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BERT L. COLE
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JORSTED CREEK SLIDE, MASON COUNTY

The Jorsted Creek Slide on U.S. Highway 101 in northern Mason County is part of the worst area of landsliding on the southeastern Olympic Peninsula. Most of the west shore of Hood Canal for 7 miles near Jorsted Creek, Eagle Creek, and Lilliwaup has been subject to slides and flows since deglaciation about 13,500 years ago. Approximately 15 percent of U.S. 101 between Jorsted Creek and Lilliwaup has been destroyed or buried by landslides at least once in the past 25 to 50 years. The Department of Highways has taken one or more of the following actions each time U.S. 101 has been blocked: removal of the landslide debris from the highway; rebuilding of the highway over the toe of the landslide; placing riprap or building bulkheads to prevent further movement of the slide; unloading the slide by cutting trees and removing material; or installing horizontal, perforated drains to dewater the slide.

The Jorsted Creek Slide, located on the west side of Hood Canal 0.7 mile south of Jorsted Creek, was reactivated during the winter and spring of 1974. Riprap was placed at the toe of the slide when it was last active in 1968. During the heavy rains in the first 5 months of 1974, and particularly in March and April, the Jorsted Creek Slide flowed and slid onto U.S. 101. The landslide mass is a combination of a slump at the top and an earthflow at the toe, with secondary flows and slumps that moved over the old riprap and onto the highway. There is a scarp about 50 feet high at the top of the landslide, 280 feet above U.S. 101. The landslide extends at least 1,000 feet along the highway, and reaches about 600 feet west from the highway. The volume of material that moved is very difficult to estimate, but is approximately one-half million cubic yards.

The causes of the landsliding along the west shore of Hood Canal, including the Jorsted Creek Slide, are numerous. The stratigraphy in the area of most of the slides consists of outwash overlying lakebeds. The out-

wash is permeable sand and gravel, whereas the lakebeds are composed of impermeable silty sediment. The melting of the glacier that excavated Hood Canal removed lateral support from the steep sides of the glacial trough. Wave action on the shore of Hood Canal further steepened the sides of the trough, and the construction of U.S. 101 resulted in many near-vertical roadcuts. During the rainy winter months, pore pressure builds up in the potential landslides because ground water percolates into the outwash but cannot escape through the lakebeds. Excessive pore pressure results in outward flowing of the toe of the landslide and downward slumping of the upper portion of the landslide. Once activated, landslides such as the Jorsted Creek Slide generally flow and slide each winter until the slope is greatly reduced naturally, or until the Department of Highways undertakes engineering modifications such as installing drains and placing riprap.

Robert J. Carson
Jeffrey J. Gryta

GEOTHERMAL LEASE APPLICATIONS

By J. Eric Schuster

As you probably know from the news media and past issues of this newsletter, geothermal energy, the heat of the earth's interior, is receiving more and more attention in the United States. Geothermal energy may provide substantial amounts of electrical power, and many industrial, agricultural, and residential uses in the future. Since January 1, 1974, most federal lands in the western United States have been open for geothermal leasing applications. The following written communication, from the United States Bureau of Land Management, Portland, Oregon, and the map on the facing page show areas for which geothermal lease applications have been received to June 1, 1974, and present the tentative priorities for development of geothermal areas on federal land in Washington and Oregon.

The Oregon State Office of the Bureau of Land Management (BLM) has developed, in cooperation with other agencies, a list of tentative priorities for developing Geothermal Resources in Oregon and Washington on lands administered by the Federal Government. These agencies include the U.S. Forest Service, U.S. Geological Survey, Oregon Department of Geology and Mineral Industries, and Washington Division of Geology and Earth Resources.

The localities below cover general geographical areas which may contain noncompetitive geothermal lease applications and competitive Known Geothermal Resource Areas (KGRA's).

1. Vale
2. Paulina Mountains
3. Crump Geyser
4. Klamath County
5. Alvord Desert-Lake
6. Skamania County
7. Breitenbush Hot Springs
8. Lakeview
9. Mt. St. Helens
10. Glass Buttes
11. Harney Lake
12. Summer Lake
13. McCredie Hot Springs-Maiden Peak
14. Belnap Hot Springs
15. Carey Hot Springs
16. Cow Lake
17. Mt. Baker-Carlton
18. Washington scattered [areas] Beulah Reservoir-Bully Creek
19. Mt. Hood-Glacier Peaks-Newberry Crater

[Underlined areas are in Washington. Numbers correspond to map numbers on the facing page.]

