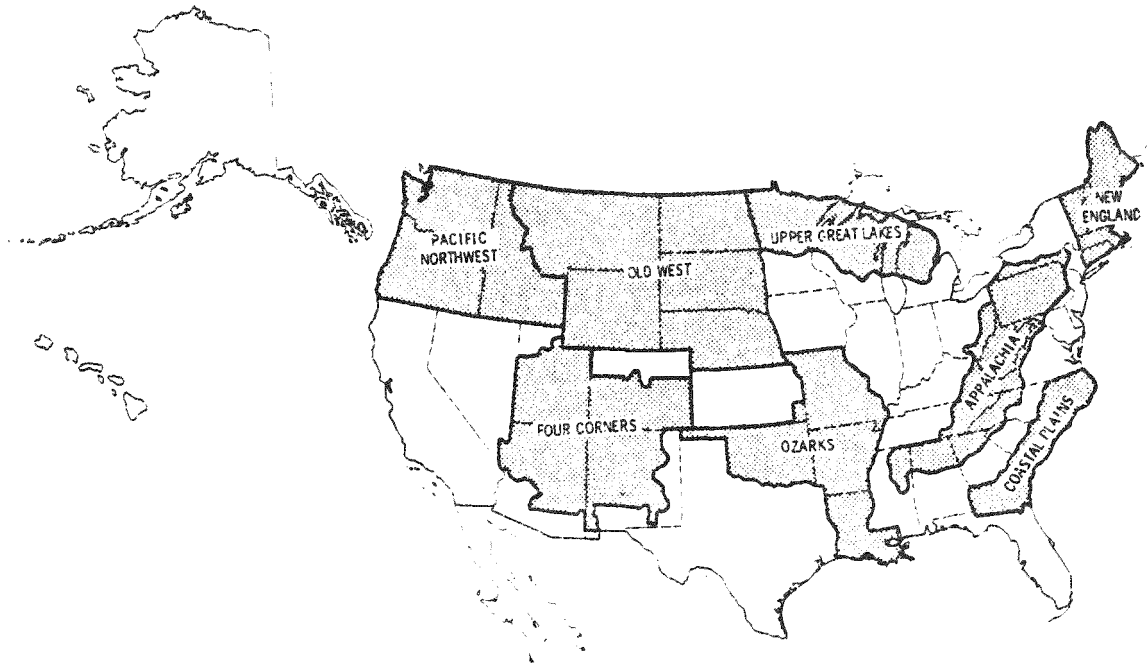

FIGURE III-A-2. Regional Commission Areas

Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Pacific Northwest River Basins Commission

Established in 1967 at the request of the Governors of Idaho, Montana, Oregon, Washington and Wyoming, the Commission consists of state and federal representatives of water-related agencies. Principal functions include coordination and recommendation of developmental and research plans for water-related issues. The Commission has an energy subcommittee that publishes comprehensive yearly reviews of power planning in the Pacific Northwest.

Pacific Northwest River Basins Commission
1 Columbia River
Vancouver, WA 98660

Telephone (206) 694-2581
(503) 285-0467

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

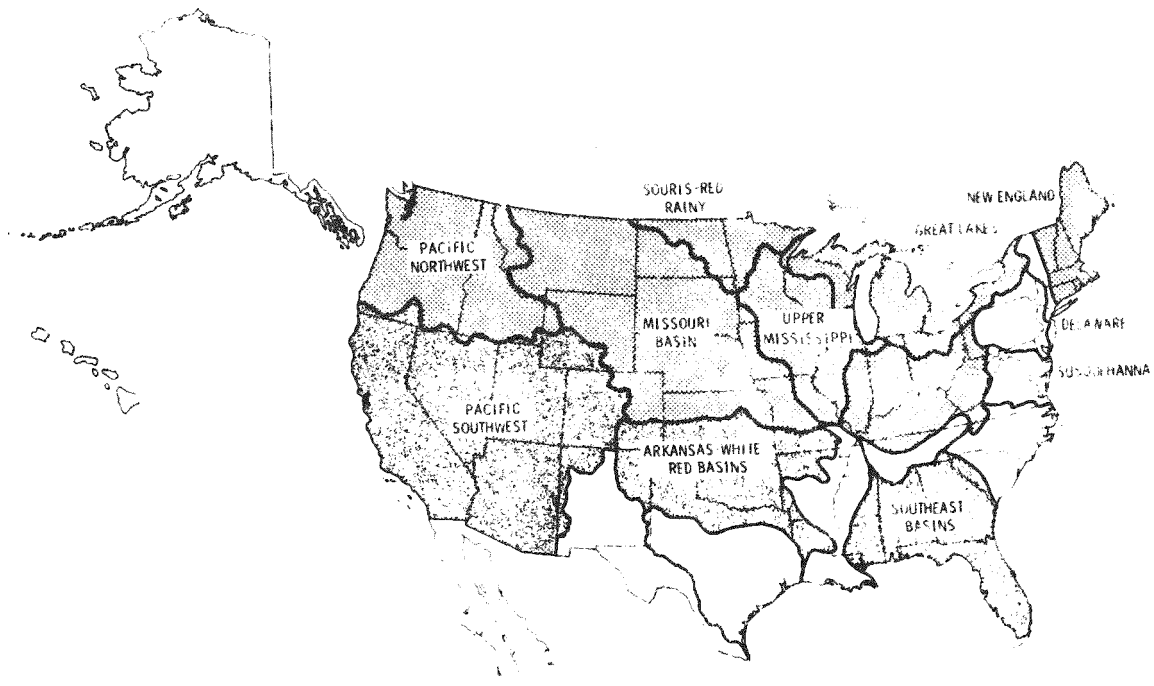

FIGURE III-A-3. River Basin Commission, Interagency Committee and Federal-State Compact Commission Areas

Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Western Interstate Energy Board

The Western Interstate Energy Board (WIEB) is the administrative unit for a staturary agreement among 12 western states and ratified by the U.S. Congress.

The Board is composed of representatives appointed by the Governor of each state and a Federal Government representative appointed by the President of the United States. Funds are supplied by appropriations from each member state.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

The Board officers and address are as follows:

Western Interstate Energy Board
Suite 2500, Stapleton Plaze
33 Quebec
Denver, CO 80207

Telephone (303) 837-5851

FIGURE III-A-4. Western Interstate Energy Compact Area

Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

REGIONAL PRIVATE ORGANIZATIONS

National Electric Reliability Council

The National Electric Reliability Council (NERC) was formed by the electric utility industry in 1968 to augment the reliability and adequacy of bulk power supply of electric utility systems in North America. NERC consists of nine regional reliability councils whose membership comprises essentially all of the electric power systems in the United States and the Canadian systems in the providences of Ontario, British Columbia, Manitoba, and New Brunswick.

National Electric Reliability Council
Research Park, Terhune Road
Princeton, NJ 08540

Telephone: (609) 924-6050

Western Systems Coordinating Council

The Western Systems Coordinating Council (WSCC) consists of four natural subregions which reflect concentrations of natural resources and economic influences: Northwest Power Pool, the Rocky Mountain Power Area, New Mexico Power Pool, and the Pacific Southwest Power Area.

The purpose of WSCC is to promote reliable operation of interconnected power systems by the coordination of planning and operation of generating and interconnected transmission facilities. WSCC provides a formal means of exchanging information and system data and for making necessary regional studies and recommendations designed to increase the reliability of the interconnected systems. Four standing committees have been formed to carry on the activities of the Council: Executive, Operating, Planning Coordination, and Public Information.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Western Systems Coordinating Council
University of Utah Research Park
540 Arapeen Drive, Suite 230
Salt Lake City, UT 84108
Telephone: (801) 582-0353

ECAR	EAST CENTRAL AREA RELIABILITY COORDINATION AGREEMENT	MAIN	MID-AMERICA INTERPOOL NETWORK	SERC	SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL
ERCOT	ELECTRIC RELIABILITY COUNCIL OF TEXAS	MARCA	MID-CONTINENT AREA RELIABILITY COORDINATION AGREEMENT	SPP	SOUTHWEST POWER POOL
MAAC	MID-ATLANTIC AREA COUNCIL	NPCC	NORTHEAST POWER COORDINATING COUNCIL	WSCC	WESTERN SYSTEMS COORDINATING COUNCIL

FIGURE III-A-5. National Electric Reliability Council Areas in the U.S.

Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Northwest Power Pool

The Northwest Power Pool is a group of utilities and agencies which voluntarily operate their power systems on a coordinated basis. It was created during World War II as a result of the War Production Board Order L-94 in 1942, directing utilities throughout the United States to cooperate with one another to increase the electrical capacity to meet added war loads.

When the Northwest Power Pool was formed, there were, in essence, two integrated power networks linked only by the intertie between Washington Water Power Company and Montana Power Company in northern Idaho. This intertie was not considered strong enough to make large power transfers between the networks. Therefore, the Pool used West Group and East Group designations in 1956 and now considers the area as a whole. The Pacific Northwest Utilities Conference Committee, which is an outgrowth of the Northwest Power Pool, maintains the designation of the West Group Area.

Northwest Power Pool
1210 Public Service Building
Portland, OR 97204

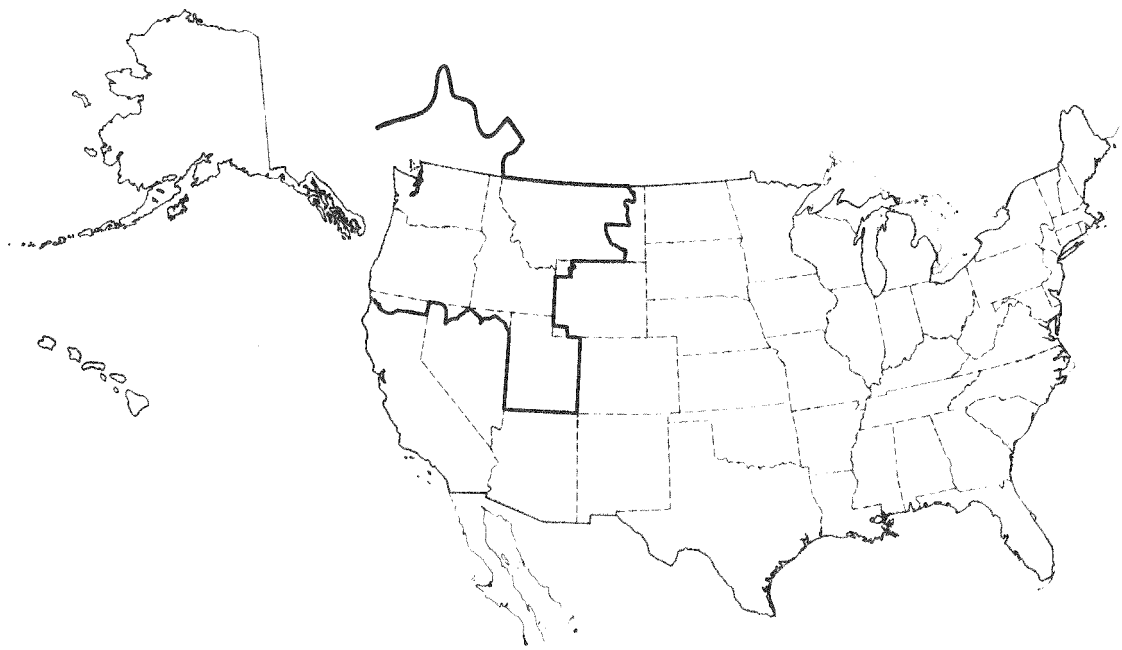

FIGURE III-A-6. Northwest Power Pool Area

Information and Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Pacific Northwest Utilities Conference Committee

The Defense Electric Power Administration (DEPA), formed under the Defense Production Act of 1950 by order of the Secretary of the Interior, required that forecasts be made periodically on loads and resources for 10 years in the future from all parts of the country. The complexities of loads and resources in the Pacific Northwest had become so involved by that time that a separate entity was needed for longer-range forecasting.

Since the Northwest Power Pool had experience in making forecasts on a one-year basis, members of the Pool in the West Group Area invited other utilities to participate and formed the Pacific Northwest Utilities Conference Committee (PNUCC). This committee made estimates of loads and resources in the Northwest for DEPA. Although DEPA withdrew this requirement June 30, 1953, estimates made by the PNUCC proved so useful to power planning engineers and others that the committee has continued making long-range forecasts on an annual basis.

The annual report of the PNUCC titled "Pacific Northwest Utilities Conference Committee WEST GROUP FORECAST of Power Loads and Resources," published in January, covers the subsequent 10-year period by months on a power-year (July through June) basis.

The main part of this report consists of a detailed analysis of total load and resources available within the West Group of the Northwest Power Pool. The loads are summations of the system peak loads and system energy loads estimated by each of the utilities operating in the area. The resources are shown as peak and average energy capabilities for both average and adverse water conditions. Summary tabulations include only that interchange with parties outside of the area presently under firm contract, although exhibits have been included in the main report to indicate potential interchange with outside parties. This "West Group Forecast" is considered one of the most informative reports on loads and resources in the Northwest.

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Pacific Northwest Utilities Conference Committee
P.O. Box 1231
Wenatchee, WA 98801

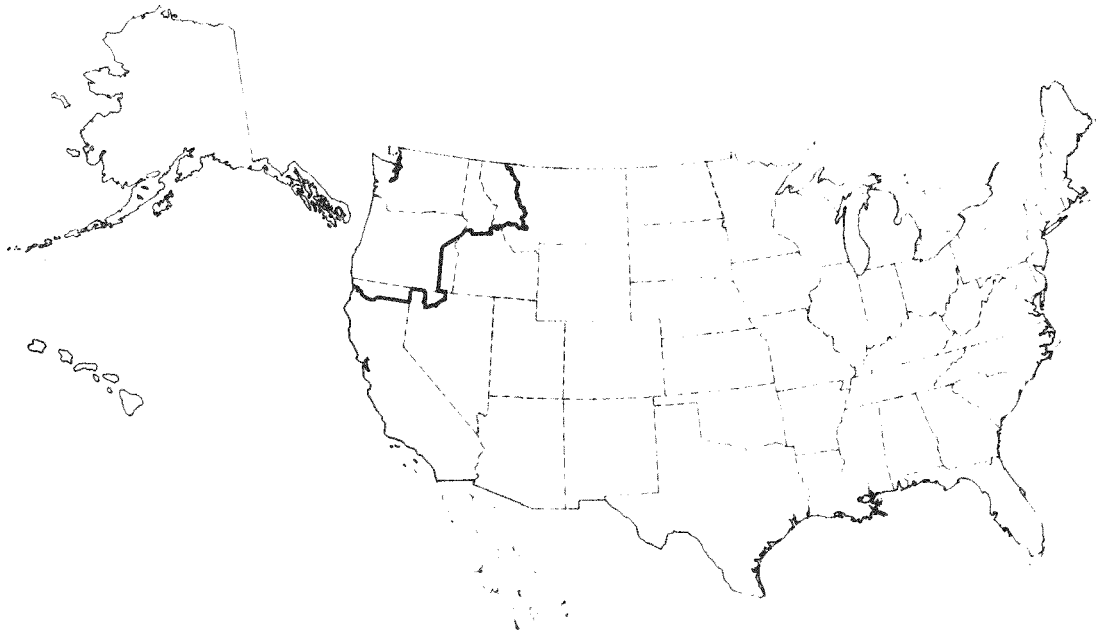

FIGURE III-A-7. Pacific Northwest Utilities Conference Committee - West Group Area

Data Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

STATE ENERGY-RELATED ORGANIZATIONS

State energy related organizations include: State Government Entities, Utility Entities, and State Energy-Related Associations.

STATE GOVERNMENT ENTITIES

Energy Conservation

Alaska State Energy Office
Mackay Building
338 Denali Street
Anchorage, AK 99501
Telephone (907) 272-0527

Idaho State Office of Energy
300 North 6th Street
Capital Park Plaza Building
Boise, ID 83720
Telephone (208) 384-3258

Oregon Department of Energy
528 Cottage, N.E.
Salem, OR 97310
Telephone (503) 378-1429

Washington State Energy Office

400 East Union Avenue
Olympia, WA 98504
Telephone (206) 754-4350

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Energy Facility Siting

Alaska Department of Natural Resources
11th Floor, State Office Building
Pouch M
Juneau, AK 99811

Telephone (907) 465-2400

Idaho Public Utilities Commission
472 W. Washington Street
Boise, ID 83720

Telephone (208) 384-3143

Oregon Energy Facility Siting Council
Department of Energy
528 Cottage, N.E.
Salem, OR 97310

Telephone (503) 378-4128

Washington Energy Facility Site Evaluation Council
820 East Fifth Avenue
Olympia, WA 98504

Telephone (206) 753-7384

Public Utility Regulation

Alaska Public Utilities Commission
1100 MacKay Building
338 Denali Street
Anchorage, AK 99501

Telephone (907) 272-1487

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Idaho Public Utilities Commission
427 W. Washington Street
Boise, ID 83720

Telephone (208) 384-3143

Oregon Public Utility Commissioner
300 Labor and Industries Building
Salem, OR 97310

Telephone (503) 378-6611

Charles Davis, Commissioner

Telephone (503) 378-6622

Washington Utilities and Transportation Commission
Highways-Licenses Building
Olympia, WA 98504

Telephone (206) 753-6430

Comprehensive Land Use Planning

Alaska Department of Natural Resources
11th Floor, State Office Building
Pouch M
Juneau, AK 99811

Telephone (907) 465-2400

Idaho Bureau of Community Affairs
State House
Boise, ID 83720

Telephone (208) 384-3416

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Oregon Land Conservation and Development Commission
1175 Cort Street, N.E.
Salem, OR 97310

Telephone (503) 378-4926

Washington Office of Financial Management
Policy Analysis Division
State Planning Division
House Office Building
Olympia, WA 98504

Telephone (206) 753-5297

Coastal Zone Management

Alaska Coastal Management
Division of Policy Development and Planning

Pouch AP
Juneau, AK 99801

Telephone (907) 465-3540

Oregon Land Conservation and Development Commission
1175 Cort Street, N.E.
Salem, OR 97310

Telephone (503) 378-4926

Washington Department of Ecology
State of Washington
Olympia, WA 98504

Telephone (206) 753-6894

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Major Electric Utilities - Alaska

3 Investor Owned Companies
10 Municipal Systems
12 Rural Electric Cooperatives

Anchorage Municipal Light and Power Department
1200 E First Avenue
Anchorage, AK 99501
Telephone (907) 279-7671

Electrical Customers - 14,714
Total Generation Capacity - 120,600 kW

Chugach Electric Association, Inc.
P.O. Box 3518
Anchorage, AK 99501
Telephone (907) 272-4441

Electrical Customers - 38,079
Generation Capacity - 240,900 kW

Major Electric Utilities - Idaho

5 Investor Owned Companies
12 Municipal Systems
10 Rural Electric Cooperatives
2 U.S. Government
1 Mutual System

Idaho Power Company
1220 Idaho Street
P.O. Box 70
Boise, ID 83721
Telephone (208) 345-7210

Electrical Customers - 207,371
Total Generation Capacity as of January 1, 1976 - 1,848,703 kW

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Idaho Falls Electric Light Division
P.O. Box 220
Idaho Falls, ID 83401

Telephone (208) 522-3191, Ext. 222

Electrical Customers - 13,203
Total Generation Capacity - 7,400 kW

Pacific Power and Light Company
Public Service Building
920 S.W. 6th Avenue
Portland, OR 97204

Telephone (503) 226-7411

Utah Power and Light Company
1407 West North Temple Street
P.O. Box 899
Salt Lake City, UT 84110

Telephone (801) 350-3535

Major Electric Utilities - Oregon

2 Investor Owned Companies
11 Municipal Systems
15 Rural Electric Cooperatives
4 Public Power Districts
3 U.S. Government

Eugene Water and Electric Board
500 Fourth Avenue, E.
Eugene, OR 97401

Telephone (503) 343-1661

Electrical Customers - 51,758
Generating Capacity - 171,580 kW

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Portland General Electric Company

621 S.W. Alder Street
Portland, OR 97205

Telephone: (503) 228-7181

Electrical Customers - 405,542
Total Generation Capacity as of January 1, 1976 - 2,285,430 kW

Pacific Power and Light Company

Pacific Service Building
920 S.W. 6th Avenue
Portland, OR 97204

Telephone: (503) 226-7411

Electrical Customers - 547,307
Total Generation Capacity as of January 1, 1976 - 2,828,837 kW

Tillamook Peoples Utility District

906 Main Avenue
Tillamook, OR 97141

Telephone: (503) 342-2535

Electrical Customers - 12,993
Generating Capacity - 0

Major Electric Utilities - Washington

3 Investor Owned Companies
18 Municipal Systems
9 Rural Electric Cooperatives
23 Public Power Districts
1 Irrigation District
2 U.S. Government
6 Mutual Systems

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Inland Power and Light Company
East 320 Second Avenue
Spokane, WA 99202
Telephone: (509) 747-7151

Electrical Customers - 14,830
Generation Capacity - 0

Pacific Power and Light Company
Public Service Building
920 S.W. 6th Avenue
Portland, OR 97204
Telephone: (503) 226-7411
(SEE OREGON)

Puget Sound Power and Light Company
Puget Power Building
Bellevue, WA 98009
Telephone: (206) 454-6363

Electric Customers - 412,432
Total Generation Capacity as of January 1, 1976 - 2,911,900 kW

Public Utility District No. 1 of Benton County
P.O. Box 6270
Kennewick, WA 99336
Telephone: (509) 582-2175

Electrical Customers - 19,094
Generation Capacity - 0

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management

Public Utility District No. 1 of Chelan County
327 North Wenatchee Avenue
Wenatchee, WA 98801
Telephone: (509) 668-8121

Electrical Customers - 20,100
Generation Capacity - 0

Public Utility District No. 1 of Clallam County
P.O. Box 951
Port Angeles, WA 98362
Telephone: (206) 452-9771

Electrical Customers - 14,522
Generation Capacity - 0

Public Utility District No. 1 of Clark County
1200 Fort Vancouver
P.O. Box 1626
Vancouver, WA 98663
Telephone: (206) 699-3000

Electrical Customers - 62,923
Generation Capacity - 0

Public Utility District No. 1 of Cowlitz County
960 Commerce Avenue
Longview, WA 98632
Telephone: (206) 423-2210

Electrical Customers - 31,205
Generation Capacity - 70,000 kW

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Public Utility District No. 1 of Franklin County
1411 W. Clark
P.O. Box 2407
Pasco, WA 99302
Telephone: (509) 547-5591

Electrical Customers - 10,834
Generation Capacity - 0

Public Utility District of Grant County
P.O. Box 878
Ephrata, WA 98823
Telephone: (509) 754-3541

Electrical Customers - 21,906
Generation Capacity - 1,642,550

Public Utility District No. 1 of Grays Harbor County
2720 Sumner Avenue
P.O. Box 480
Aberdeen, WA 98520
Telephone: (206) 532-4220

Electrical Customers - 30,003
Generation Capacity - 0

Public Utility District No. 1 of Lewis County
981 Pacific Avenue
Chehalis, WA 98532
Telephone: (206) 748-4461

Electrical Customers - 16,956
Generation Capacity - 0

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Public Utility District No. 3 of Mason County
Third and Cota Streets
Shelton, WA 98584
Telephone (206) 426-8255

Electrical Customers - 15,802
Generation Capacity - 0

Public Utility District No. 1 of Okanogan County
P.O. Box 912
Okanogan, WA 98840
Telephone (509) 422-3310

Electrical Customers - 12,500

Public Utility District No. 2 of Pacific County
405 Duryea Street
Raymond, WA 98577
Telephone (206) 942-2411

Electrical Customers - 11,730
Generation Capacity - 0

Public Utility District No. 1 of Snohomish County
2320 California Avenue
P.O. Box 1107
Everett, WA 98206
Telephone (206) 259-9661

Electric Customers - 112,334
Generation Capacity - 0

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Seattle Department of Lighting
1015 Third Avenue
Seattle, WA 98104
Telephone: (206) 625-3000

Electrical Customers - 262,034
Total Generation Capacity as of January 1, 1976 - 1,439,300 kW

Tacoma Public Utilities - Light Division
P.O. Box 11007
Tacoma, WA 98411
Telephone: (206) 383-2471

Electrical Customers - 88,555
Total Generation Capacity as of January 1, 1976 - 830,700 kW

Washington Public Power Supply System
3000 George Washington Way
P.O. Box 968
Richland, WA 99352
Telephone: (509) 946-1611

Electrical Customers - 76 Wholesale
Generation Capacity - 860,000 kW

Washington Water Power Company
411 East Mission Ave.
P.O. Box 3727
Spokane, WA 99220
Telephone: (509) 48909500

Electrical Customers - 192,661
Total Generation Capacity as of January 1, 1976 - 854,200 kW

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Natural Gas Utilities

Cascade Natural Gas Corporation
222 Fairview N.
Seattle, WA 98109
Telephone: (206) 624-3900

Northwest Natural Gas Company
200 S.W. Market Street
Portland, OR 97201
Telephone: (503) 226-4811

Northwest Pipeline Corporation
315 E. 2nd Street
Salt Lake City, UT 84110
Telephone: (801) 534-3600

Pacific Gas Transmission Company
77 Beale Street
San Francisco, CA 94106
Telephone: (415) 781-0474

Washington Natural Gas Company
815 Mercer Street
Seattle, WA 98111
Telephone: (206) 622-6767

Washington Water Power Company
411 East Mission Avenue
P.O. Box 3727
Spokane, WA 99220
Telephone: (509) 489-0500

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

STATE ENERGY-RELATED ASSOCIATIONS

Alaska Rural Electirc Cooperative Association, Inc.
Box 1148
Palmer, AK 99645

Eastern Washington Public Utility District Commissioner's Association
1601 Tower Building
Seattle, WA 98101
Telephone (206) 622-7441
Ken Billinton, Executive Director

Idaho Cooperative Utilities Association, Inc.
c/o Buris O. Russel
P.O. Drawer 8
Grangerville, ID 83530
Telephone (208) 983-1610

Oregon PUD Directors Association
P.O. Box 433
Tillamook, OR 97141

Oregon Rural Electric Cooperative Association
795 Winter St., N.E.
Salem, OR 97301
Telephone (503) 585-9988

Pierce County Power Cooperative Association
c/o John Curtis
914 East 112th Street
Tacoma, WA 98445
Telephone (206) 537-3512

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

Western Washington Public Utility District's Association
1601 Tower Building
Seattle, WA 98101

Telephone (206) 622-7441

Washington Public Utilities District's Association
1601 Tower Bldg.
Seattle, WA 98101

Washington Rural Electric Cooperative Association
S. 222 Scott Street
Spokane, WA 99202

Telephone (509) 525-3725

Information Source: Ref. 3, Organizations Influencing Northwest Energy Policies and Management.

STATE WATER QUALITY AGENCIES

Alaska

Department of Environmental Conservation
Water Programs Division
Water Quality
Pouch O
Juneau, Alaska 99801

Idaho

Department of Health and Welfare
Division of Environmental Services, Air and Water Programs
Bureau of Water Quality
State House
Boise, Idaho 83720

Oregon

Department of Environmental Quality
Water Quality Control Division
1400 S.W. Fifth Avenue
Portland, Ore. 97201

Washington

Department of Ecology
Office of Water Programs
P.O. Box 829
Olympia, Wash. 98504

Information Source: Ref. 4, Environmental Reporter.

STATE AIR QUALITY AGENCIES

Alaska

Department of Environmental Conservation
Terrestrial Programs Division
Air Quality Control
419 Sixth St.
Juneau, Alaska 99801

Idaho

Department of Health and Welfare
Division of Environmental Quality
Bureau of Air Quality
State House
650 State St.
Boise, Idaho 83720

Oregon

Department of Environmental Quality
Air Quality Control Division
1234 S.W. Morrison
Portland, Ore. 97205

Washington

Department of Ecology
Office of Air Programs
Olympia, Wash. 98504

Information Source: Ref. 4, Environmental Reporter.

STATE SOLID WASTE AGENCIES

Alaska

Department of Environmental Conservation
Terrestrial Programs Division
Solid Waste Management Section
Pouch O
Juneau, Alaska 99811

Idaho

Department of Health and Welfare
Division of Environment
Bureau of Solid Waste Management
Statehouse
Boise, Idaho 83720

Oregon

Department of Environmental Quality
Solid Waste Division
1234 S. W. Morrison
Portland, Ore. 97205

Washington

Department of Ecology
Office of Land Programs
Solid Waste Office
Olympia, Wash. 98504

Information Source: Ref. 4, Environmental Reporter.

Washington

Statutory Source: State Environmental Policy Act of 1971, Rev. Code Wash. Ch. 43.21C (Supp. 1973). For State Highway Project Environmental Impact Report Requirements, see Rev. Code Wash. Ch. 47.04 (Supp. 1973). [State Air Laws — 541:0201]

Guidelines: Guidelines currently in use: "Guidelines for Implementation of the State Environmental Policy Act of 1971." Current guidelines were prepared by the Department of Ecology.

State Contact: Stephen B. Crane, State of Washington Council on Environmental Protection, No. 5 South Sound Center, Lacey, Washington 98504, *or* Peter R. Haskin, Environmental Review and Evaluation, Office of Planning and Program Development, State of Washington Department of Ecology, Olympia, Washington 98504 (Phone: 206-753-6890).

Information Source: Ref. 4, Environmental Reporter.

STATUTES AND REGULATIONS

While state and local legislation and other political and institutional factors may create more immediate constraints and incentives regarding the location of energy developments, federal legislation can supersede state and local powers, and often sets a precedent for similar state legislation (i.e., NEPA and Washington's SEPA). This section examines institutional barriers and incentives to energy development, and investigates potential management strategies for energy impacts.

Laws and their resulting policies and guidelines comprise the constraints and incentives that limit and/or encourage certain development policies and actions. These laws set parameters along several dimensions within which all development actions must occur. The dimensions are 1) air quality, 2) water quality, 3) land use, and 4) energy (economics).

First is provided an overview of the federal legislative constraints and incentives, including some discussion of their content and the implications of each piece of legislation for energy resource development. Secondly, a brief summary in comparative tabular form is presented for state legislation and programs.

FEDERAL

A detailed analysis of the interpretation and operation of federal and state laws has not been possible given the time and resources available. A complete analysis could study and discuss energy-related legislation and the energy planning process in each state of the Region, and could analyze impact management strategies and mitigation measures.

This brief overview of the many federal statutes that may influence energy development highlights several basic concepts regarding the federal role in the development process.

Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 1.

First, federal legislation that influences energy projects and their resulting impacts encompasses many substantive areas, including not only direct federal regulation and administration of energy research and development, but also regulation of environmental impacts and the provision of several assistance programs for community development. This range of statutes can potentially control and regulate energy development and can help shape energy policy. In addition, statutes which set priorities for the research and development of energy alternatives will influence the future direction of this country's energy program. Ultimately, the interpretation and operation of the statutes will determine the thrust of energy policy, and future research can hopefully examine these interpretations.

Second, federal ownership and control of land and resource rights in the western states is significant. As the major landowner in these resource-rich states, the federal government is the primary actor in formulating and carrying out regulations that determine the direction and extent of energy development in this Region. The federal government is not only able to promulgate regulations and legislation regarding federal goals in resource development, but it can also assure that the interpretation and implementation of such regulations are consistent with legislative intent.

The federal government's power to regulate leasing and development of the oil and natural gas resources beneath the Outer Continental Shelf makes it a major controller of the development of these resources. Land and mineral ownership in the western states and control of the Outer Continental Shelf, plus federal control over the licensing of nuclear power plants, contribute to the federal government's ability to assure that its own development policy will be carried out.

Federal environmental regulations and standards are a third major factor that affects energy resource development in the western states. These regulations are imposed upon all federal projects and upon all projects on federal

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, pp. 27 and 28.

lands, thus affecting most of the coal, oil shale, natural gas and oil developments in the West. Interpretation of these statutes, particularly for the maintenance of air and water quality levels, will be crucial in the final administration of the law.

Air Quality

The federal government's responsibility to maintain air quality is governed by the Clean Air Act and its 1970 amendments. The Clean Air Act as amended gave the Environmental Protection Agency (EPA) power to establish national ambient air quality standards, standards of performance for new stationary sources, and national emission standards for hazardous air pollutants. The Supreme Court later ruled that State Implementation Plans are required for all states to prevent the significant deterioration of present air quality levels. Another court order directed the EPA to promulgate regulations designed to maintain the National Ambient Air Quality Standards after 1975. The EPA has standards for these five areas of responsibility, all of which will significantly impact the energy development areas of the Northwest.

The EPA regulations will affect not only direct source emissions (such as SO_2 emitted from coal-fired power plants) but also indirect source emissions resulting from many of the development activities that occur during urban growth. Some EPA regulations may also affect the location of new energy development facilities. For example, if the new Clean Air Act amendments now before Congress are enacted (which require maintenance of existing air quality for a 60-mile radius from national parks and wilderness areas), it may be difficult for new coal development facilities to locate in the Rocky Mountain states.

Water Quality and Use

The quality and uses of the nation's water are regulated by several major federal laws. Because water availability for cooling and transport

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 7.

is critical in energy development, laws governing water are especially important. Also, in the semi-arid states of the Northwest (eastern Oregon and eastern Washington) there are problems of water ownership and water rights, as well as conflicting and incompatible demands for water.

In 1965 joint Federal-State River Basin commissions and the Water Resources Council were established--a first recognition of the need for conservation, development and utilization of water-related land resources in a comprehensive and coordinated fashion. The Water Resources Council was given the mandate to continually study the adequacy of water supplies needed to meet requirements in each water resource region.

Another basic law governing water quality is the Federal Water Pollution Control Act (FWPCA) and its amendments. This act provides financial and technical assistance to the states for state and area-wide water quality management planning and implementation programs. The act provides that EPA will certify eligibility for financial assistance to any state or local public body carrying out waste treatment projects. The act also mandates EPA to conduct research in several areas (including harmful effects of pollutants, practical means of treating municipal sewage, lake pollution, oil pollution control studies, solid waste disposal equipment for vessels, effects of pollution on estuaries and estuarine zones) and to develop demonstration programs that show the alleviation of some of these water problems.

Another law that provides authority to maintain water quality is Section 13 of the Rivers and Harbors Act of 1899 (also known as the Refuse Act). This act authorizes the Department of Transportation and EPA to prohibit refuse matter from being dumped into navigable waters or onto the banks of navigable waters.

Another source of federal technical assistance for the preservation of water resources is the Water Bank Act. This act authorizes the Department of Agriculture to preserve, restore and improve the wetlands of the nation,

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 9.

and to thereby conserve surface waters and contribute to improved water quality. One of the main purposes of this act is the promotion of total water management planning.

Financial and technical assistance is also provided to the states under the Safe Drinking Water Act. This act sets up national primary drinking water standards, and states are given major responsibility for enforcement.

Generally these pieces of legislation place constraints upon energy resource developments and upon use and effect on waters; they do so through their influence on the type, size, and location of developments that either require large amounts of water or that deteriorate the quality of water for other users.

There are also several laws which may affect, most specifically, the transport of oil and natural gas. The Jones Act prohibits any merchandise from being transported between points in the United States except in vessels built in the United States and owned by United States citizens. The Deepwater Port Act of 1974 regulates the location, ownership, construction and operation of deepwater ports in waters beyond the territorial limits of the United States. The Secretary of Transportation is mandated to issue the licenses under this act, and cannot issue a license unless the adjacent coastal state to which the deepwater port is to be directly connected by pipeline "has developed, or is making at the time the application is submitted, reasonable progress toward developing an approved coastal zone management program." The Ports and Waterway Safety Act of 1972 gives the Coast Guard authority over tanker design and operation (additional authority is given to the Coast Guard in the FWPCA).

There are also several pieces of legislation which cover resource development and extraction in offshore waters. The federal government, through the Coastal Zone Management Act of 1972, encourages states to develop and implement plans for managing coastal areas that will preserve and protect

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 10.

these natural resources. While not mandatory, this legislation encourages state management by providing financial assistance and by passing control of federal activities to states with approved programs.

A proposed amendment to the Coastal Zone Management Act would partially assist energy development in coastal areas by providing funds for coastal energy facility siting and related planning, and by providing assistance to impacted states and communities.

The federal government (Department of Interior) has jurisdiction over mineral resources, including oil and gas off the continental shelf not reserved for states by the Submerged Lands Act. Federal jurisdiction over off-shore lands generally begins beyond the three-mile limit, which falls within state jurisdiction (Submerged Lands Act of 1953). Under the Outer Continental Shelf (OCS) Lands Act, the Department of Interior leases land for the development of oil, gas and other minerals, and permits geological and geophysical exploration. In addition, the Coast Guard has authority over navigational regulations (oil drilling apparatus).