GEOTHERMAL RESOURCES ACTIVITY IN WASHINGTON

TO JUNE 1, 1974

Legend

Known Geothermal Resource Area

Geothermal Lease Application

Map courtesy of U.S. Bureau of Land Management, Portland, Oregon

The order of priority was established on the basis of the following criteria: (a) Geologic Setting, (b) Replies to questionnaires sent to Industry, (c) Information from the Oregon Department of Geology and Mineral Industries, Washington Division of Geology and Earth Resources, U.S. Geological Survey, and U.S. Forest Service, (d) State of completion of the BLM Bureau Planning System for the planning unit or units involved on lands administered by the BLM, (e) Land Status and Mineral Ownership.

This tentative priority list was established on the best technical information available at this time [June 11, 1974]. It is subject to revision due to improved geologic information, revised industry preferences, or coordination with and input from other agencies.

The sequence in which these geographical areas appear reflects the order of processing and environmental consideration and does not necessarily reflect the order leasing will occur. In the process of environmental consideration through the Environmental Analysis Record and if necessary the Environmental Impact Statement, it may be found that geothermal leasing cannot be allowed in all or part of any of the designated areas. Where geothermal leasing can be permitted, special protective lease stipulations will be developed and areas of no surface occupancy identified.

DR. ROALD FRYXELL

We join with many other individuals in our expression of sorrow in the untimely death of Dr. Roald Fryxell, of the Anthropology Department at Washington State University. Apparently, he was on his way to the WSU Lind Coulee archeology site near Warden at the time of the one-car fatal accident.

Dr. Fryxell's discovery of the skeletal remains of the ancient Marmes Man in southeast Washington in 1968 gave him great prestige in the scientific world. Carbon dating established that the Marmes Man existed over 10,000 years ago—the oldest well-documented human remains discovered in the Western Hemisphere. Dr. Fryxell was also one of the first American scientists to examine soil samples from the moon, while he was serving as a member of the NASA lunar preliminary examination team. Roald was a tireless, patient worker and a man of many interests. His friends and colleagues, as well as the profession, will miss him.

His wife Helen, son Tom, and daughter Jenny live at the family home in Pullman. His parents are Dr. and Mrs. Frittiof Fryxell of Rock Island, Illinois.

Frxyell, on the right, with colleague examing fragments of Marmes skull

KEITH WHITING RETIRES

After 41 years with American Smelting and Refining Co., Keith Whiting retired on June 30, 1974. He graduated with a degree in geology from the University of Washington, and in 1933 began his career with the company in Wallace, Idaho. After serving as chief geologist of Asarco's Northwestern Mining Department from 1946 until 1951, Keith transferred to Salt Lake City as exploration engineer. In 1953, he opened the Toronto office for the Canadian section of the company, and in 1961, opened the new office in Vancouver, B.C. Spokane was his next destination, where in 1966 he opened the present office.

Keith plans to remain in Spokane and do some consulting work. He will continue to serve as a member of our division's Geology and Mineral Industry Advisory Committee.

Dr. John C. Balla is the new supervisor for Asarco's office in Spokane. He earned his doctorate in geological engineering at the University of Arizona. Before joining Asarco at Tuscon in 1971, Dr. Balla worked for Bear Creek Mining Co., a subsidiary of Kennecott Copper Co.

HAL KELLY RETIRES FROM USBM

Hal J. Kelly, U.S. Bureau of Mines Liaison Officer for the State of Washington, retired on June 30, 1974, completing 30 years with the Bureau, all in Washington and Oregon. Hal will continue in his present capacity for about one month until the arrival of his replacement, J. R. Welch. Bob Welch, is a native of Wenatchee and a graduate of Washington State University in mining engineering. He has worked in Israel, Africa, and Nepal, and prior to moving to Washington, D.C., was with the Bureau of Land Management in Portland, Oregon, for 12 years.

The liaison program was started by Dr. E. F. Osborn in 1970, when he became director of the Bureau of Mines. The primary purposes of the liaison offices are to conduct all of the Bureau's business that can best be accomplished at the local level, to insure participation of appropriate state agencies in actions of mutual concern, and to serve as primary public contacts. In carrying out this mission, the liaison officer works closely with many state agencies in addition to those directly concerned with mining. He monitors state and federal legislation that may influence the mining industry, and serves as an observer of trends and developing problems in the industry.

While we were talking to Hal about his retirement, he said, "In my 4 years in this assignment one of my most pleasant experiences has been working with the cooperative and highly effective Division of Geology and Earth Resources." Hal's work as the USBM Liaison Officer has increased our very satisfactory relationship with the USBM. We shall miss him.

WHAT'S MARSHALL DOING THESE DAYS?

Many persons ask us about Marshall Huntting, who served as our division supervisor before Ted Livingston. Marshall retired on June 30, 1971, after 30 year's service. While he was with the division he made many friends, and they often ask us, "What is Marshall doing these days?"

Well, we talked to Marshall today at his ranch in Silver Creek, in Lewis County. It's raining some, and he has 4 acres in berries. The raspberries are about ready and a little sunshine would help the crop. Marshall has 230 acres on his farm, partly farm land (with 10 acres in filberts) and partly trees. He also has 45 head of beef cattle.

Marshall had been living in Olympia until this spring while he was building his new home on the ranch; he and his wife Martha are permanently at home now in Silver Creek. Marshall still finds time to do some consulting work occasionally.

NEW ACTING DEAN AT IDAHO COLLEGE OF MINES

Dr. John G. Bond, professor of geology at the University of Idaho College of Mines in Moscow, has been appointed acting dean replacing Dr. Rolland R. Reid. Dr. Reid resigned as dean and director of the Idaho Bureau of Mines and Geology to return to full-time teaching at the University.

Dr. Bond holds a bachelor's degree in geology from the University of Idaho and master's and doctor's degrees from the University of Washington.

FOREST SERVICE MINING ENGINEER WILL HEADQUARTER IN WENATCHEE

Daniel Meschter, mining engineer for the U.S. Forest Service, will work out of the Forest Supervisor's office in Wenatchee beginning July 22. He was formerly stationed in the regional office in Portland.

EASTERN WASHINGTON STATE COLLEGE GEOLOGY DEPARTMENT GETS NEW CHAIRMAN

Under a 3-year rotating chairmanship system, Dr. Eugene P. Kiver stepped down as chairman of the geology department at EWSC, and Dr. Martin D. Mumma began his tenure as chairman on June 24. Among Dr. Kiver's notable accomplishments while acting as chairman was the beginning of a master's degree program in geology.

Dr. Mumma, who did his undergraduate and master's degree work at the University of Missouri and earned his doctorate at Louisiana State University, works in the field of paleontology and stratigraphy.

COMMISSIONER BERT L. COLE PRESENTS SERVICE AWARDS

Among 45 employees of the Department of Natural Resources that were presented service awards by Commissioner Cole on June 25th were three members of the Division of Geology and Earth Resources.

Wayne S. Moen, geologist, and William H. Reichert, librarian, received 15-year awards; and Laura Bray, editor, received her 10-year pin.

Figures released by the U.S. Bureau of Mines in Information Circular 8642, "Land utilization and reclamation in the mining industry, 1930-71," for the State of Washington in the 42-year period indicate that the combined production of sand and gravel, crushed stone, coal, and clay accounted for over 90 percent of the land used for mining.

MINERAL PRODUCTION IN WASHINGTON 1973

Preliminary production figures from the U.S. Bureau of Mines show Washington's mineral production for 1973 as $117.8 million. This represents an increase of $10.2 over the 1972 production. Metallic minerals showed the greatest increase—about 13 percent, while the production of nonmetallic minerals increased only 1 percent.

The production of gold, silver, lead, tungsten, and zinc was placed at $7.149 million; the production of fuel minerals (coal and uranium) amounted to $24.482 million; and the production of nonmetallic minerals (mainly

sand and gravel, stone, and cement) was valued at $86.226 million.

For comparison purposes, 1973 production figures for the major Washington natural resources are as follows:

Forest products	$1,371.5	million
Agriculture	$1,700	"
Hydro power	$144	"
Minerals	$117.8	"
Fishing (commercial 1972)	$95.9	"

POULSBO SLIDE

An unusually wet winter and spring have resulted in numerous landslides throughout the state. These slides caused millions of dollars of damage in the Puget Lowland.