This OCS act gives the federal government power over natural resource development beyond state jurisdiction on offshore lands, thus enabling the federal government to influence the timing and direction of energy exploration and development in these areas. A proposed amendment would impose strict liability for oil spills, and would set up an offshore Oil Pollution Settlement Fund. This proposed amendment would likely discourage some investments in this type of development, but also would encourage other coastal and water-related investments that would be protected by the legislation.

A final area of federal involvement in water issues is the treaties between Indian tribes and the United States government. These treaties are particularly concerned with water rights, and according to a Supreme Court ruling, the water on reservations is exempt from appropriation by non-Indians

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 11.

pursuant to state law; sufficient water must therefore be reserved for present and future needs of Indians, whatever the use and without limit.

Land Use

Agricultural/Recreational/Open Space

The concepts of multiple use and sustained yield dominate the administration of national forests (Multiple Use and Sustained Yield Act of 1970 and Classification and Multiple Use Act of 1964). Under these laws, the Forest Service and the Bureau of Land Management are to develop criteria for determining the disposal or retention of specific federally owned lands. They also are authorized to take actions which assure that public lands held even temporarily are administered so as to promote the multiple use and sustained yield concepts. This authority, however, may be pre-empted by the President (under the Pickett Act), who may withdraw public lands temporarily from settlement, location, or sale for several purposes, including setting up resource reserves or irrigation. These lands would still be open to mineral exploration and purchase, so they would not create a major constraint to potential resource development. While these acts do not directly constrain the development of mineral resources, their focus on federal management of surface resources may indirectly limit mineral development by protecting or promoting the several renewable surface resources that would be affected by many resource development processes (e.g., forests).

Federal concern over maintaining renewable resources is also evidenced by the Forest and Rangeland Renewable Resources Act of 1974, which provides assistance for developing long-range plans and programs for the nation's renewable resources. Under this act the Department of Agriculture is authorized to conduct periodic surveys and assessments of the renewable resources and the impact of programs upon the multiple use and sustained yield concepts which govern the administration of national forests and other public lands. Finally, this legislation calls for the provision of an

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 13.

adequate transportation system within the national forests, a condition which tends to make such areas more accessible to resource development.

Another law affecting national forest and park lands is the National Trails System Act. This act authorizes the establishment of trails within urban areas and more remote scenic areas, designating the Appalachian Trail and Pacific Crest Trail as initial components. It mandates that efforts be made to avoid activities incompatible with the purpose for which such trails were established. This federal commitment to provide a system of recreational trails may constrain the location of resource developments in certain areas, particularly in the western mountain states.

The authority of the Department of Interior to designate unused public lands as grazing districts (Taylor Grazing Act of 1934), while intended to promote the highest use of such lands pending their final disposal, may discourage unrestricted resource exploration and development in these areas. Where individuals are utilizing public lands for grazing purposes, there may be pressures to maintain that use and not open up the lands for other uses. These potentially competing demands would be resolved by the Department of Interior; the need to resolve such conflicts would limit the ease with which resource developers could enter some areas for exploration and development.

The Open Space Act imposes an indirect constraint upon land use impacts resulting from energy development activities. The growth generated by energy developments would put pressure upon surrounding urban or local areas to accommodate an influx of population and thus increase pressure for urban development of any undeveloped lands that might be planned as urban open space under this act.

Native Americans

In addition to general federal laws affecting land use, the Alaska Native Claims Settlement Act significantly influences the development of resources in that state. Under this act, Alaskan native groups and villages

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Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 15.

are to select, within the state, lands for their use, except for 80 million acres set aside by the Department of Interior for public lands. While current mining claims in lands selected will be held valid for 5 years, the right to explore, develop, and remove minerals from the surface estate of native lands is subject to approval of the Native Village Corporation. However, the regional corporations hold jurisdiction over the subsurface estate rights and can lease those mineral rights separately from the land. This federal act, which supersedes state laws, is an important constraint to resource development in Alaska, since it turns authority for approving such development over to the native corporations.

Mining

The potential massive coal developments in Alaska have generated widespread interest in the types of regulations governing coal development. Reclamation is also an important issue, but presently no federal legislation governs reclamation. Several pieces of legislation, however, impose regulations and requirements on mining, and as a result will have a major impact on coal mining and development.

Basically there are two types of mineral claims: locatable and leasable. The Mining Law of 1872 uses the location-patent system (uranium is now mined under this system) and the Mineral Leasing Act of 1920 uses a system of prospecting permits and mineral leases. The mineral leasing acts require that leased lands be developed within a certain number of years. However, these requirements have not been enforced until recently. The Multiple Mineral Development Act of 1954 provides an answer to conflicts that can arise when an area is valuable for mineral leasing under the 1920 Act and for minerals locatable under the 1972 Act. Its basic principle is that each activity must be conducted "so far as reasonably practicable" to avoid damage to minerals subject to the other.

Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, pp. 15 and 16.

Energy (Economics)

Several major federal laws regulate different aspects of energy development activities. The National Environmental Policy Act (NEPA) mandates that any federal activity which creates a "significant" change in the environment must be preceded by an environmental impact statement outlining all effects of the project, including socioeconomic impacts and alternatives to the proposed actions. Thus, this legislation regulates rather severely the initial planning and development stages of energy facilities by insuring that careful consideration will be made of possible alternatives and all possible consequences of the development.

The Trans-Alaska Pipeline Authorization Act regulates the construction and operation of the oil pipeline in Alaska. This Act decreed that the pipeline be built without further compliance with NEPA and without further delay (environmental regulations had been responsible for several years' delay in the construction starting date). The Act sets up a Liability Fund for vessels loading oil at terminals, and also decrees that holders of the right-of-way are liable for control and total removal of any pollutant that damages or threatens to damage the environment. This Act both encourages energy development by removing all obstacles to pipeline construction and constrains energy development activity by imposing costs of pollutant clean-ups upon the responsible parties.

The Natural Gas Pipeline Safety Act of 1968 also establishes constraints (or safety standards) that must be complied with by the builders of both natural gas and onshore oil pipelines. It is possible under this act to obtain waivers of safety standard compliance, and if the establishment of a standard affects continuity of gas services the Federal Power Commission and the state commissions must be consulted, and both the construction activity and the effective date of the standards must be deferred until they have an opportunity to grant appropriate authorization.

Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 16.

The transmission of electric power and the sale and transport of natural gas are also regulated by specific laws. The Bonneville Power Act and the Federal Columbia River Transmission Act regulate the electric power transmission network from the federal dams to the major load centers in the Northwest. The Bonneville Power Administration (BPA) markets the power generated at the Federal dams on the Columbia River, and under the authorization of this act the BPA administrator can provide electric transmission lines and substations, and can acquire land necessary for easements, rights-of-way, transmission lines and substations.

The Federal Power Act and Natural Gas Act are both administered by the Federal Power Commission (FPC). The Federal Power Act created the FPC and provides guidelines for the system it is to use in licensing water power sites (hydroelectric facilities). The licensee is to cooperate fully with the FPC by providing required information, and the FPC is to decide on the fair value of power from government dams. Under the Natural Gas Act the FPC has the authority to regulate the wellhead price of natural gas and to license onshore natural gas pipelines in interstate commerce.

The oil industry is regulated in its exploration and development by mining and water use (OCS Lands Act) legislation, and its pricing has been regulated by United States tax laws.

The geothermal industry is regulated by the Geothermal Steam Act of 1970, which set up regulations for leasing known geothermal resource areas. The act regulates the amount of land any one person or corporation may lease at one time, and prohibits the leasing of land in national recreation areas, in wildlife refuges, and in areas reserved for the protection and conservation of fish and wildlife threatened with extinction.

The geothermal and solar industries are also affected by research and development legislation that provides incentives for demonstration programs and further research.

Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 17.

The nuclear industry is regulated by the Nuclear Regulatory Commission, established under the Energy Reorganization Act. This commission sets standards and safeguards for the industry, and regulates its further development.

STATE

A brief summary of State Statutes and Regulations follows in Table III-A-6.

Information Source: Reference 5, The Influence of Selected Federal Statutes on Energy Development, RAP-5, p. 18.

TABLE III-B-6

STATE LAWS AND REGULATIONS

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	1. ENERGY-RELATED LAWS		
ALASKA	SCS CSHB 779ams Chapt. No. 278 (SR)	1976	An act creating the Alaska Power Authority by amending 44 with the addition of a new Chapter 56.
	HCR 100; 9th Legislation, 2nd Session (SR)	1976	A resolution relating to electric and gas utility regulations.
	HCS CSSSSB-06 (Judiciary) (SR) Chapter No. 266	1976	An act relating to oil terminal facilities and the marine transportaion of their by-products; and providing for an effective date.
	HCR 123; 9th Legislation, 2nd Session (SR)	1976	A resolution relating to a coastal zone management program.
	SCR 66; 9th Legislation, 2nd Session (SR)	1976	A resolution relating to north slope natural gas.
	HB779 Utilities/Public Power (SR)	1976	Organic Alaska Power Authority Act
	HR100 Utilities/Rate Regulation (SR)	1976	Utility study
	SB 406 Resource Development/ Impact Amelioration (SR)	1976	Organic marine petroleum transportation act.
	HB26 Vol. III Utilities/ Public Power (SR)	1975	
	HB192 Vol. III Utilities/ Consumer (SR) Protection	1975	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
ALASKA (contd)	HB297 Vol. III Resource Development/Revenue (SR)	1975	
	HJR29 Vol. III Resource Development/Coastal/OCS (SR)	1975	
	HJR5 Vol. III Resource Development/Renewable Resources (SR)	1975	
	HB171 Vol. III Resource Development/Financial Incentive (SR)	1975	
IDAHO	SJR 190; 43rd Legislation (SR)	1976	A joint resolution allowing political subdivisions to create indebtedness for rehabiliating existing electrical generating facilities
	SB 1487; 43rd Legislation (SR)	1976	An act relating to the liability of electric power and gas suppliers, providing nonliability of such suppliers for inability to serve due to inadequate and insufficient supplies.
	HB 468; 43rd Legislation (SR)	1976	An act relating to tax incentives for installation of insulation and alternative energy devices.
	SCR 132 (SR)	1976	A concurrent resolution authorizing the legislative council to undertake and complete a study of matters relating to energy development in the state.
	SJR 109 Utilities/Public Power (SR)	1976	Municipal bond constitutional amendment
	SB 1138 Vol. II, Emergency Powers/Responses (SR)	1975	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
OREGON	No session in 1976		
	HB2202 Vol. I Tax Exemptive/ Incentives/Solar Heating and Cooling (signed) (SR)	1975	
	SB283 Vol. I Conservation/ Building Efficiency Standards (Signed) (SR)	1975	
	SB55 Vol. I Resource Development/Nuclear (SR)	1975	
	SB483 Vol. II Resource Development/Nuclear (SR)	1975	
	SB163 Vol. III Resource Development/Nuclear (SR)	1975	
	HJR31: SB483 Vol. II Resource Development/Facility Siting (SR)	1975	
	HB2629 Vol. II Resource Development/Revenue (Signed) (SR)	1975	Provides impact assistance revenus for energy development area by requiring prepayment of property taxes.
	HB2036; HB2040; HB3185; HBJR66; SB483 Vol. II Resource Development/Renewable Resources (SR)	1975	
	SB483 Vol. II; SB884 Vol. III Management (SR)	1975	
	HB3219 Vo-. II Miscellaneous (SR)	1975	
	SB483 Vol. II Utilities/Rate Structure (SR)	1975	
	SB483 Vol. II Emergency Powers/ Responses (SR)	1975	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON	SB3129; 2nd Ex. Session (SR)	1976	Rural electrical cooperatives-nuclear, thermal power facilities; an act relating to electric utilities
	SB3172 (SR)	1976	An act relating to energy, fostering wise and efficient energy use and the promotion of self-sufficiency through the use of indigeous and renewable energy sources.
	SB 2130 (SR)	1975-76	An act relating to solid waste management, letter control, recovery and recycling.
	SB3172 Resource Development/ Facility Siting (SR)	1976	Reconstitutes facility siting council
	SB3172 Energy Management/ Organization (SR)	1976	Creates Energy Office
	SB3172 Emergency Powers (SR)	1976	Governor's power to declare "energy supply alert"
	SB2106 Vol. I; HB665 Vol. III (vetoed) Conservation/Building Efficiency Standards (SR)	1975	
	HB544 Vol. I Resource Development/ by State Government (SR)	1975	
	SB2159 Vol. III Tax Applications/ Motor Fuel (Vetoed) (SR)	1975	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	2. WATER RELATED LAWS		
ALASKA	Department of Environmental Conservation Act (ER) (Laws of Alaska, Title 44, Chapter 46-1971)	1977	Department of Environmental Conservation Guidelines to prevent and control water pollution
	Wastewater Disposal Regulations (ER) (Alaska Administrative Code, Title 18, Chapter 72-1973)	1977	Department of Environmental Conservation
	Oil Pollution Control Regulations (ER) (Alaska Administrative Code, Title 18 Chapter 75-1973)	1977	Department of Environmental Conservation Surface oiling, discharge reporting, cleanup and disposal.
	Water Quality Standards (ER) (Alaska Administrative Code, Title 18, Chapter 70-1972)	1973	Water Quality Standards to be applied to all waters of the state.
IDAHO	Water Quality Standards and Wastewater Treatment Requirements (ER)	1973	Rules and regulations for establishing standards of wastewater treatment requirements for waters of Idaho
	Water Pollution Control Law (ER) (Idaho Administrative Code, Title 39, Health and Safety, Chapter 26)	1970	Department of Health and Welfare
OREGON	Water Pollution Control Laws (ER) (Revised statutes of 1969, Chapter 468)	1977	Department of Environmental Quality

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
OREGON (contd)	Rules of General Applicability and Organization (EIC) (Regs. Relating to Water Quality Control, Chapter 340, Division 1)	1975	
	Water Pollution Control (EIC) (Regs. Relating to Water Quality Control Chapter 340, Div. 4)	1975	
	Special Waste Sources (EIC) (Regs. Relating to Water Quality Control, Chapter, Div. 5)	1975	
	State Financial Assistance (EIC) (Regs. Relating to Water Quality Control, Chapter, 340, Div. 8)	1975	
	Synthetic Cleaning Agent (ER) (Housing Bill 1336)	1971	Guidelines to prevent pollution of water by synthetic cleansing agents
	Water Quality Control Regulations (ER) (Oregon Administrative Rules Chapter 340, Division 1)	1971	
WASHINGTON	Water Quality Standards (ER) (Administrative Code, Chapt 173-201-1973)	1977	Establishes water quality standards for surface waters of the state of Washington
	NPDES Permit Program Regulations (ER) (Administrative Code, Chapter 173-220-1974)	1976	Establishes state permit program for discharge of pollutants and materials to navigable waters of the state.
	Hearings Regulations (ER) (Administrative Code 173-225-010 to 173-225-030	1975	Establishes procedures for public notice and public hearings in relation to the processing of applications for certification

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON (contd)	Permit Processing Procedure (ER) (Administrative Code, Chapter 173-10)	1975	Department of Ecology
	Environmental Coordination Procedures (ER) Act of 1973 (Chapt. 185, Laws of 1973)	1974	Coordination of procedures in relation to projects which contemplate use of the state's natural resources
	Certification of Compliance with Federal Water Pollution Control Act of Federally Licensed Projects (EIC) (Adminstrative Code, Chapter 173-224)	1973	
	Pollution Disclosure (EIC) (Administrative Code, Chapt. 173-40)	1972	
	Water Resources Act of 1971 (EIC) (Revised Code, Chapter 90, 54	1971	
	Water Pollution Control Laws (ER) (Revised Code, Chapt 90.48)	1971	Department of Ecology
	Wastes Discharge Permits (ER) (Administrative Code Chapter 372-24)	1968	Guidelines regarding permits to discharge commercial and industrial waste
	Department of Ecology Organization (ER) (Administrative Code Chapter, 173-02)		Regulations to assist interested people in dealing with the Dept. of Ecology by describing the organization
	Waste Works Regulations (ER) (Administrative Code, Chapt. 372-20)		

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON (contd)	Water Pollution Control Planning Regulations (ER) (Administrative Code, Chapt. 372-68)		
	Regulations of Public Ground Waters (EIC) (Revised Code, Chapter 90.44)		
	Public Sewage and Industrial Waste Works (EIC) (Administrative Code, Chapt. 373-20)		
	Permits to Discharge Commercial and Industrial Waste (EIC) (Administrative Code, Chapt. 373-24)		
	Water Code-1917 Act (EIC) (Revised Code, Chapt. 90.03)		
	Water Pollution Control Facilities-Financing (EIC) (Chapt 90.50)		

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	3. AIR-RELATED LAWS		
ALASKA	Department of Environmental Conservation Act (ER) (Laws of Alaska, Title 44, Chapt. 46) Effective 1971	1976	Department of Environmental Conservation provides duties and guidelines for the Department of Envir. Conservation
	Air Quality Control Regs (EIC) (Administrative Code, Title 18, Chapt. 50)	1974	Department of Environmental Conservation
	Air Pollution Control Laws (ER) (Administrative Code, Title 18, Chapter 50)	1974	Regulations governing local air quality standards
	Air Quality Data Submittal Form (EIC)		
	Permit to Operate: Information and Instructions (EIC)		Department of Environmental Conservation
IDAHO	Environmental Protection and Health Act of 1972 (ER) (Administrative Code, Title 39)	1976	An act relating to state policy on environmental protection
	Air Pollution Control Regulations (ER)(Rules and Regs. for the Control of Air Pollution in Idaho, Reg. A Through S)-1972	1976	Rules and regulations regarding air contaminants, sources of air pollution and ambient air quality levels for Idaho.
OREGON	Air Pollution Control Laws (ER) (Revised statutes of 1969)	1977	Department of Environmental Quality
	Air Pollution Control Regulation (ER) (Administrative Rules, Chapt, 340)	1976	Department of Environmental Quality

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
OREGON (contd)	Rules of General Applicability and Organization (EIC) (Air Pollution Control Rules and Regs. Chapt 340, Div. 1)	1976	
	Air Pollution Control, Emission Standards and Regs. (EIC) (Air Pollution Control Rules and Regs. Chapt 340, Div. 2)	1976	
	Air Pollution Control Standards for Air Purity and Quality (EIC) (Air Pollution Control Rules and Regs. Chapt 340, Div. 3)	1976	
	Summary of 1975 Legislation Affecting Oregon Revised Statutes (EIC) (Chapt 449, 454, 459, 467 or 468)		
WASHINGTON	Clean Air Act (ER) (Revised Code Chapt 70.94)	1978	Department of Ecology provides for a coordinated state-wide program of air pollution control and prevention, and appropriate distribution of responsibility
	Emergency Episode Plan (ER) (Admin. Code. Chapt 18-18-1972)	1978	Sets up a plan to regulate air pollution episodes which occur under meterological conditions
	Open Burning Regulations (ER) (Admin. Code. Chapt. 173-425)	1977	Establishes controls for open burning to minimize emissions, establish rules and procedures and encourage alternative methods of disposal.
	Field Burning Regulations (ER) (Admin. Code. Chapt. 173-430)	1977	Regulations for burning field and turf grasses grown for seed.