One of the most costly slides occurred at Poulsbo, on a sea cliff overlooking Liberty Bay. A large (4 acres) ancient slump, possibly late Pleistocene in age, was reactivated after a period of extremely heavy rain. Precipitation interacting with geologic factors played a major role in the reactivation of this slide. A storm drain emptying directly on the head scarp of the slide may also have added a greater than normal amount of water to the slide block. The slump mass moved about 4 feet in January and February. This amount of offset does not seem excessive, but it was enough to make the 32-unit Liberty View Apartment building (three stories high), which was built across the slide scarp, a total loss. Damage to the apartment building was assessed at about $330,000. Other costs for damages to and protection of utilities were as follows:

Repair and reroute water main	$ 81,625
Reroute phone lines (approximately)	20,000
Repair streets, curbs, gutters, and stabilize slide	100,000
Reroute power line (approximately)	8,000
Total	$209,625

This approximate figure gives an indication of the large costs that can result from the movement of a relatively small slide in a developed area.

Mackey Smith

LAND USE PLANNING IN CLARK COUNTY

The Division of Geology and Earth Resources has received a grant from Clark County to do environmental mapping throughout the county. Clark County is one of the faster growing counties in Washington State and has asked for pertinent geologic information for use in their land use planning.

Division geologists will prepare three geologic factor maps of the county. These maps will show landslides and slope stability, mineral resources, and geologic factors pertaining to construction and engineering.

The landslide and slope stability map will show areas of ancient and historical landsliding, as well as delineating present-day landslides. Areas that may be unstable due to geologic conditions will also be outlined. The mineral resource map will provide the county with information pertaining to aggregate deposits as well as other mineral deposits. The third map will be a combination of factors relating to construction. The map will delineate the areas where ground failure and(or) differential settlement may occur from ground shaking by man-caused vibrations or seismic events, and will also show bedrock rippability in areas where the bedrock is exposed or near the surface.

The project will start this fall and continue through next summer. These maps will provide Clark County with useful tools for planning throughout the county.

Allen Fiksdal

FOOTE MINERAL SELLS ROCK ISLAND PLANT

Hanna Mining Company of Cleveland has signed an agreement to purchase the Foote Mineral ferrosilicon and silicon metal plant at Rock Island, near Wenatchee, in Douglas County. The plant was built during World War II and consequently is not in compliance with air quality standards. It is Hanna's intent to have the required pollution-control equipment installed by July of 1975.

The Wallace Miner reports that the plant will continue to produce both ferrosili-

con and silicon metal, but that the production will be for use in Hanna's nickel smelters and not for commercial sale.

Reaction to the sale expressed by local leaders has been favorable. The area will retain a much needed payroll and the air pollution problem associated with the old plant will be cleaned up.

USBM HAS NEW QUARTERS IN SPOKANE

The operations of the Western Field Operation Center, R. N. Appling, Jr., chief, and the Mining Research Center, George B. Wallace, research director, are both located in the new U.S. Bureau of Mines office building in Spokane. Designed by the bureau, this is the first combining of these centers in the United States. Their new address is E. 315 Montgomery, Spokane, WA, 99207.

WORLD'S DEEPEST WELL DRILLED

According to WORLD OIL (June 1974), Lone Star Producing Company reached a depth of 31,441 feet in their Bertha Rogers 1 well in Oklahoma. The well will be plugged and abandoned below a depth of 14,000 feet.

YOUR STATE GEOLOGIST REPORTS

The failure of the Land Planning bill to pass the U.S. House of Representatives has been viewed with considerable consternation by the various environmental groups and some legislators of similar interests. As for myself, when the bill failed to muster the necessary votes to pass, I breathed a sigh of relief. Some land planning is necessary to protect one's rights; however, invariably it seems that when the rights of one person are being protected, the rights of someone else are sometimes being trampled on. Because of this, I believe that planning or land use decisions are best made by people at the local level, rather than by a remote governing body, 3,000 miles away. The local groups are the most familiar with the problems of a particular area and their possible solutions. They are also accountable and have to face their peers when decisions are made; this tends to make them more thoughtful than if they make their decisions by remote control.

In reviewing the various pieces of land use legislation that have been considered by the U.S. Congress and the state legislatures, I was impressed that the bills were, at least to me, excessively inclusive; they included provisions to force planning of enormous tracts of land (states and counties, or large fractions thereof) without regard to whether these measures were justified. It's a very difficult thing to foresee the future and develop a plan that will be usable 5 years hence. It's more logical to develop planning as the need arises, and this can best be done at the local level. I'm not convinced that the people of King County know what is best for the people of Stevens County, for instance; nor that the people of Okanogan County know what is best for the town of Twisp. The more our regulatory activities can be implemented at the local level, the better off we are, because those regulatory activities will more nearly fit the actual need that exists.