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON (contd)	Regulations on Motor Vehicles (ER) (Admin. Code. Chapt 18-24) 1968	1977	Regulations to prevent and control air contaminant emissions from the operation of motor vehicles
	Regulations on Kraft Pulping Mills (ER) (Admin. Code. Chapt. 173-405)	1976	Provides systematic reduction and control of air pollution in the Kraft pulping industry
	General Regs. for Air Pollution Sources (EIC) (Admin. Code Chapt. 18-04)	1976	
	General Air Pollution Regs. (ER) (Revised Code, Chapt. 43.21C)	1974	Department of Ecology provides basic framework for state's program on air pollution prevention and control.
	Sulfite Pulping Mills (EIC) (Admin. Code, Chapt. 18-38)	1976	
	Primary Aluminum Plants (EIC) (Admin. Code, Chapt. 18-52)	1976	
	Establishing a Permit Processing Procedure (EIC)(Admin Code, Chapt. 173-10)	1975	
	Environmental Coordination Procedures Act (EIC)(Revised Code, Chapt. 90.62)	1974	
	Environmental Acts: (EIC) (Revised Code, Chapt. 43.21a to 43.21C)		
	State Environmental Policy Act of 1971 (ER) (Revised Code, Chapt. 43.21C)	1974	Department of Ecology policies to promote efforts to prevent and eliminate damage to the environment and biosphere, and enrich understanding of important ecological systems and natural resources.

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON (contd)	Suspended Particulate (EIC) (Admin. Code Chapt. 18-40)	1973	
	Sulfur Oxides Standards (EIC) (Admin. Code. Chapt. 18-56)	1972	
	Carbon Monoxide Standards (ER) (Admin. Code Chapt 18-32-1969)	1972	
	Record Keeping, Reporting, and Public Availability of Emission Data (EIC) (Admin. Code Chapt. 18-02)	1972	
	Sensitive Areas (EIC) (Admin. Code Chapt. 18-06)	1972	
	Particle Fallout Reg. (EIC) (Admin. Code Chapt. 18-44)	1972	
	Photochemical Oxidant Hydrocarbon Nitrogen Dioxide (EIC) (Admin. Code Chapt-18-46)	1972	
	Emissions Standards from Air Contaminant Sources (EIC) (Admin. Code Chapt. 18-60)	1971	
	Methods of Operation and Organization (EIC) (Admin. Code. Chapt. 173-02)	1971	
	Environmental Quality Reorganization Act of 1970 (ER)	1970	
	Regulations on State Financial Aid (ER) (Admin. Code, Chapt 18-20-1967	1969	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
WASHINGTON (contd)	Regulations on Reporting by Thermal Power Plants, Aluminum Plants, and Chemical Wood Pulp Mills (ER) (Admin. Code Chapt. 18-28)	1968	Provides a basis for obtaining and compiling information to enable the state air pollution control board to establish standards

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	4. SOLID WASTE-RELATED LAWS		
ALASKA	Solid Waste Management Regulations (ER)(Admin. Code Title 18, Chapt. 60)	1973	Department of Environ. Conservation
	Department of Environmental Conservation Act (ER) (Laws of Alaska, Title 44, Chapt 46)	1971	Establish the dept; prohibits certain acts of pollution; sets penalties for violation; provides for variances; and establishes admin. procedures for carrying out the statute.
	Waste Discahrge Permits and Certifications of Reasonable Assurance (EIC)		Department of Environmental Conservation General Information and Instructions for applicants - and application
IDAHO			
	Solid Waste Law (ER) (Title 31, Chapt. 44)	1974	
	Solid Waste Regs. and Standards (ER)	1973	Board of Environment and Community Services
OREGON			
	Solid Waste Control Law (ER) (Revised Statues, 1977 Replacement Part, Chapt. 459)	1977	Department of Environmental Quality
	Hazardous Waste Management Rules (ER) (Admin. Rules, Chapt. 340, Div. 6)	1976	Established requirements for environmental hazardous waste management, classifies certain wastes as envir. hazardous and declassifies certain wastes as not being environmentally hazardous

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
OREGON (contd)	Sewage Treatment and Disposal Systems (EIC) (Chapt. 459, Sect. 459.005 through 459.995)	1976	
	Subsurface and Alternative Sewage Disposal Regs (EIC) (Chapt. 340, Div. 7)	1975	
	Procedures for Insurance, Denial, Modification and Revocation of Licenses for the Disposal of Environmentally Hazardous Wastes (Solid Waste Management Regs. Chapt 340 Division 6)	1972	
	Solid Waste Management in General (EIC)(Solid Waste Managment Regs. Chapt. 340, Div. 6, Sub. Div 1)	1972	
WASHINGTON	Rules and Regs: Litter (EIC) (Admin. Code. Chapt 173-310)	1973	
	Solid Waste Handling (EIC) (Admin. Code, Chapt. 173-301)	1972	
	Model Litter Control Act (EIC) Revised Code, Chapt. 70.93)	1971	
	Solid Waste Management Law (ER) (Revised Code. Chapt. 70.95)		Department of Ecology

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	5. LAND-RELATED LAWS		
ALASKA	Land Excavation and Reclamation Regs. (EIC)(Admin. Code, Title 18, Chapt. 20, Sect. 20.010-20.080)	1974	Department of Envir. Conservation
	Pesticide Control Regs. (EIC) (Admin. Code, Title 18, Chapt. 90.010-90.060)	1973	Department of Environment Conservation
	HCR 123 Coastal Zone Planning (SR)		A bill to direct the Legislative Affairs Agency to codify all laws relating to coastal zone management
IDAHO	Pesticide Law Rules and Regs (EIC)	1972	
	Pesticide Law (EIC) (Chapt. 34, Title 22)	1972	
	Pesticide Use, Application Rules and Regs (EIC) (Sections 1-14)	1972	
	Pesticide Use and Application Law (EIC)(Sect. 22-2208-22 2232)	1972	
OREGON	Land Use Goals and Guidelines Regulations (ER)	1974	
	Statues Relating to Comprehensive Land Use Planning (EIC)	1975	
	Pesticide Control Act (EIC) (Chapt 634, Sect. 634.006-634.992)	1974	
	Restricted Use of Highly Toxic Pesticide Regs. (EIC) (Chapt. 603, Subdiv. 7)	1974	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
OREGON (contd)	Land Use Law (ER) (Revised Statutes, Chapt 80)	1973	
	Pesticide Application Act; Use, Spraying, and Application of Pesticides (EIC) (Chapt. 603)	1968	
WASHINGTON	Shoreline Management Act of 1971 (ER) (Revised Statutes, Chapt. 90.58)	1977	Department of Ecology
	Shoreline Development Permit Regulations (ER) (Admin. Code, Chapt. 173-14)	1976	Establishes basic rules for the permit system
	Thermal Power Plant Site Evaluation Council Laws and Regs (EIC)	1975	
	State Master Program (EIC) (Admin. Code, Chapter 173-19)	1975	
	Thermal Power Plant Siting Law (ER) (Revised Code, Chapt. 80.50)	1974	Thermal Power Plant Site Evaluation Council
	Wetlands (EIC) (Admin. Code, Chapt. 173-22)	1973	
	Pesticides (EIC) (Admin. Code, Chapt. 16-222)	1973	
	Pesticide Use (EIC) (Admin. Code Chapt. 16-235)	1972	
	Pesticide Control Act (EIC) (Revised Code, Chapt. 15.58)	1971	

TABLE III-B-6 (contd)

State	Section or Title[a]	Year of Passage, Promulgation, or Most Recent Amendment	Content or Administering Agent
	6. RADIATION-RELATED LAWS		
ALASKA	Radiation Protection Regs (EIC) (Admin. Code, Title 18, Chapt. 85, Articles 1-8)	1971	Department of Environmental Conservation
IDAHO	General Provision (EIC) (Radiation Control Regs. Part A)	1973	
	Licensing and Registration (EIC) (Rad. Control Regs. Part B)	1973	
	Standards for Protection Against Radiation (EIC) (Rad. Control Regs. Part C)	1973	
	Radiation Safety Requirements for Industrial Radiographic Operations (Rad. Control Regs. Part D)	1973	
	Radiation Safety Requirements for Accelerator Operations (EIC) (Rad. Control Regs. Part H)	1973	
	Radiation Safety Requirements for Radioactive Mineral Mill Tailings (EIC) (Rad. Control Regs. Part I)	1973	
OREGON	Proposed Rules Pertaining to Management of Environmentally Hazardous Wastes (EIC) (Chapt. 340, Div. 3, Subdivision 6)	1976	
WASHINGTON	Nuclear Energy and Radiation Legislation (Revised Code, Chapt. 70.98)		

(a) Sources: Ref. 6, EIC - Environmental Information Center, "State Laws and Regulations: A guide to Environmental Legislation in the Fifty States and the District of Columbia."
Ref. 4, ER - Environmental Reporters.
Ref. 7, SR - Energy: The States' Response in 1976 and 1975.

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

Administrative Order 21

Pursuant to authority established through Article 3, Section 23 of the Constitution of Alaska, I hereby direct that there is administratively established the Alaska Energy Allocation Assistance Office within the Office of the Governor.

In conjunction with a recent agreement between the State of Alaska and the Energy Office for Federal Region X, the Alaska Energy Allocation Assistance Office shall employ necessary personnel to work in concert with a federally assigned Deputy Regional Director for fuels allocation.

As a part of the duties assigned this office the Alaska Energy Allocation Assistance Office shall be responsible for the allocation of any state "set aside" of allocable petroleum distillate fuels in conformance with federal regulations.

These duties include, but are not limited to, assisting emergency and hardship allocation requirements to local wholesale purchasers and end users of allocable energy fuels as defined in regulations of the Federal Energy Office adopted January 15, 1974.

It shall also be a requirement of the Alaska Energy Allocation Assistance Office to establish and maintain an informational program through the public media advising Alaskans of the services available through the office and to conduct an informational effort to inform the public regarding energy conservation measures.

Dated this 24th day of January, 1974.

William A. Egan
Governor

Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

SUMMARY OF ALASKA ENERGY ACTIVITIES

Energy Allocation Assistance Office

Governor William A. Egan issued Administrative Order 21 on January 24, 1974. This administrative action established the Alaska Energy Allocation Assistance Office which is responsible for the distribution of any state "set aside" of allocable petroleum distillate fuels in conformance with federal regulations.

Other duties of the Office include emergency assistance and hardship allocation to local wholesale purchasers and end users as defined by regulations of the Federal Energy Office adopted in January 1974.

The Energy Allocation Assistance Office maintains a public information program through the news media which advises Alaskans of services available through the program, including energy conservation measures.

Initially located in Juneau, the Office is being moved to Anchorage. Regional Offices will be located in Juneau and Fairbanks.

SUMMARY OF IDAHO ENERGY ACTIVITIES

Office of Energy

The Idaho Office of Energy was established in November 1973. The Office serves as the state focal point for all problems related to energy policy. This includes supervision of the state's role in the Federal Mandatory Fuel Allocation Program.

The Office of Energy maintains close liaison with citizens and businesses to ensure proper fuel distribution and prevention of possible hardships. Staff research coordinators have prepared basic data files which include a

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Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

complete distribution system within the state and basic energy requirements of those public and private services essential to the protection of public health safety and welfare.

A staff of eight persons is responsible for functioning of the program.

SUMMARY OF OREGON ENERGY ACTIVITIES

Governor's Energy Task Force

Governor Tom McCall created an Energy Task Force by Executive Order in early 1972 to deal with the energy crisis.

The following State recommendations were submitted to the Governor by the Energy Task Force:

1. Request the President of the Senate and Speaker of the House to create a legislative ad hoc committee on energy for the purpose of identifying the need for new legislation to respond to energy shortages. It would be helpful if the chairmen of energy-related substantive committees could serve on the proposed committee.
2. Request the Legislature to provide the Governor with the necessary authority to take appropriate action in time of an energy related emergency--action that is not in contravention of existing law.
3. Direct every state agency with energy-related programs to review its statutory responsibilities and report to the Governor by June 18 any legal authority needed to respond to the alternative energy conservation methods identified by this Task Force.

Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

4. Direct the Emergency Services Division of the Executive Department to prepare a detailed plan of essential services in times of any energy curtailment. This report should be submitted to the Governor no later than thirty days from now.

5. Assign the function of receiving all problems, complaints, information, and questions regarding energy shortages to the Public Utilities Commissioner. The responsibility of the Commissioner shall be to remedy those problems within his jurisdiction and to refer those problems not within his jurisdiction to the appropriate private or public agency for resolution. The results of his findings or decisions should be provided to the inquiring party in a timely manner.

6. Initiate an immediate review of all potential energy conservation measures to identify those options which are technically and economically feasible. In excess of thirty such options, including reduced speed limits, time zone adjustments, adoption of the British "Roto-cut" system, etc., have been identified by the Task Force and are currently the subject of detailed analysis.

7. Develop immediately a standby petroleum rationing system for implementation in Oregon in the event that the federal voluntary allotment system proves unworkable.

8. Consider inverting the present electric, natural gas, fuel oil power rate structure so that rates would increase in relationship to increase in the amount of energy used.

State Legislation

Senate Bill 424, passed by the Legislative Assembly, requires the Public Utility Commission to conduct an energy study and publish its findings by January 1, 1975. For biennial expenses of the energy study, $153,505 is appropriated from the General Fund.

Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

Senate Bill 859, also passed, prohibits a service station owner selling diesel fuel to public from discriminating in sale of such fuel subject to established rationing policies of State of federal government.

House Bill 2439, a new law, requires electric and gas utilities to submit a plan to the Public Utility Commissioner for load curtailment during emergencies.

House Bill 2853, passed by the Legislative Assembly, authorizes formation of joint operating agencies by cities or people's utility districts in cooperation with public or private power companies or electric cooperatives to plan, acquire, construct, own and operate plants, systems and facilities for generation and transmission of electric power.

SUMMARY OF WASHINGTON ENERGY ACTIVITIES

Energy Policy Council

On February 7, 1973, Governor Daniel J. Evans issued an Executive Order creating the State Energy Policy Council. Consisting of thirty-two members, the group includes representatives of government, business and industry, environmental groups and the public.

The Energy Policy Council is charged with development of a State energy policy, including implementation procedures and recommendations for State decision making. It will report its findings and recommendations to the Governor.

Fuel Allocation Program

The Fuel Allocation Program of the State of Washington is located within the Department of Emergency Services.

Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

The overall objective of the Fuel Allocation Program is to ease petroleum shortages which occur within the State. The Office also is surveying the State on a county-by-county basis to determine appropriate volumes of gasoline needed in each community.

Energy Information and Conservation Center

An Energy Information and Conservation Center has been developed by Governor Evans to provide citizens with information on energy saving techniques. The Center also is actively waging an educational campaign to stress the need for energy conservation.

Information Source: Ref. 8, Southern Interstate Nuclear Board, "The States and The Energy Crisis."

TABLE III-B-7.

STATE LAND USE PROGRAMS

State	Type of Program: Comprehensive Permit System[a]	Coordinated Incremental[b]	Mandatory Local Planning[c]	Coastal Zone Management[d]	Wetlands Management[e]	Powerplant Siting[f]	Surface Mining[g]	Designation of Critical Areas[h]	Differential Assessment Laws[i]	Floodplain Management[j]	Statewide Shoreline Act[k]
Alaska		X		X		X			B		
Idaho			X				X		A		
Oregon		X	X	X		X	A	X	B		
Washington		X		X	X	X	A		B	X	X

(a) State has authority to require permits for certain types of development
(b) State-established mechanism to coordinate state land-use-related problems.
(c) State requires local governments to establish a mechanism for land use planning (e.g., zoning, comprehensive plant, planning commission).
(d) State is participating in the Federally-funded coastal zone management program authorized by the Coastal Zone Management Act of 1972.
(e) State has authority to plan or review local plans and the ability to control land use in the wetlands.
(f) State has authority to determine the siting of powerplants and related facilities.
(g) State has statutory authority to regulate surface mines. (A) State has adopted rules and regulations; (B) State has issued technical guidelines.
(h) State has established rules, or is in the process of establishing rules, regulations, and guidelines for the identification and designation of areas of critical state concern (e.g., environmentally fragile areas, areas of historical significance.
(i) State has adopted a tax measure which is designed to give property tax relief to owners of agricultural or open space lands. (A) Preferential Assessment Program; assessment of eligible land is based upon a selected formula, which is usually use value. (B) Deferred taxation; assessment of eligible land is based upon a selected formula, which is usually use value and provides for a sanction, usually the payment of back taxes, if the land is converted to a noneligible use. (C) Restrictive agreements: eligible land is assessed at its use value; there is a requirement that the owner sign a contract, and a sanction, usually the payment of back taxes if the owner violates the terms of the agreement.
(j) State has legislation authorizing the regulation of floodplains.
(k) State has legislation authorizing the regulation of shorelands of significant bodies of water.

Data Source: Ref. 9, "Council on Environmental Quality," Seventh Annual Report, 1976.

TABLE III-B-8.

PROVISIONS OF ENERGY FACILITY SITING LAWS

State	Power Siting Law	One-Stop Provision	Site Certification Authority	Size and Composition of Site Panel	Method of Acquisition	Application Fee	Annual Utility Forecast
Alaska	No						
Idaho	No						
Oregon	Yes	Yes	Energy Facility Siting Council	Seven government appointments	Eminent domain	$15,000 minimum	10 yr plan
Washington	Yes	Yes	Governor	13 state officials, one government appointment	Eminent domain	$25,000	None

Data Source: Ref. 9, Southern States Energy Board, "Energy Facility Siting in the U.S." 1978.

TABLE III-B-9

COMPARATIVE SUMMARY OF STATE POWER PLANT SITING LEGISLATION[a]

	Washington	Oregon
Law number	80.50RCW	Chapter 606, Oregon laws, 1975 (Senate Bill 483)
Date	February 23, 1970	July 1, 1975
Licensing body	Thermal Power Plant Site Evaluation Council	Energy Facility Siting Council
Chairman	Appointed by Governor	Elected from membership
Membership	15 State agencies, one county member	Seven members, all public
Staff director	Executive Secretary, Thermal Powerplant Site Evaluation Council	Director, Department of Energy
Name of certificate	Certification	Site Certificate
Who must apply	All electric utilities	All electric utilities
Minimum plant size	250 MW per site (50 MW floating)	25 MW per unit
Transmission lines (T-lines)	Associated T-lines in excess of 200 kV	T-lines greater than 230 kV
Application fees	$25,000 per plant application. Applicant must approve expenditures beyond $25,000	$5000 for Notice of Intent to file for large plants. Powerplant $0.05 per kW. Applicant must approve expenditures beyond $0.05 per kW and unspent money is refunded
Annual fees	None	1. Power plant $0.025 per installed kW 2. Share of $200,000 based on annual kW hr
Public hearing schedule	1. Informational - within 60 days in the county of the site 2. Formal - before council recommendation to Governor 3. More if necessary	After application is filed
Time limit for approvals	Council has 12 mo for disposition. Governor has 60 days for disposition	1. For large plants, file notice of intent 2. Application cannot be filed until 1 yr after Notice of Intent 3. Council must act within 2 yr after application 4. Certificate cannot be issued until 3 yr after Notice of Intent (unless waived) 5. Void if not signed by Governor within 30 days
Unique features	A Counsel for the Environment is appointed by the Attorney General	Siting authority over all types of thermal power, hydroelectric power, pipelines and nuclear installations. Counsel designates suitable and unsuitable areas for sites for large thermal plants

(a) All of the States a) require independent studies, B) monitor after approval, and c) consider the need for the facility.

Information Source: Ref. 10, Review of Power Planning in the Pacific Northwest, p. 32.

DATA QUALITY FOR PERSPECTIVES ON REGIONAL INSTITUTIONS

	Resolution (temporal, spatial) of the data available and included in the data book	Finer resolution of date available at the laboratory but not included in the data book
A. INSTITUTIONAL STRUCTURES	Federal and state regional agencies involved with the environment and energy development.	State agencies, cities involved with the provision of power, planning agencies.
B. STATUTES AND REGULATIONS	State laws and regulations for air and water pollution, energy solid waste and radiation.	Strip mining, water rights, shore and protection, sediment control, endangered species, mining spoils, and dumping laws are not available from recommended sources. Information compilation from state agencies would be time consuming.

CHAPTER III REFERENCES

1. The Impact of Increased Coal Consumption in the Pacific Northwest. Regional Assessment Program, Report 21, Battelle, Pacific Northwest Laboratories, Richland, WA, March 1978.

2. R. Johnson, W. Woodhead and K. Tickner, Review and Analysis of State Statutes Pertaining to Statewide Development Planning and Land, Water and Air Resource Management. p. 3, 1975 (Unpublished). Cited in Alison Birmingham, Regional Electric Energy Planning, M.S. Thesis, p. 95. Univeristy of Washington, Seattle, WA, 1976.

3. G. L. Wilfert, Organizations Influencing Northwest Energy Policy and Management. Battelle, Pacific Northwest Laboratories, Richland, WA, August 1977.

4. Environmental Reporter, Bureau of National Affairs, Washington, DC.

5. M. Curre and M. Greene, The Influence of Selected Federal Statutes on Energy Development. RAP-5, Battelle, Pacific Northwest Laboratories, Richland, WA, June 1976.

6. Environmental Information Center, Inc., State Laws and Regulations: A Guide to Environmental Legislation in the Fifty States and the District of Columbia. Washington, DC, (1977).

7. National Conference of State Legislatures, Energy Policy Project, Energy: The States' Response in 1975 and 1976. FEA, Washington, DC, 1976 and 1977.

8. Southern Interstate Nuclear Board, The States and The Energy Crisis.

9. Council on Environmental Quality, Environmental Quality. 1976 7th Annual Report, U.S. Government Printing Office, Washington, DC, December 1977.

10. Southern States Energy Board, Energy Facility Siting in the U.S. 1978.

11. Power Planning Committee, Review of Power Planning in the Pacific Northwest. Pacific Northwest River Basins Commission, 1977.

12. Energy Northwest. Battelle, Pacific Northwest Laboratories, Richland, WA, 1977.

13. G. E. Liepins, M. A. Smith, A. B. Rose, and K. Haygood, Buildings Energy Use Data Book, Ed. 1, Oak Ridge National Laboratory.

UNIQUE REGIONAL CONSIDERATIONS

HYDROPOWER EXPANSION

Perhaps the most severe limiting factor to the expansion of our hydropower system is that few suitable major dam sites remain in the area. Many technologically feasible sites remain, but using them would necessitate a major change in our priorities. It would require placing large areas of productive land under water, and/or altering the appearance, streamflow patterns, wildlife species, and fish migration in the few remaining wild streams. The controversies that have raged over proposals to raise the height of Seattle City Light's High Ross Dam and to dam the Snake River in Hell's Canyon have illuminated many of the problems in developing additional large hydroelectric facilities in the Northwest.

HYDROPOWER FOR PEAK DEMANDS

Also of concern is the rate at which energy can be extracted from the hydroelectric system. This is of importance because of the seasonal, weekly, and daily fluctuations in demand for electricity. Over a year, the peak demands are approximately double the average demands for the system. Daily demands currently may fluctuate as much as 80%. As more and more thermal generating capacity is added to the Regional system, less of the hydropower will be used to provide the base load and more will be used to provide the peaking power. This is because it is not economically feasible to use large thermal plants to supply peaking power.

Additional hydro-peaking capacity can be provided by adding turbines and generators to existing dams where possible, or by providing off-peak storage capacity, such as "pumped-storage" systems. (In the latter scheme, excess energy generated during off-peak periods is used to pump water up to a reservoir for later use during peak-demand periods.) During peaking, maximum flow of water through the turbines is used, causing sudden and sizable changes in reservoir levels and the river flows downstream. The impact of these fluctuations upon the natural environment and upon recreational or commercial

uses of the river system is not well understood, and may limit the degree to which the hydrosystem may be used to provide peaking.

UTILIZING WESTERN COAL

There are many drawbacks that must be overcome, and some trade-offs that must be made. Most of the Western coal will be strip-mined. The coal would then be used for the onsite production of electrical energy, which is easier to transport than the coal itself. Water, however, may prove to be a limiting factor. There is a growing concern that the upper Colorado and Missouri River Valleys are already stretching their water supplies to the limit. The increased population needed for the mining and for the operation of the thermal facilities will increase the domestic water needs. More importantly, the actual generation of the electrical energy will require large amounts of water for cooling.

Thus, there are several possible adverse environmental impacts: strip mining may remove valuable land from agricultural and grazing uses and may cause substantial wildlife disturbances and ground water contamination; the actual plant operation will use large amounts of water, thus removing it from agricultural and domestic uses; and the generating facilities will release into the atmosphere large amounts of waste heat and carbon dioxide (both of which may have long-term climatological effects) as well as sulfur dioxide, nitrogen oxides, and particulate matter. The relatively scant rainfall in this area may hamper attempts to reclaim the mined land. These factors may limit the amount of coal that can be recovered and/or may escalate the cost.

It should also be noted that in the scenario of onsite energy production, all of these environmental impacts would occur in the producing states, such as Montana and Wyoming. Most of the energy, however, will be used in the West Coast states of California, Oregon and Washington. It seems unwise to assume that the Great Plains states will be willing to pollute their environments indefinitely to supply our energy needs. A compromise involves transporting the coal to this Region for use in fuel plants to be built here, such as the Carty coal plant at Boardman, Oregon.

NUCLEAR

The enrichment process from ^{238}U to ^{235}U is both complex and energy-intensive. Currently, this process is only being performed by the federal government. Hanford's location is unique in that the governmental operation exists along with the required amounts of water for cooling. Additionally, spent waste disposal at the Hanford site will make it attractive for the reprocessing of fuel when technology becomes available.

FEDERAL LANDOWNERSHIP IN THE REGION

The percentage of federal landownership within the Region is extremely high, and has a major effect upon the use of land and land development. The Northwest Region contains 56.7% of the United States' federally owned land. This figure, however, is inaccurate, as land has been returned to the state and to its people under the native claims act. Idaho has the next highest percentage (63.7%), with Oregon just slightly under that (52.3%). Washington is well below the other states in the Region; however, a significant amount (29.5%) is still under federal ownership.

REGIONAL DEPENDENCY UPON HYDROELECTRIC POWER

Excluding Alaska, the Northwest Region is not endowed with vast amounts of energy resources, other than hydroelectric power. The importance of hydroelectric power to the Region is unique. Generally, hydroelectric generation plays a minor role in the provision of energy in most states. But the unique Idaho-Oregon-Washington area is heavily dependent upon this resource as a power source. The low cost of hydropower in comparison to other conventional energy sources has also increased the use of electricity for space heating and industrial processing. Policy changes that influence the use of fuel sources must consider the Regional nature of power sources.

Presently, the Northwest has located dams on all feasible sites. Alaska has the largest uncaptured hydroelectric potential in the United States. However, development costs have encouraged the use of natural gas over hydropower. Thus, the Region is confronted by major policy issues when choosing future types of energy resource utilization.

ALASKA'S ISOLATION

Presently the Northwest Region includes Alaska, Idaho, Oregon and Washington. The lower three states often form a contiguous group for the discussion and study of issues, problems, institutional arrangements, environmental concerns, and energy resources. In this sense, Alaska must be viewed as a somewhat separate entity. This is by no means a homogenous or balanced Region.

When summarizing the Region's energy resources, for instance, there would appear to be adequate reserves; however, when broken down into a state-by-state analysis it becomes clear that Alaska is rich in resources, while the lower three states are essentially dependent, or "poor."

In short, the Northwest Region presents a unique situation: one of its states--one that represents 16% of the United States' total land area--is separated from its other Regional members by another country, by a large body of water, by climatic conditions, and by overall environmental characteristics. This all combines to leave Alaska somewhat "out of the picture" in some respects, and data covering certain aspects of Alaska are consequently either limited or altogether non-existent.

ISSUES/PROBLEMS

The energy-related issues that exist in the Region are in many cases national—even international—issues. It is also very evident from the events of the past few years that energy issues tend to become social, economic and political issues. Thus, the question of what is truly an energy issue is not easy to answer. Nevertheless, the issues identified on the following pages have been the ones that most knowledgeable individuals believe are the most important to the Region at this time. The listing and discussion are not intended to be all encompassing in any respect. The objective is merely to highlight those energy-related issues that seem most important to the federal and state governments and to the people of the Region.

CONSERVATION

Issue: To What Extent Should Energy Conservation Be Pursued?

Interest is growing in the Northwest concerning the use of energy conservation to reduce the need for more power plants, to slow the drain on finite resources, and to decrease dependence upon foreign imports. Continuing reliance upon conservation measures seems likely in light of possible future power shortages – particularly in critical water years.

Some reduction in Northwest energy use has occurred since the public became aware of the "energy crisis" in 1973. Continued reductions might be made by a composite of voluntary, mandatory, and incentive measures implemented at the individual, local, state, and national levels.

In the process of deciding how far energy conservation should be pursued, other questions must be addressed. These include: What conservation opportunities exist? What are the potential costs and effects, and what mechanisms are required for implementation?

ELECTRIC RATES

Issue: Should Northwest States Revise the Existing Electric Utility Rate Structures as a Means of Encouraging Energy Conservation?

In most cases, the Northwest now has a declining block rate structure for electric power pricing. Large consumers pay lower unit prices, and "the more you use the less you pay per unit of power" applies to all consumers. Reversal of this pricing structure could provide an economic incentive for all consumers to conserve as much energy as possible.

CLEAN AIR ACT OF 1970

Issue: Should EPA's Air Quality Regulations be Less Stringent for Energy-Generating Facilities?

The Clean Air Act of 1970, as interpreted by the courts, requires EPA to "prevent significant deterioration" of air quality. Although Congress is reviewing the definition of "significant" deterioration in its consideration of amendments to the Clean Air Act, present EPA regulations could affect the siting of energy facilities in the Northwest, even with the best available pollution control technology.

CONTINENTAL SHELF DEVELOPMENT

Issue: How and When Should Alaska's Outer Countinental Shelf (OCS) Oil and Gas Resources be Developed?

The continental shelf of Alaska represents 65% to 70% of the U.S. continental shelf. These lands are believed to contain major undiscovered reservoirs of oil and natural gas.

Areas of special oil interest include the Gulf of Alaska and Lower Cook Inlet on the south, the Bristol Bay area north of the Aleutian Chain, areas around the Seward Peninsula, and the Beaufort Sea off the North Slope. All of these regions are remote, are subject to severe environmental conditions, and have abundant marine resources that might be damaged by petroleum exploration and production.

Development of the OCS also will have socioeconomic impacts onshore, as activities in support of the offshore work develop in sparsely populated areas. Although major short-term construction activities are normally associated with offshore development (construction of platforms), it is likely that a permanent onshore service industry also will develop.

Any comprehensive plan for developing the Alaskan OCS will have to address such concerns as the costs of the recovered oil and gas, the timing of lease area sales, federal participation in reducing onshore socioeconomic impacts, and the reduction of fisheries industry and environmental impacts.

TRANSMISSION CORRIDORS

Issue: How Should Energy Transmission Corridors be Used?

An issue related to facility siting is the availability and capacity of transmission corridors. Future generating facilities must be able to transmit the energy to demand centers. Currently, transmission lines fill most existing corridors. Although the capacity of the corridors could be increased, aesthetics, system imbalance and reliability must be considered.

New technologies have the potential to improve the method of transmitting larger amounts of energy source materials over present corridor networks. Alternating current lines that operate at 1200 kV are in prototype development, and research and development are underway on capacity-increasing, supercooled transmission cables. Another potentially large energy carrier is the coal-slurry pipeline, whose approximately 50-in. diameter pipe could carry a coal-water mixture total that is equivalent to a 10,000 MW-yr electric transmission line.

CENTRALIZED ELECTRIC GENERATION

Issue: Should Alaska Develop a Network of Large, "Centralized" Power Generation Facilities and Distribution Corridors, or Continue to Rely Upon Many Smaller Plants That Are Not Interconnected?

Alaska has two major electric load centers: the Cook Inlet area and Fairbanks. Unlike load centers in the Region's other three states, these

centers are not interconnected with electric transmission corridors. Each Alaskan load center produces all of its own electric energy.

The alternative to these independent load centers is the development of large, interconnected electric generation facilities. The primary advantage of such a system would be the ability to distribute peaking power among load centers. Environmental considerations, however, could hamper development of transmission corridors through wilderness areas.

ELECTRIC GENERATION MIX

Issue: What Should be the Role of Various Electric Generation Technologies (Hydropower, Nuclear, Fossil Fuel, Solar, Geothermal, Wind) in Meeting Future Energy Demands in the Northwest?

The Northwest has relied primarily upon hydroelectric power, but that hydroelectric resource has essentially been developed. Increased consumption must now be met with electricity from fossil fuel or nuclear plants. If utility growth forecasts are used, power generated by hydroelectric facilities--now supplying about 80% of the area's electricity--could be supplying only 35% of electricity needs in 20 years.

Idaho, Oregon and Washington now have two operating nuclear powerplants, with three under construction and six more planned. There is only one operating coal plant in these states (at the coal mine in Centralia, Washington), but another is being built in Oregon.

The cost of electricity to Pacific Northwest customers will experience significant increases as coal and nuclear thermal generation are added. Coal and nuclear generation costs about nine times what hydrogenerated electricity costs. Idaho and Oregon lack large coal reserves, but could import coal from British Columbia, Montana, Wyoming, and possibly Alaska. Coal use, however, may be influenced by federal and state air quality decisions, strip-mining regulations, taxes, and other factors.

Alternative energy sources such as solar, geothermal or wind are not expected to make major contributions soon. However, reductions in the electric power growth rate resulting from conservation programs could be significant.

ELECTRIC POWER PLANNING

Issue: How Should Northwest Federal Power Generation Be Allocated?

Additional sources of the inexpensive, abundant federal hydroelectricity that has furnished the basis for a heavily electrified energy structure in the Pacific Northwest have essentially been exhausted. As a result, traditional electrical power planning assumptions in the region no longer apply.

It is generally accepted that allocating the present inexpensive federal hydroelectric resources and the new, expensive thermal-generated resources (usually privately owned) requires regional power planning that includes the participation of all the public and private utilities, the Bonneville Power Administration (BPA), and the states.

According to a State of Oregon analysis, failure to accomplish that reallocation may increase the disparity in private utility rates, which are already significantly higher than those charged the customers of publically owned utilities. The growing disparity has increased local, state and regional interest in formation of new preference customers that would be eligible for federal power. Also, difficulties encountered in obtaining timely rate increases have adversely impacted the ability of the investor-owned utilities to finance needed new generation facilities, which leads to uncertainty of future power supply for the region.

In 1976, BPA notified its preference customers that it would be unable to supply their energy load growth requirements after June 30, 1983. Each preference customer will then have an allocation of BPA firm energy until its contract with BPA expires. Thereafter, its power allocations will be dependent upon allocation principles BPA intends to develop and adopt over the next 12 to 24 months. Until such allocation principles have been adopted, no preference customer has assurance of a long-range power supply from BPA.

Under present circumstances, BPA would be unable to renew contracts with its direct-service industrial customers (DSIs) as these contracts begin expiring in the 1980s. This would sharply increase rates paid by them and

may cause some BPA direct-service industries to choose to leave the Pacific Northwest and possibly locate overseas.

Authorizing federal legislation will be required to put a regional power plant into effect once the planning process and goals to reallocate federal electric power are agreed upon by competing interests.

The three central issues that are frustrating agreement on the process and goals are:

1) lack of adequate public participation in the planning process, (although task teams have met with many state, local and regional interests to discuss a Pacific Northwest Utilities Conference Committee (PNUCC) legislative proposal);

2) whether it is in the national or regional interest to provide electric power to direct-service industries, predominantly the aluminum reduction companies, and if so, whether power should be supplied at the marginal cost or at a melded cost; and

3) whether it is in the interest of the "preference customers" (publicly owned) to give up their preferred position in the interest of a diversified electric power generating system.

No mechanism currently exists to adequately deal with these issues.

Two major Congressional attempts to reallocate Northwest federal power through federal legislation have been presented in the past. Congressman James Weaver of Oregon introduced legislation in March of 1977 to create a quasi-government corporation (the Columbia Basin Energy Corporation) to replace BPA. The PNUCC has drafted proposed legislation that would change the role of BPA to allow the agency to guarantee purchase of power from new publicly and privately owned plants, meld the costs charged to its customers for hydroelectric and thermal generation, and sell power in differential rate blocks in order to help close the rate disparity between public and private utilities.