I guess my problem is that I can see no compelling reason for a federal land use planning act. The states—at least Washington State—are beginning to take the initiative in land use planning, and more and more counties are developing comprehensive plans that meet their specific needs. It seems to me that whether a county chooses to base part of its economy on some type of industry or not is the business of the people of that county. What a happy place this old world would be if people would learn correct principals and live by them, and stop trying to gain an advantage over the next guy by developing a plan to control him.

Ted Livingston

"When your troubles get you down, remember, a diamond is only a piece of coal that has been hard pressed for a long time."

Triassic Valley Bulletin

VIDEO TAPES ON DIVISION SYMPOSIUM

NOW AVAILABLE

The Division of Geology and Earth Resources Symposium on "Geology and Land Planning Development" was held on March 26-27, 1974. Ernest Artim, chairman, has completed his review of the video tapes. Copies of the following tapes are now available to the public:

Title	Speaker	Time (minutes)
Study of Landforms	Norman R. Anderson University of Puget Sound Tacoma, Washington	44
Seismic Hazards	Lloyd S. Cluff Woodward-Lundgren and Associates Oakland, California	45
Methods Used for the Detection and Mapping of Landslides	Gerald W. Thorsen Division of Geology and Earth Resources Olympia, Washington	35
Landslide Studies—A Team Effort of Geologist and Engineer	L. Keith Bestwick Shannon and Wilson Seattle, Washington	35
Ground Water Resources and the Effect Upon Planning and Development	Bruce L. Foxworthy U.S. Geological Survey Tacoma, Washington	39
Land Use Planning and Development Around Seismic Hazards	Charles L. Taylor Woodward-Lundgren and Associates Oakland, California	39

Copies of the video tapes may be checked out from the Washington State Library for a period of two weeks. Inquiries about permanent copies may be directed to the Department of Natural Resources, Public Information Office, Olympia, 98504, phone: (area code 206) 753-6663.

DIVISION STAFF ATTENDS MEETINGS

The following meetings were attended by various members of our staff recently.

Approaches to Environmental Geology, presented by the Bureau of Economic Geology at the University of Texas, in Austin. Mackey Smith, staff geologist, attended on May 13-14.

Geothermal Regulations, Geothermal Resources Council Special Short Course No. 2, held on May 23-24, 1974, in San Francisco. Donald M. Ford attended.

Expo '74's Conference on Energy, held in cooperation with the National Science

Foundation, in Spokane. Vaughn E. Livingston, Jr., attended on May 26-29.

Association of American State Geologists, in Bend Oregon. Attended by Vaughn E. Livingston, Jr., and Donald M. Ford on June 8-14.

USGS OPEN-FILE REPORTS

Two map-type reports, by Garald G. Parker, Jr., were recently made available to the public by the U.S. Geological Survey.

Public Water Supply in the Seattle-Tacoma Urban Complex and Adjacent Areas, Washington

Urbanized Areas Served by Sewers and Septic Tanks in the Seattle-Tacoma Urban Complex and Adjacent Areas, Washington

The reports are the third and fourth in a series that defines hydrologic conditions in these areas. The four map-sheet reports are available without charge from the U.S. Geological Survey, Water Resources Division, 1305 Tacoma Ave. S., Tacoma, WA 98402.

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES

(New maps received in Division of Geology and Earth Resources Library since April 1, 1974)

Name	Latitude (indicates southeast corner)	Longitude	County
Amboy	45°52'30"	122°22'30"	Clark, Cowlitz
Anatone	46°07'30"	117°07'30"	Asotin
Birch Point	48°52'30"	122°45'00"	Whatcom
Black Butte	46°00'00"	117°00'00"	Asotin
Cliffdell	46°52'30"	121°00'00"	Yakima, Kittitas
Glenwood	46°00'00"	121°15'00"	Yakima, Klickitat
Hudson Creek	46°52'30"	120°45'00"	Kittitas, Yakima
Lawrence	48°45'00"	122°15'00"	Whatcom
Milk Canyon	46°45'00"	120°45'00"	Yakima
Mount Adams East	46°07'30"	121°22'30"	Yakima
Nile	46°45'00"	120°52'30"	Yakima
Piscoe Meadow	46°22'30"	121°00'00"	Yakima
Tieton	46°37'30"	120°45'00"	Yakima
Trout Lake	46°00'00"	121°30'00"	Skamania, Klickitat, Yakima
Weissenfels Ridge	46°07'30"	117°00'00"	Asotin
White River Park	46°52'30"	121°30'00"	Pierce, Yakima
Windy Point	46°15'00"	121°15'00"	Yakima