Both proposals have been incorporated into the Jackson bill. The bill addresses the major concerns of both. The promotion of conservation

is emphasized with the constraint of available technology before nonrenewable resources are utilized. The bill however does not identify an administrative system outside of BPA. Thus, the bill gives BPA major administrative power. BPA has asked for a mechanism for more public control which would involve state and local government directives. Previously, the directives have come from industry and utilities. The bill is still in committee in order that the problems involved will be solved to provide concensus. The bill will probably be passed during next years session.

ENVIRONMENTAL AND SAFETY REGULATIONS

Issue: Are Electric Power Generation Facilities Subject to Adequate Environmental and Safety Regulations?

Many people in the Region believe that electric energy generation facilities--especially nuclear power plants--are not designed or built with sufficient features to protect the public from potential environmental or safety hazards. All forms of electric power generation--whether based on wood, coal, oil, nuclear, or other energy sources--cause some negative impacts on the environment. Efforts to reduce environmental effects totally, even if technically possible, must be considered in light of the need to provide the consumer with economically feasible power.

Concerns most frequently voiced involve nuclear power--specifically, the operation of nuclear plants, the reprocessing of nuclear fuel, the transportation of nuclear materials, and the storage of nuclear wastes. The potential for theft of nuclear materials and the development of safeguards against that potential also concern the people of the Region.

Federal agencies charged with regulating electric energy generation facilities generally believe that existing federal regulations, procedures and safeguards will prevent these possibilities. Some groups, however, maintain that there is a need for additional environmental and safety requirements, as well as for increased regulation by appropriate governmental entities.

WATER USE

Issue: What Should Be the Priority of Electric Energy Generation in the Management of Northwest Freshwater Resources, Especially During Critical Water Years?

Hydroelectric power generation during low water years could seriously conflict with agricultural and other water uses. In addition, when more thermal power plants are built in the Northwest, the use of hydropower capacity for peaking loads, although very efficient, can cause significant fluctuations in river flows and reservoir levels, and can have adverse effects upon fisheries, water quality, recreation and transportation uses. Also, thermal power generation requires considerable quantities of water for cooling. Thus, water is essential to energy production, just as it is to agriculture, fisheries and other uses, and its allocation during low-flow years becomes a critical issue.

ELECTRIC ENERGY FORECASTS

Issue: Should the States Assume the Responsibility for Providing Electric Energy Forecasts, and How Should the Public Participate in the Forecasting Process?

Recent utility forecasts indicate an electric energy use growth rate of 1.4% to 4.3% each yr for the next 10 yr. These forecasts suggest power shortages will cause major curtailments in interruptible and firm loads between 1978 and 1983. Potential energy shortages, particularly those affecting residential and firm industrial loads, require trade-offs involving social equity and economics. In making these decisions, the validity of power forecasts by utilities has been questioned by public interest groups and private parties. Therefore, since the time needed for planning and constructing new power plants is now reaching a 10 yr span, and since approval processes are required by federal, state, and local entities, these interests are pressuring for involvement in the development of power forecasts.

OIL TANKERS

Issue: Where Should a Pipeline Terminal-Supertanker Port for Transport of Surplus Oil to the Northern Tier States be Constructed?

This is a complex issue; various facets of it are of local, state, Regional, national and international concern.

Projections of crude oil surpluses on the West Coast and crude oil demands of the northern tier states and upper Midwest, coupled with U.S. policy to use Alaskan oil in domestic markets, has created strong pressure for west-to-east crude oil transportation systems. One of several such proposed systems, the Northern Tier Pipeline Proposal, would have a terminal at Port Angeles, Washington, capable of handling up to 900,000 bbl/day. Another major proposal is to transhipp the oil at Kitimat, in northern British Columbia.

The major concern is the increased oil tanker traffic and the impact of very large oil spills on aesthetic, recreational and fisheries resources associated with the extensive shoreline in the relatively closed waters of Puget Sound and the adjacent Strait of Georgia in British Columbia. Washington State passed a law limiting the size of oil tankers allowed into inner Puget Sound to 125,000 deadweight tons (dwt). The law has been appealed by Atlantic Richfield to the U.S. Supreme Court. There is controversy at each of the proposed locations, based upon socioeconomic, environmental and other considerations. In addition, there are differences of opinion between various elements of state government and between Washington and British Columbia on whether a superport-pipeline terminal is acceptable, and if so, on where it should be located and how the site should be selected.

A related consideration is the cut-off of Canadian crude to the Northern Tier States. The markets of eastern Washington and Oregon and some Idaho markets are served by oil refineries in Billings, Montana and Salt Lake City, Utah. Both of these refinery centers have received crude oil from Canada; Billings refineries use about 50% Canadian crude, and Salt Lake City refineries use a small amount. The Billings refineries will be particularly hard pressed to find alternative supplies of crude oil (in terms of both quality and quantity) as Canadian exports are cut.

The Northern Tier States have urged Washington State to approve a site and expedite development of a transhipment facility. Some have indicated, however, that they would be satisfied with the Kitimat, British Columbia proposal.

OTHER ISSUES IDENTIFIED BUT NOT ASSESSED

- Preference clause
- Pricing disparities
- Low-income user pricing disparities (Background Papers)
- Graduated pricing (conservation)
- Future generations' rights

Information Source for Section: Energy Northwest.

Mass Conversions

From	To: lb (avoirdupois)	kg	Short Ton	Long Ton	Metric Ton
lb (avoirdupois)	1	0.4536	5.0×10^{-4}	4.4643×10^{-4}	4.5362×10^{-4}
kg	2.205	1	1.1023×10^{-3}	9.8425×10^{-4}	1.0×10^{-3}
Short ton	2000	907.2	1	0.8929	0.9072
Long ton	2240	1016	1.12	1	1.016
Metric ton	2205	1000	1.102	0.9842	1

Length Conversions

From	To: cm	In.	Ft	Yd	m	Mile	km
cm	1	0.3937	3.281×10^{-2}	1.0936×10^{-2}	1.0×10^{-2}	6.214×10^{-6}	1.0×10^{-5}
In.	2.54	1	8.333×10^{-2}	2.778×10^{-2}	2.54×10^{-2}	1.578×10^{-5}	2.54×10^{-5}
Ft	30.48	12	1	0.333	0.3048	1.894×10^{-4}	3.048×10^{-4}
Yd	91.44	36	3	1	0.9144	5.682×10^{-4}	9.144×10^{-4}
m	100	39.37	3.281	1.0936	1	6.214×10^{-4}	1.0×10^{-3}
Mile	160,934	63,630	5230	1760	1609	1	1.609
km	100,000	39,370	3281	1093.6	1000	0.6214	1

Energy Conversions

From	To: Ft-lb	kg-m	hp-hr	Metric hp-hr	Btu	kWh	Joule
Ft-lb	1	0.1383	5.0505×10^{-7}	5.12×10^{-7}	1.285×10^{-3}	3.766×10^{-7}	1.355
kg-m	7.233	1	3.653×10^{-6}	3.704×10^{-6}	9.295×10^{-3}	2.724×10^{-6}	9.808
hp-hr	1.98×10^{6}	2.7375×10^{5}	1	1.0139	2544	0.7457	2.683×10^{6}
Metric hp-hr	1.953×10^{6}	270,000	0.9863	1	2510	0.7355	2.646×10^{6}
Btu	778.2	107.6	3.93×10^{-4}	3.985×10^{-4}	1	2.931×10^{-4}	1055
kWh	2.655×10^{6}	3.671×10^{6}	1.341	1.3596	3412	1	3.6×10^{6}
Joule	0.738	0.102	3.727×10^{-7}	3.779×10^{-7}	9.479×10^{-4}	2.778×10^{-7}	1

Volume Conversions

From	To: $In.^3$	Ft^3	U.S. Gal	Liter	Bbl
In^3	1	5.787×10^{-4}	4.329×10^{-3}	0.01639	1.031×10^{-4}
Ft^3	1728	1	7.481	28.32	0.1781
U.S. Gal	231	0.1337	1	3.785	2.381×10^{-2}
Liter	61.02	3.531×10^{-2}	0.2642	1	6.29×10^{-3}
Bbl	9702	5.615	42	158.97	1

Heat Content for Various Fuels

Fuel Oils			Natural Gas		
Crude	138,100	Btu/gal	Liquid	95,800	Btu/gal
Residual	149,700	Btu/gal	Wet	1,095	Btu/ft^3
Distillate	138,700	Btu/gal	Dry	1,021	Btu/ft^3
Automotive Gasoline	125,000	Btu/gal	Coal		
AVGAS	124,000	Btu/gal	Anthracite	25.4 x 10^6	Btu/short ton
Jet Fuel (Kerosine)	135,000	Btu/gal	Bituminous	26.2 x 10^6	Btu/short ton
Jet Fuel (Naphta)	127,500	Btu/gal	Lignite	13.4 x 10^6	Btu/short ton
Diesel Oil (#2)	138,700	Btu/gal	(Electrical generation and distribution efficiency)		~30%
Coal Products			Lubricants	144,405	Btu/gal
Crude Light Oil	130,000	Btu/gal	Waxes	155,643	Btu/gal
Crude Coal Tar	150,000	Btu/gal	Petroleum Coke	143,423	Btu/gal
Crude Petroleum	138,100	Btu/gal	Asphalt and Road Oil	158,000	Btu/gal
Ethane	73,390	Btu/gal	Natural Gasoline and Cycle Pro-Ducts	110,000	Btu/gal
Still gas	142,286	Btu/gal			

1 Btu/gal = 278.7 joule/liter = 2.787 x 10^5 joule/m^3

1 Btu/short ton = 942.0 joule/metric ton

Data Source: Ref. 13, Buildings Energy Use Data Book, Ed. 1, by G. E. Liepins, M. A. Smith, A. B. Rose, and K. Haygood. Oak Ridge National Laboratory.

GLOSSARY

abatement: The method of reducing the degree or intensity of pollution; also, the use of such a method.

acre-foot: The quantity of water required to cover 1 acre to a depth of 1 ft; equal to 43,560 CF or 325,851 gal.

adaptation: A change in structure or habit of an organism that produces better adjustment to the environment.

afterbay: The body of water immediately downstream from a hydroelectric plant.

agricultural land: Land that is used or is suitable for use in the production of food and forest products due to climate, soil type, topography, etc. The term covers both the commercial generation of such products, and the raising of the products as an income supplement, which is characterisitic of rural and semirural areas.

agricultural pollution: The liquid and solid wastes from all types of farming, including: runoff from pesticides, fertilizers, and feedlots; erosion and dust from plowing; animal manure and carcasses; and crop residues and debris. It has been estimated that agricultural pollution in the U.S. has amounted to more than 2.5 billion tons/yr.

air pollution: The presence of contaminants in the air in concentrations that are too high for the normal dispersive capabilities of the air and that interfere directly or indirectly with man's health, safety, or comfort, or with the full use and enjoyment of his property.

air pollution episode: The occurrence of abnormally high concentrations of air pollutants usually caused by a lack of wind and a temperature inversion, and accompanied by an increase in illness and death.

air quality control region: An area designated by the federal government where two or more communities--either in the same or in different states--share a common air pollution problem.

air quality criteria: The levels of pollution and the lengths of exposure at which adverse effects on health and welfare occur.

air quality standards: The prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified geographical area.

ambient air: Any unconfined portion of the atmosphere; the outside air.

ambient noise: The level of constant background noise.

anthracite coal: A hard coal with high heat content and little or no volatile matter, mined principally in eastern Pennsylvania. Produces an intensely hot fire and no smoke. Accounts for about 1% of total U.S. coal consumption.

aquatic plants: Plants that grow in water and either float on the surface, grow beneath the surface, or grow up from the bottom.

aquifer: An underground bed or stratum of earth, gravel, or porous stone that contains water. A layer of sand/gravel which has the potential of producing quantities of drinking water from wells or springs. Deep aquifers are those usually located below hardpan layers; shallow aquifers normally lie above the hardpan.

aquifer recharge areas: Areas on the surface which, because of soil type and depth, allow rainfall and runoff to seep into aquifers.

> prime aquifer recharge areas: Land surfaces that have special natural characteristics regarding location, elevation, topography, thickness of hardpan, and types and thicknesses of material above the hardpan which allow significant quantities of water to seep into the aquifer. Covering prime aquifer with roof tops and paving without adequate provision for recharge can dramatically reduce the amount of water that can be obtained from wells.

area of origin: In case of interbasin water transfers, the area that exports water.

background level: In the case of air pollution, this is the amount of pollutants caused by natural sources present in the ambient air.

barrel (U.S.): A liquid volume equal to 42 U.S. gal and commonly used in the petroleum industry.

baseload: See load, base.

BCF: billion cubic feet.

bedrock: The solid or weathered rock that underlies the veneer of unconsolidated material or is expsoed at the surface.

billion cubic feet: BCF.

biochemical oygen demand (BOD): A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. Large amounts of organic waste use up large amounts of dissolved oxygen; thus, the greater the degree of pollution, the greater the BOD.

biome: A major regional ecological community of plants and animals extending over large natural areas. The plants of land biomes comprise the "formations" of plant ecologies.

biota: The flora and fauna of a region.

bituminous coal: A coal with high heat content and 15% to 50% volatile matter--referred to as soft coal. It burns with a smoky, luminous flame, and is mined in many areas of the country. It is the most predominantly used coal.

BOD: Biochemical oxygen demand.

British thermal unit (Btu): The amount of heat required to raise the temperature of 1 lb of water 1°F at its point of maximum density.

Btu: British thermal unit.

Buncker C fuel oil: Fuel oil grade No. 6. A high-viscosity oil used mostly in commercial and industrial heating and as fuel for ships. Requires preheating in the storage tank to permit pumping, and additional preheating at the burner.

by-products (residuals): Secondary products that have commercial value and are obtained from the processing of a raw material. They may be the residues of the gas production process, such as coke, tar, and ammonia, or they may even be the products of further processing of such residues, such as ammonium sulphate.

capability: The maximum load that a generator, turbine, power plant, transmission circuit, or power system can supply under specified conditions for a given time interval without exceeding approved limits of temperature and stress.

maximum plant capability (hydropower): The maximum load that a hydroelectric plant can supply under optimum head and flow conditions without exceeding approved limits of temperature and stress. This may be less than the overload rating of the generators, due to encroachment of tailwater on head at high discharges.

peaking capability: The maximum peak load that can be supplied by a generating unit, station, or system in a stated time period. For a hydroproject, the peaking capability would be equal to the maximum plant capability only under favorable pool and flow conditions; often the peaking capability may be less because of reservoir drawdown or tailwater encroachment.

ultimate plant capability (hydropower): The maximum plant capability of a hydroelectric plant when all contemplated generating units have been installed.

capacity: The load at which a generator, transmission circuit, power plant, or system is rated. Capacity is also used synonymously with capability.

dependable capacity: The load-carrying ability of a station or system under adverse conditions for the time interval and period specified that relates to the characteristics of the load to be supplied, For hydropower projects, the term refers to the capability in the most adverse month of the critical period--January of 1932 in the case of the 1928-1932 period.

firm capacity: Capacity that has assured availability to the customer on a demand basis. System firm capacity consists essentially of hydrosystem dependable capacity plus thermal plant installed capacity plus firm imports minus maintenance and forced outage reserves.

hydraulic capacity: The maximum flow that a hydroelectric plant can utilize for power generation.

installed capacity: Same as nameplate capacity unless otherwise specified.

interruptible capacity: The capacity component of interruptible power (see power, interruptible).

nameplate capacity: The nominal rated capacity of a generating unit or other similar apparatus. The term gives an indication of the approximate generating capacity of the unit, though in many cases the unit is capable of generating substantially more than the nameplate capacity on a continuous basis (see overload capacity).

overload capacity: The maximum load that a machine, apparatus, or device can carry for a specified period of time under specified conditions when operating beyond its nameplate rating but within the limits of the manufacturer's guarantee, or in the case of expiration of the guarantee, within safe limits as determined by the owner. For example, most of the generators installed in the Region's newer hydroelectric plants have a continuous overload capacity that is 115% of the nameplate capacity.

peaking capacity: Same as peaking capability.

reserve capacity: Extra generating capacity available to meet unanticipated demands for power or to generate power in the event of generation loss resulting from scheduled or unscheduled outages of regularly used generating capacity. Reserve capacity provided to meet the latter is also known as "forced outage reserve."

supplemental peaking capacity: The future capacity required to meet a given load above the system thermal and hydro-peaking capabilities. Sources of supplemental peaking capacity are additional hydroelectric turbine, or pumped-storage generation.

capacity factor: The ratio of the average load on the generating plant for the period of time considered to the capacity rating of the plant. Unless otherwise identified, capacity factor is computed on an annual basis.

carbon dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal part of the ambient air. CO_2 is a product of fossil fuel combustion.

carbon monoxide (CO): A colorless, odorless, highly toxic gas that is a normal byproduct of incomplete fossil fuel combustion. CO, one of the major air pollutants, can be harmful even in small amounts if breathed for a period of time.

carrying capacities: An analytical concept to determine the natural ecological limitations of the land, and a basis for evaluating development proposals.

CEQ: National Council on Environmental Quality (established by NEPA).

CF: Cubic foot.

CFA: Cubic feet per acre.

CFS: Cubic feet per second; a measure of the amount of water passing a given point.

chemical oxygen demand (COD): A measure of the amounts of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The greater the degree of pollution, the greater the COD.

chlorinated hydrocarbons: A class of generally long-lasting insecticides, of which the best known is DDT.

climax plant community: Natural vegetation adapted to a particular environment and in pristine condition.

climax vegetation: A stable, balanced vegetation community in an ecosystem that will remain in an area if undistrubed. The vegetative types present are determined by the climate.

CO: Carbon monoxide.

CO_2: Carbon dioxide.

coastal zone: Coastal waters and adjacent lands that exert a measurable influence upon the uses of the sea and its ecology.

COD: Chemical oxygen demand.

coke: Bituminous coal from which the volatile constituents have been driven off by heat in the absence of air so that the fixed carbon and ash are fused

together. Anthracite coal is used for bleeding. Coke is principally used in the steel-making process.

coliform organism: Any of a number of organisms common to the intestinal tract of man and animals whose presence in waste water is an indicator of pollution and of potentially dangerous bacterial contamination.

commercial sector: Includes wholesale trade, retail trade, services, finance, insurance, and real estate.

conservation: Those measures of management directed toward perpetuating resources for the enjoyment of present and future generations. Conservation is inclusive of preservation.

constant dollar estimates: Constant dollar estimates represent an effort to remove the effects of price changes from statistical series reported in current dollar terms. In general, constant dollar series are derived by dividing current dollar estimates by appropriate price indices. The result is a series as it would presumably exist if prices were the same throughout as in the base year--in other words, as if the dollar had constant purchasing power. Any changes in such a series would reflect only changes in the real (physical) volume of output. For the purpose of the federal-state survey forms, 1967 constant dollars are being used.

conventional hydroelectric plant: A hydroelectric power plant that utilizes streamflow only once as it passes downstream, as opposed to a pumped-storage plant, which recirculates all or a portion of the stream flow in the production of power.

cooling tower: A structure designed for the evaporative cooling of hot water.

coordinated Columbia River system: Contractually, the system of hydroelectric projects located on the Columbia River and major tributaries which are operated together on a coordinated basis under the terms of the Pacific Northwest Coordination Agreement. The term is sometimes used in a more general sense to include those projects that are operated by utilities not participating in the Coordination Agreement.

cost allocation: The apportionment of the costs of a multipurpose water project among the various purposes served.

critical areas: Sensitive lands can be protected from development via special zoning classifications, environmental reviews, and higher standards, etc.

critical period: Period when the limitations of hydroelectric power supply caused by water conditions are most critical with respect to system energy requirements.

crude oil: A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and that remains liquid at atmospheric pressure after passing through surface separating facilities.

crude oil stocks: Stocks of crude oil and lease condensate held at refineries, pipeline terminals, and on leases.

crude petrolem: A mixture of hydrocarbons that exist in natural underground reservoirs; it is liquid at atmospheric pressure after passing through surface-separating facilities.

cubic foot(CF): The most common unit of measurement of gas volume. It is the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor.

cubic foot per acre: See CFA.

cubic feet per second: See CFS.

deadweight ton: dwt.

degradation: The state of being reduced, in rank or quality; disintegration of the earth's surfaces by erosion, for instance.

degree days, cooling: A measure of temperature as it affects energy demand for space cooling. If the average of a day's high and low temperatures is below $75^{\circ}F$, the degree days for that day are taken to be zero; otherwise, they are equal to the difference between the average and $75^{\circ}F$.

degree days, heating: A measure of temperature as it affects energy demand for space heating. Most buildings require no heat to maintain an inside temperature of about $70^{\circ}F$ when the daily mean temperature is $65^{\circ}F$ or higher. If the average of a day's high and low temperature extremes is above $65^{\circ}F$, the degree days for that day are taken to be zero; otherwise, they are equal to the difference between the average and $65^{\circ}F$. Note that a larger number of degree days implies colder temperatures.

depleted uranium: Uranium consisting primarily of ^{238}U and depleted of the ^{238}U isotope. Depleted uranium generally contains less than 0.2 wt% ^{238}U.

depletion: The withdrawal of water from surface or groundwater reservoirs at a rate greater than the rate of replenishment.

desalting: The technical process of converting seawater or brackish water to fresh water or an otherwise more usable condition by removing dissolved solids. Also called "desalinization" and "desalination."

diesel fuel, heavy: A residual fuel oil for use in low- and medium-speed engines used for sustained loads at substantially constant speed.

discharge: The rate of flow of a spring, stream, canal, sewer, or conduit.

distillate fuel oil: The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades No. 1 and 2 heating oils, diesel fuels, and No. 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on- and off-highway diesel engines, and railroad diesel fuel.

dissolved oxygen: Oxygen suspended in water in the form of microscopic bubbles.

dissolved solids: Dissolved material, organic and inorganic, contained in water or wastes.

drainage basin: The land area from which water drains into a river; for example, the Columbia River Basin.

drawdown The distance the water surface of a reservoir is lowered from a given elevation as the result of water withdrawal. In specific cases, drawdown may refer to the maximum drawdown for power operation, from normal full pool to minimum power pool. Sometimes drawdown is also expressed in terms of acre-feet of storage withdrawn.

dust: Fine-grain particulate matter that is capable of being suspended in air.

dwt: Deadweight ton.

ecological impact: The total effect of an environmental change, either natural or manmade, upon the ecology of an area.

ecology: The interrelationships of living things to one another and to their environment, or the study of such interrelationships.

ecosystem: A system composed of a community of animals, plants, and bacteria and the physical and chemical environment with which it is interrelated; the interacting system of a biological community and its nonliving environment.

ecotone: A fairly broad transition region between adjacent biomes.

effluent: A discharge from a pollution source that is relatively self-contained; generally referred to in regard to discharges into waters, but may also mean discharges into air.

electric power productivity: Value added divided by electricity consumed expressed in dollars/kWh.

electric utility sector: Publicly and privately owned utilities located within states' lines.

electricity consumption, commercial sector: Sales of electricity to businesses with a demand generally less than 1000 kWe.

electricity consumption, residential sector: Sales of electricity for residential and household purposes.

electricity demand: The rate at which electric energy is delivered to or by a system or to a piece of equipment at a given instant or averaged over any designated period of time.

electricity generated with nonfossil fuels: Electrical generation produced by nuclear, hydroelectric, and other sources such as wood, waste products, geothermal, and solar sources.

emission: Emission is generally used in regard to discharges into air. See effluent.

emission factor: The average amount of a pollutant emitted from each type of polluting source in relation to a specific amount of material processed. The emission factor for a residential furnace would be the number of pounds of particulates per cubic foot of fuel.

emission inventory: A list of air pollutants emitted into a community's atmosphere (in amounts such as tons per day) by type of source. The emission inventory is basic to the establishment of emission standards.

emission standard: The maximum amount of a pollutant legally permitted to be discharged from a single source, either mobile or stationary.

end user: An ultimate consumer of any type of fossil fuel (petroleum, coal, natural gas) or electricity, whether generated by fossil fuel or other energy sources. End users are classified in five sectors: agricultural, commercial, residential, industrial, and transportation. Electric utilities are excluded.

endangered: Any species, subspecies, or subpopulation of animal which is threatened with extinction resulting from very low or declining numbers, alteration and/or reduction of habitat, detrimental environmental changes, or any combination of the above. Continued survival under such threatening conditions is unlikely without implementation of special measures.

energy: That which does or is capable of doing work. It is measured in terms of the work it is capable of doing; electric energy is commonly measured in kWh or average MWe.

> average annual energy: Average annual energy generated by a hydroelectric project or system over a specified period. In the Pacific Northwest the average output of most projects is based on the historical flows experienced during the period 1928-1958, as modified by appropriate irrigation depletions.

firm energy: Electric energy that is considered to have assured availability to the customer to meet all or any agreed-upon portion of his load requirements. Firm energy is based upon certain specified probability considerations, which in the Pacific Northwest are related to the 1928-1958 sequence of historical streamflows adopted for making system power regulations. System firm energy capability includes hydrosystem prime energy, thermal plant energy capabilities, and firm imports.

prime energy: Hydroelectric energy assumed to be available 100% of the time: specifically, the average energy generated during the critical period.

pumping energy: In this report, pumping energy refers to the energy required to sustain the pumping portion of the pumped-storage operating cycle.

secondary energy: All hydroelectric energy other than prime energy: specifically, the difference between average annual energy and prime energy.

usable energy: All hydroelectric energy that can be used to meet system firm and secondary loads.

energy consumption, industrial sector: Real consumption by, apparent demand by, sales to, or deliveries to construction, manufacturing, agricultural, and mining establishments.

energy consumption, residential and commercial sectors: Real consumption by, apparent demand by, sales to, or deliveries to private households, housing units, nonmanufacturing business establishments, (e.g., wholesale and retail businesses), health and educational institutions, and public buildings.

energy consumption, transportation sector: Real consumption by, apparent demand by, sales to, or deliveries to both private and public passenger and freight transportation, as well as to government transportation, including military operations.

energy consumption, electric utility sector: Real consumption by, apparent demand by, sales to, or deliveries to privately and publicly owned establishments that generate electricity primarily for sale or resale.

energy producing sector: Includes all energy types, whether mined, drilled, or otherwise.

environment: The external conditions that exist within an area, which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance.

environmental controls: Dealing with noise, air, and water quality, flood controls, etc.

environmental impact statement (EIS): A detailed statement setting forth the environmental effects and considerations anticipated by a proposed action, policy, or project that has been determined to be a "major federal action significantly affecting the environment" under the provisions of the National Environmental Policy Act.

environmental quality: The properties and characteristics of the environment, either generalized or local, as they impinge upon human beings and other organisms. Environmental quality can refer to varied characteristics or the potential effects such characteristics may have on physical and mental health.

EPA: Environmental Protection Agency, which administers the National Environmental Protection Act as well as other environmental legislation such as the Clean Air Act.

erosion: The wearing away of land by the action of wind, water, gravity, or a combination thereof. Erosion occurs naturally from weather or runoff, but is often intensified by man's land-clearing practices.

erosive: Refers to wind or water having sufficient velocity to cause erosion. Not to be confused with erodible as a quality of soil.

estuaries: Areas where fresh water meets salt water. For example, bays, mouths of rivers, salt marshes, and lagoons. Estuaries are delicate ecosystems; they serve as nurseries, spawning, and feeding grounds for a large group of marine life and provide shelter and food for birds and wildlife.

eutrophication: The overfertilization of a water body caused by increases in mineral and organic nutrients that produce an abundance of plant life which uses up oxygen, sometimes creating an environment hostile to higher forms of marine animal life.

evapotranspiration: The sum of water removed by vegetation and water lost by evaporation for a particular area during a specified time.

excess capacity: Measure of the surplus of a facility's capacity which is available for additional users. It is the difference between a facility's design capacity and its existing one.

exports: Shipments from the 50 states and the District of Columbia to foreign countries and U.S. possessions and territories.

extirpated: Any species of animal that has disappeared, as a part or full time resident, from the state. (This is different from the word "extinct," which means the total loss of the species in the world).

firm load-carrying capability: The firm load that a system could carry through coordinated operation under critical period streamflow conditions with the use of all reservoir storage. More specific terms are Firm Energy Load-Carrying Capability and Firm Peak Load-Carrying Capability. The general term refers collectively to both.

flood plain: The land area bordering a river that is subject to flooding.

floodway: The riverbed and immediately adjacent lands needed to convey high velocity flood discharges.

floodway fringe: Lands immediately adjacent to floodways that are still subject to flooding but that are not needed for high velocity flood discharge and are flooded less frequently and for shorter durations than floodways.

forebay: The impoundment immediately above a dam or hydroelectric plant intake structure.

fossil fuels: Coal, oil, and natural gas; so-called because they are derived from the remains of ancient plant and animal life.

game fish: Those species of fish sought by sports fisherman; for example, salmon, trout, black bass, striped bass, etc. Game fish are usually more sensitive to environmental changes and water quality degradation than "rough" fish.

gas, natural: A naturally occurring mixture of hydrocarbon and nonhydrocarbon gases found in porous formations beneath the earth's surface, often in association with petroleum. The principal consituent is methane.

associated: Free natural gas in immediate contact, but not in solution with, crude oil in the reservoir.

dissolved: Natural gas in solution with crude oil in the reservoir.

liquefied (LNG): Natural gas that has been liquefied by reducing its temperature to -260°F at atmospheric pressure. It remains a liquid at -116°F and 673 psig. In volume it occupies 1/600 of the gas in the vapor state.

liquids: Those liquid hydrocarbon mixtures that are gaseous at reservoir temperatures and pressures, but are recoverable by condensation or absorption. Natural gasoline and liquefied petroleum gases fall into this category.

nonassociated: Free natural gas not in contact with, nor dissolved in, crude oil in the reservoir.

substitute natural (SNG): A gas manufactured from carbonaceous material whose characteristics are substantially interchangeable with natural

gas. The resultant gas is composed primarily of methane. At this writing, SNG feedstocks are the light hydrocarbons, propane, butane, and the naphthas. Development is underway of processes for production from heavier feedstocks and from coal.

generation: The act or process of producing electric energy from other forms of energy; also, the amount of electric energy so produced.

geothermal energy: The heat energy available in the rocks, hot water, and steam in the earth's subsurface.

government sector: Energy consumption by federal, state, county, city, or other governmental subdivisions of a state and any special purpose district.

gradient: Degree of inclination, or a rate or change in certain variable factors (such as pressure and temperature, etc.), or rising or descending either gradually or by uniform degrees.

gross energy consumption: Total energy inputs into the economy, including coal, petroleum, natural gas, and the hydropower, nuclear, and geothermal power inputs for electricity generation. Also includes feedstocks and raw materials from fossil fuels such as asphalt, lubricants, chemical plant feedstocks, and coke. Gross consumption includes conversion, transmission, and distribution losses by the electric utilities sector.

ground cover: Grasses or other plants grown to keep soil from being blown or washed away.

groundwater: The supply of fresh water under the earth's surface in an aquifer.

groundwater mining: The condition when withdrawals are made from an aquifer at rates in excess of net recharge; sooner or later the underground supply will be exhausted or the water table will drop below economic pump lifts.

groundwater runoff: Groundwater that is discharged into a stream channel as spring or seepage water.

habitat: The sum total of environmental conditions of a specific place that is occupied by an organism, a population, or a community.

hardness: Derived largely from contact with soil and rock formations, hardness in water is caused by divalent metallic cations--principally calcium, magnesium, strontium, ferrous iron, and manganour ions. Hard waters are as satisfactory for human consumption as soft waters. Because of hard water's adverse action with soap, however, its use for cleaning purposes is quite unsatisfactory, producing scale in hot water pipes, heaters, boilers, and other units in which the temperature of water is increased materially.

hazardous air pollutant: According to law, a pollutant such as asbestos, berylium, and mercury to which no ambient air quality standard is applicable and that may cause or contribute to an increase in mortality or in serious illness.

head (as used in pumped-storage site inventory): The difference between the full pool elevations of the upper and lower reservoirs.

design head: The head at which the turbine will operate to give the best overall efficiency under specified operating conditions. Usually this is the head at or near which the project will operate most of the time.

gross head: The difference of elevations between water surfaces of the forebay and tailrace under specified conditions. Gross head generally refers to the difference between normal full pool and average tailwater.

net head (effective head): The gross head less all hydraulic losses except those chargeable to the turbine.

rated head: The head at which a turbine will deliver rated output at specified gate and efficiency. In many cases this is the same as design head, but in certain specific cases may be defined by other conditions.

headwaters: The place where a river originates.

heating degree days: The departure of the mean daily temperature below a given standard (in this case, $65^{o}F$ or $18.3^{o}C$). One degree-day is counted for each degree of departure below the standard during one day. Degree days are usually accumulated over a month, season, or year.

H_2S: Hydrogen sulfide, a type of air pollution.

hydrocarbons: A type of air pollution including organic acids, aldehydes, unsaturated hydrocarbons, and acromatics.

hydrology: The science dealing with the properties, distribution, and circulation of water and snow.

imports: Power imported from outside the system being considered.

indigenous: Native; originating or occurring naturally.

infiltration: The flow of a fluid into a substance through pores or small openings. Commonly used in hydrology to denote the flow of water into soil material. Connoting flow into a soil in contradistinction to "percolation," which connotes flow through a porous substance.

infiltration rate: The rate at which surface soil absorbs water.

instream use: Use of water that does not require withdrawal or diversion from its natural watercourse. For example, the use of water for navigation, waste disposal, recreation, and support of fish and wildlife.

interbasin transfer: The physical transfer of water from one watershed to another. On a large scale, the transfer of large quantities of water from one major river basin to another.

interstate compact: In the case of water resources, agreements between two or more states for dealing with water resource problems involving more than one state and beyond the legal authority of one state alone to solve. Such agreements require the consent of Congress. The federal government may participate in some compacts, in which case the agreement is called a federal-interstate compact.

kilowatt (kW): The electrical unit of power which equals 1000 watts or 1.341 horsepower.

kilowatt hour (kWh): The amount of electrical energy involved with a one-kilowatt demand over a period of one hour. Equivalent to 3412 Btus.

land use distribution: The quantitative breakdown of a specific geographic area's land into land use categories such as "vacant," "single-family," etc.

lignite: A coal with a low heat content and a high percentage of moisture. Tends to crumble when exposed to air. Strip-mined, principally in the northern Great Plains states and Texas.

limited: Any species of animal occurring in limited numbers because of a restricted or specialized habitat or at the perimeter of its historic range.

liquefied gases: Gases received from natural gas processing plants or produced by a refinery. Includes propane, prophlene, butane, butylene, isobutane, normal butane, other butane, propane-butane mix, natural gasoline, isopentane, and plant condensate.

load: The amount of power delivered to a given point.

base load: The minimum load in a stated period of time.

firm load: The part of the system load which must be met with firm power.

peak load: Literally, the maximum load in a stated period of time. Sometimes the term is used in a general sense to describe that portion of the load above the base load.

load factor: The ratio of the average load over a designated period to the peak load occurring in that period. In this report the term applies to annual load factor.

load shape (load pattern): The characteristic variation in the magnitude of the power load with respect to time. This can be for a daily, weekly, or annual period.

losses:

electric system losses: Total electric energy losses in the electric system. They consist of transmission, transformation, and distribution losses and unaccounted-for energy losses between sources of supply and points of delivery.

pumped-storage operating cycle losses: Losses occurring in the mechanical, hydraulic, and electrical systems during the pump-generation cycle plus associated transmission losses.

lubricating greases: A solid-to-semifluid product consisting of dispersion of a thickening agent in a lubricating oil.

lubricating oils: All liquid lubricants containing more than 50% by volume of refined petroleum distillates or specially treated petroleum residuum.

M: Thousand.

megawatt (MW): One thousand kilowatts.

megawatt-hour (MW-hr): One thousand kilowatt-hours.

MG/D: Millions of gallons per day, a measurement of the rate of flow of water.

million: MM.

mitigating factors: Ways of lessening severe impacts.

MM: Million.

MMCF: Million cubic feet.

multiple use: Management of natural resources to serve two or more uses simultaneously.

natural gas: Naturally occurring mixtures of hydrocarbon gases and vapors, including methane, ethane, propane, butane, pentane, and hexane. The average energy content of dry natural gas in the U.S. is about 1021 Btu/ft . Also, a mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

natural gas consumption, commercial sector: Deliveries to nonmanufacturing establishments, including those engaged in agriculture. forestry, and fishing.

natural gas consumption, electric utility sector: Deliveries to electric utilities for the generation of electric power.

natural gas consumption, industrial sector: Deliveries to establishments engaged primarily in processing unfinished materials into another form or product. Includes mining, petroleum refining, and manufacturing.

natural gas consumption, residential sector: Deliveries to private households for heating, cooking, and other household uses.

natural gas liquids (input to refineries): Products obtained from natural gasoline plants, cycling plants, and fractionators after processing the natural gas. Included are ethane, liquefied petroleum (LP) gases (propane, butane, and propane-butane mixtures), natural gasoline, and plant condensate.

natural hazard: A feature of the environment which has the potential for posing a danger to life or property. Examples are flood, landslide, earthquake, storm.

natural resources: Source of supply or support for human activities that are available for the natural environment land itself, (water, air, soil, food, etc.).

natural system: One of several processes which operate in the natural environment. Natural systems have a relationship (either direct, as in the case of the evaporation-rainfall-runoff cycle or erosion-deposition cycle, or indirect, as in the case of the predator-prey relationship) to human needs and activities.

NEPA: National Environmental Policy Act (1969).

nitrogen dioxide (NO_2): A compound produced by the oxidation of nitric oxide in the atmosphere; a major contributor to photochemical smog.

NO: Nitrogen oxide.

NO_2: Nitrogen dioxide.

NO_x: Either nitrogen dioxide or nitrogen oxide, also referred to as nitric oxides.

no discharge policy: The policy that prohibits discharge of any harmful substance into a water body. Strictly applied, the policy would even forbid discharges that are within the capacity of a water body to assimilate and render harmless.

noise: Any undesired audible signal. Thus, in acoustics, noise is any undesired sound.

non-game wildlife: All species that are not commonly pursued, killed, or consumed, either for sport or profit; includes wild mammals, birds, reptiles, fish, amphibians, mollusks, and crustaceans that are not classified as big game, small game birds, or mammals, raptors, furbearers, varmints, sport fish, sport amphibians, sport crustaceans, or mullusks.

nonpoint-source: The diffuse discharge of waste into a water body which cannot be located as to specific source, as with sediment, certain agricultural chemicals, and acid mine drainage.

nonrenewable natural resource: A natural resource that is not capable of being regenerated through action of natural processes within a reasonable time period, even when the cause of loss is removed. Examples are land itself, commercially valuable deposits of sand and gravel, agricultural soil, scenic views.

Northwest: In this report, the Northwest denotes the four-state area of Alaska, Idaho, Oregon, and Washington.

Northwest Region: See Northwest. (Also, Region).

O_x: Total oxidants.

once-through process: The withdrawal of water from a water body for use in cooling or processing and subsequent return of that water, usually at a higher temperature or other altered condition. Contrasts with water recycling processes.

open space: Land that is preserved for or in use as undeveloped areas. Open space can provide food and fiber production in addition to its aesthetic values. For example: lands under the current use assessment, state lands, pasture, and farms. Through the acquisition zoning or other regulatory powers (incentives, donation, easements, etc.) a locality can preserve open space and recreation areas, as well as maintain low densities.

Pacific Northwest: In this report, the three-state area of Idaho, Oregon, and Washington.

particulates: Finely divided solid or liquid particles in the air or in an emission. Particulates include dust, smoke, fumes, mist spray, and fog.

particulate loading: The introduction of particulates into the ambient air.

peaking: Power plant operation to meet the variable portion of the daily load. See load, peak.

peaking plant: A power plant that is usually operated to provide all or most of its generation during maximum load periods.

per capita: Division of the total by the number of persons within an area to obtain a calculation for each individual.

percolation, soil water: The downward movement of water through soil, especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

perennial plant: A plant that normally lives for three or more years.

permeability: Associated with drainage, but it is more closely a function of texture, structure, and type of clay in the soil. It is that quality of soil which permits passage of water, roots, or air and is measured in terms of flow of water through a unit cross section of soil in a given time. It is based on the least permeable layer within the soil profile.

petroleum: Crude oil (including lease condensate), refined petroleum products including natural gas liquids, and nonhydrocarbon compounds blended into finished petroleum products.

petroleum consumption, electric utility sector: Domestic demand for all fuel oils at electric utilities.

petroleum consumption, industrial sector: Domestic demand for petroleum products for use by establishments engaged in processing unfinished materials into another form or product. Excludes industrial space heating.

petroleum consumption, "other" sector: Domestic demand for miscellaneous products and for some agricultural uses.

petroleum consumption, residential and commercial: Domestic demand for petroleum products by private households and nonmanufacturing establishments. Includes industrial space heating and road paving.

petroleum consumption, transportation sector: Domestic demand for petroleum products for on-highway use, aircraft and vessel bunkering, and railroad use.

petrochemical feedstock: Fossil fuels used for their chemical properties, rather than their values as fuel, e.g., oil used to produce plastics and synthetic fabrics.

pH: A measure of the acidity or alkalinity of a material, liquid, or solid. pH is represented on a scale of 0 to 14, with 7 representing a neutral state, 0 representing the most acid, and 14 the most alkaline.

petrochemical oxidants: A type of air pollution formed by interaction of the atmosphere with nitrogen oxides.

PM: Particulate matter.

point source: In air pollution, a stationary source of a large individual emission, generally of an industrial nature. Also, a specific site from which wastewater is discharged into a water body and which can be located as a source, as with effluent, treated or otherwise, from a municipal sewage system, outflow from an industrial plant, or runoff from an animal feedlot.

pollutant: Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

pollution: The presence of matter or energy whose nature, location, or quantity produces undesired environmental effects.

pondage: Reservoir power storage capacity of limited magnitude that provides only daily or weekly regulation of streamflow.

power: The time rate of transferring energy. Note: The term is frequently used in a broad sense as a commodity of capacity and energy, having only general association with classic or scientific meaning.

> firm power: Power that is considered to have assured availability to a customer to meet all or any agreed-upong portion of his load requirements. It is firm energy supported by sufficient capacity to fit the load pattern. The availability of firm power is based upon the same probability considerations as is firm energy.
>
> interruptible power: Nonfirm power; power made available under agreements that permit curtailment or cessation of delivery by the supplier. In the Pacific Northwest, interruptible power loads are met with secondary hydroelectric energy.
>
> prime power: Prime energy shaped to fit the regional load pattern.
>
> secondary power: Same as secondary energy.

power supply area: Geographic grouping of electric power supplies as established by the Federal Power Commission in accordance with utility service areas.

ppm: Parts per million. The unit commonly used to represent the degree of pollutant concentration where the concentrations are small. Larger concentrations are given in percentages. Thus, BOD is represented in ppm, while suspended solids in water are expressed in percentages. In air, ppm is usually a volume/volume ratio--in water, a weight/volume ratio.

proved reserves, crude oil: Proved reserves of crude oil as of December 31 of any given year are the estimated quantities of all liquids statistically defined as crude oil that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

proved reserves, natural gas: Proved reserves of natural gas as of December 31 of any given year are the estimated quantities of natural gas that geological and engineering data demonstrate with reasonable certainty to be recoverable in the future from known natural oil and gas reservoirs under existing economic and operating conditions.

proved reserves, natural gas liquids: Estimates of proved reserves of natural gas liquids on December 31 of any given year include 1) reserves of nonassociated gas produced from gas wells and processed through lease separators, and 2) reserves of liquids expected to be recovered from associated-dissolved and nonassociated gas when processed in field facilities or gas processing plants. Estimates of proved reserves of natural gas liquids are based on 1) proved reserves of natural gas on December 31, and 2) rates at which liquids can be recovered from natural gas by using processing equipment of the type currently installed or planned as of December 31.

pumped-storage plant: A hydroelectric power plant that generates electric energy for peak load use by utilizing water pumped into a storage reservoir during off-peak periods.

quadrillion: One million billion or 10^{15}.

rare: A species that occupies only a small percentage of the preferred habitat within its range, or a species that is found through its range in extremely low densities; cannot always be found by a skilled observer even during intensive survey work.

radionuclide: A radioactive nuclide.

recycling: The process by which waste materials are transformed into new products in such a manner that the original products may lose their identity.

refined petroleum products: Products obtained from the processing of crude oil, unfinished oils, and natural gas liquids. Includes aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, ethane, liquefied petroleum gases, petrochemical feedstocks, special naphthas, lubricants, wax, coke, asphalt, oils, road oil, still gas, and miscellaneous products.

refiner: An industrial plant that processes crude oil and/or unfinished oils and manufactures refined petroleum products.

Region: In this report, the capitalized form of the word represents the four-state Northwest Region. See Northwest.

region: In this report, this lower case form represents the three-state Pacific Northwest area and all other references to regions other than the Northwest Region.

renewable natural resource: A natural resource that is capable of being regenerated through action of natural processes within a reasonable time period when the cause of loss is removed. Examples are water resources, clean air, agricultural produce, forest products, wildlife.

reserve capacity: The difference between the available dependable capacity of the system, including net firm power purchases, and the actual or anticipated peak load for a specific period.

reserves, energy: Refers to the bank of natural resources; such as natural gas liquids, petroleum, coal, lignite, and energy available from waste power.

estimated potential natural gas reserves: Refers to an estimate of the ultimate finding of natural gas in a specified area, whether or not presently considered to be proved or recoverable.

estimated proved recoverable natural gas reserves: An estimated quantity of natural gas that analysis of geologic and engineering data demonstrates with reasonable certainty to be recoverable in the future from known oil and gas reservoirs under existing economic and operating conditions. Reservoirs that have demonstrated the ability to produce by either actual production or conclusive formation test are considered "proved."

reservoir: A pond, lake, aquifer, or basin, either natural or artificial, in which water is stored, regulated, or controlled.

residual: Material or energy flow, the value of which is less than the cost of using it.

residual fuel oil: The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products known as ASTM grades No. 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

resource energy productivity: Value added divided by energy consumed per man hour expressed in dollars per billion Btu.

return flow: The portion of withdrawn water that is not consumed by evapotranspiration and that returns instead to its source or to another body of water.

riparian rights: Rights of a land owner to the water on or bordering his property, including the right to prevent diversion or misuse of upstream water.

river basin: See drainage basin.

road oil: Oil or petroleum residue intended for cold application to road surfaces.

runoff (hydraulics): That portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include surface runoff, groundwater runoff, or seepage. The portion of rainfall, melted snow, or irrigation water that flows across ground surface and eventually is returned to streams. Runoff can pick up pollutants from the air or the land and carry them to receiving waters.

sediment: Solid particulate matter, mineral or organic, that has been deposited in water, is in suspension in water, is being transported, or has been removed from its site of origin by the processes of soil erosion.

sedimentary rock: Rock formed by the accumulation of sediment in water or from air.

sedimentation: The action or process of depositing particles of waterborne or windborne soil, rock, or other materials. In waste water treatment, the settling-out of solids by gravity.

seepage: 1) Water escaping through or emerging from the ground along an extensive line or surface, as contrasted with a spring, where the water emerges from a localized spot. 2) The process by which water percolates through the soil. 3) The slow movement of gravitational water through the soil (percolation).

sensitive areas: Area streams and creeks, aquifers, floodplains, shorelands, wetlands, woodlands, and hillsides.

sensitivity level: A particular degree or measure of viewer interest in scenic qualities of the landscape.

silt: 1) A soil separate consisting of particles between 0.05 and 0.002 mm in equivalent diameter. 2) A soil textural class. 3) Finely divided particles of soil or rock. Often carried in cloudy suspension in water and eventually deposited as sediment.

siltation: The deposit of sediment downstream of an erosion site.

slope: The incline of the surface of a soil. It is expressed in percentage of slope, which equals the number of ft per 100 ft of horizontal distance.

socioeconomic: Of or relating to the structure of society and its economic activity.

soil: The natural surface layer of earth that supports plant life.

soil reaction: The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline.

soil series: The basic unit of soil classification consisting of soils that are essentially alike in all major characteristics.

soil survey: A general term for the systematic examination of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or other purposes.

solid waste: Useless, unwanted, or discarded material with insufficient liquid content to be free flowing. 1) Agricultural--solid waste that results from the raising and slaughtering of animals, and the processing of animal products and orchard and field crops; 2) Commercial--waste generated by stores, offices, and other activities that do not actually turn out a product; 3) Industrial--waste that results from industrial processes and manufacturing; 4) Institutional--waste originating from education, health care, and research facilities; 5) Municipal--residential and commercial solid waste generated within a community; 6) Pesticide--the residue from the manufacturing, handling, or use of chemicals intended for killing plant and animal pests; 7) Residential--waste that normally originates in a residential environment, sometimes called domestic solid waste.

solid waste management: The purposeful, systematic control of the generation, storage, collection, transport, separation, processing, recycling, recovery, and disposal of solid wastes.

SO : Sulfur dioxide, a form of air pollution.

SO : Sulfur trioxide, a form of air pollution.

SO : Sulfur oxides, either sulfur dioxide or sulfur trioxide.

standard metropolitan statistical area (SMSA): An integrated economic and social unit with a large population nucleus. There are over 245 SMSAs in the U.S. Each contains at least one central city with 50,000 inhabitants or more, or two adjoining cities constituting, for economic and social purposes, a single large community.

status questioned: Insufficient data available on which to base a reliable assessment as to the status of endangered wildlife.

stocks (petroleum): The amount of crude oil (including lease condensate), natural gas liquids, and petroleum products held by refining and pipeline companies and bulk terminal storage facilities, in pipeline (fill) and working tanks, and in tankers and barges. Excludes oils of foreign origin in transit or held in bonded storage that have not yet been entered for consumption. Stocks are commonly reported by custody regardless of ownership of the oils.

storage:

dead storage: The volume of water remaining in a reservoir after all of the usable storage has been withdrawn.

gross (total): The total volume of water in a reservoir at normal full pool.

seasonal storage: Water held over from the annual high-water season to the following low-water season.

underground: The utilization of subsurface facilities for storing gas that has been tranferred from its original location for the primary purpose of load balancing, better utilization of pipeline facilities, and more effective and economic delivery to markets. The facilities are usually natural geological reservoirs, such as depleted oil or gas fields or water-bearing sands sealed on the top by an impermeable cap rock. The facilities also may be man-made or natural caverns.

usable storage: The volume of storage in a reservoir that can be withdrawn for various conservation purposes (gross storage minus dead storage). As used in this report, the term refers to storage that can be withdrawn either jointly or exclusively for power generation.

weekly storage: The storage necessary to operate a pumped-storage plant on a weekly cycle (see weekly cycle).

storage project: A project with a reservoir of sufficient size to permit carry-over from the high-flow season to the low-flow season and thus to develop a firm flow substantially greater than the maximum natural flow. A storage project may have its own power plant, or may be used only for increasing generation at a downstream plant.

streamflow: The discharge in a surface stream course.

subbituminous coal: A coal with a heat content less than bituminous but greater than lignite. Because of a high percentage of moisture, tends to crumble on exposure to air. Principally strip mined in the northern Great Plains states.

sulfur dioxide (SO_2): A heavy, pungent, colorless gas formed primarily by the combustion of fossil fuels. SO_2 damages the respiratory tract, as well as vegetation and materials, and is considered a major air pollutant.

surface soil: The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils, ranging in depth from about 5 in. to 8 inches. Frequently designated as the plow layer, the Ap layer, or the Ap horizon.

suspended particulate (total): Particles moted in the air, kept in suspension because they have nearly the same specific gravity.

suspended solids (SS): Small particles of solid pollutants in sewage that contribute to turbidity and that resist separation by conventional means.

sustained yield: In the case of groundwater aquifers, the quantity of water that can be withdrawn annually without depleting the available supply over a period of years.

T: Trillion.

tailwater: The water surface immediately downstream from a dam or hydroelectric power plant.

thermal plant: A power-generating plant that uses heat to produce energy. Such plants may burn fossil fuels or use nuclear energy to produce the necessary thermal energy.

thousand: M.

threatened species: Any species or subspecies of wildlife which is not in immediate jeopardy of extinction but is vulnerable because it exists in such small numbers or is so extremely restricted throughout all or a significant portion of its range that it may become endangered.

ton: The American ton, often called the short ton, is 2000 lb. The metric tonne, or 1000 kg, equals 2204.62 lb, and the long ton, or 1016 kg, equals 2240 lb.

transmission grid: An interconnected system of electric transmission lines and associated equipment for the movement or transfer of electric energy in bulk between points of supply and points of demand.

transpiration: The process by which water vapor is released to the atmosphere by the foliage or other parts of a living plant.

transportation: This sector includes energy consumption of household automobiles, buses, trucks, aircraft, waterborne shipping, and pipelines.

trillion (T): One million million or 10^{12}.

turbidity: Thickness or opaqueness of water caused by suspended sediment.

turbine: A mechanical device that converts kinetic energy of water into rotational energy, usually connected with a generator. The turbine (or water wheel) has three classifications:

propeller type: These can be either fixed or adjustable blades, and are generally used for lower-head hydropower projects.

francis type: A fixed-blade rotor that can be used for generating, pumping, or both.

impluse type: Operates with jets discharging freely in the atmosphere against low-shaped buckets on the runner.

U_3O_8 (uranium oxide): The international standard for the form in which uranium concentrate is marketed.

utility: A facility that generates electricity by any means and sells it to the public. See electric utility sector.

U.S. gallon (gal): A unit of volume containing 231 cubic inches. It is 0.83268 times the volume of the Imperial gal.

value added: Value of goods sold, less the cost of the necessary materials and power, expressed in 1958 dollars to account for inflation.

water pollution: The addition of sewage, industrial wastes, or other harmful or objectionable material to water in concentrations or sufficient quantities to result in measurable degradation of water quality.

water quality standard: A plan for water quality management containing four major elements: The use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the water; criteria to protect those uses; implementation plans (for needed industrial-municipal waste treatment improvements) and enforcement plans; and an antidegradation statement to protect existing high-quality waters.

watershed: A geographic area that drains into a particular water body. (See drainage basin).

water table: The upper level of an underground water body.

wildlife: Any form of animal life generally living in a state of nature.

watt: The electrical unit of power or rate of doing work. The rate of energy transfer equivalent to one ampere flowing under a pressure of one volt at unity power factor. Analogous to horsepower or ft-lb/min of mechanical power. One horsepower is equivalent to about 745 watts.

weekly cycle: The operation of a pumped-storage plant that utilizes the total available storage in a weekly period. Sufficient storage is provided to permit balancing of pumping and generating energy on a weekly basis with pumping on weekends and other periods of low demands, thereby offsetting drafts occurring on days of high demands.

West Group: A group of 16 public, private, and federal power-generating entities serving the Pacific Northwest area. The West Group load area includes all of the Pacific Northwest except the areas served by Idaho Power Company, Montana Power Company, and Utah Power Company.

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