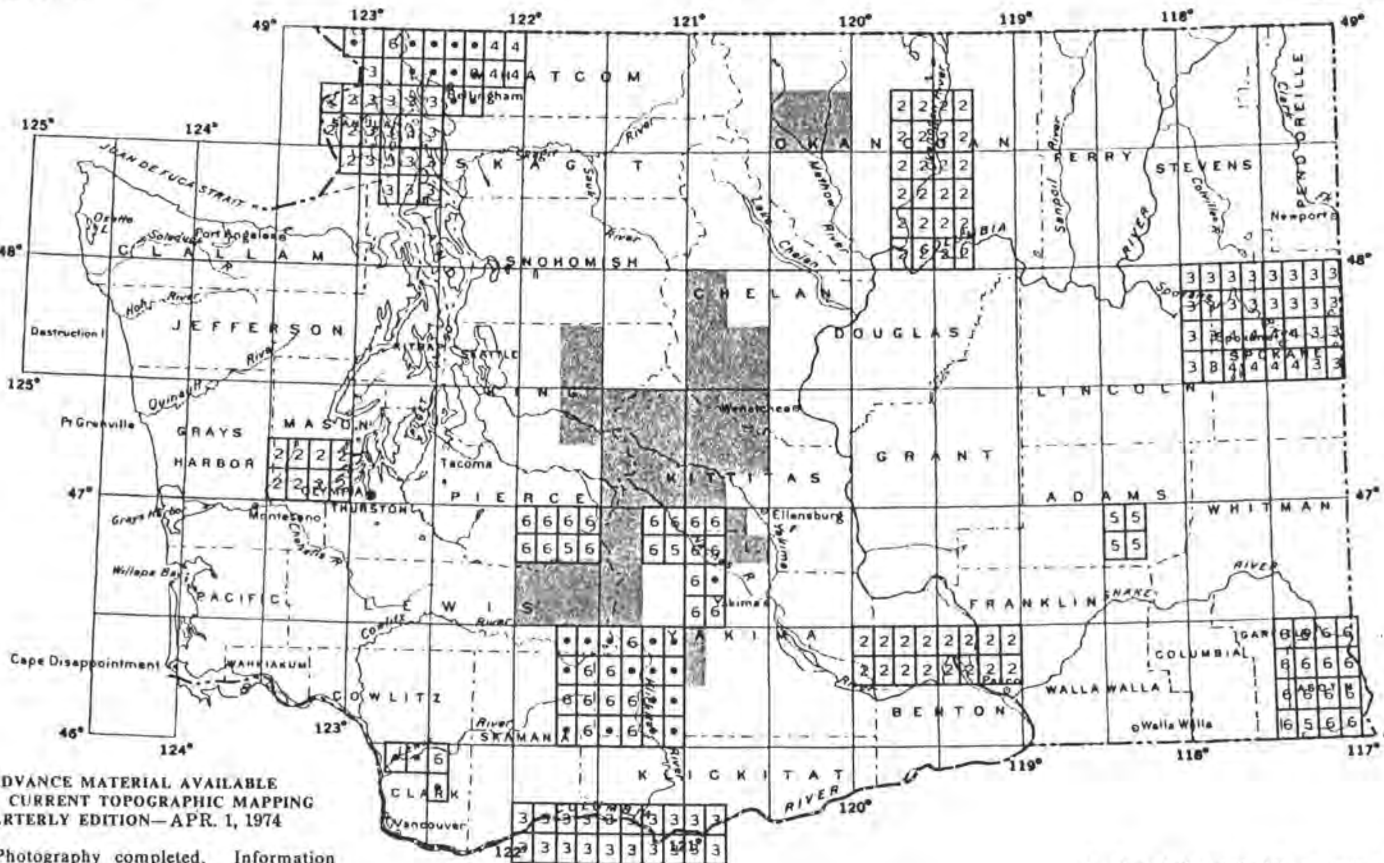
U.S. GEOLOGICAL SURVEY SERIES OF TOPOGRAPHIC MAPS, 1:250,000

Wenatchee sheet, 47° Latitude, 120° Longitude, 1957 edition, revised 1971.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WASHINGTON

TOPOGRAPHIC DIVISION
WESTERN MAPPING CENTER
MENLO PARK, CALIFORNIA



ADVANCE MATERIAL AVAILABLE
FROM CURRENT TOPOGRAPHIC MAPPING
QUARTERLY EDITION—APR. 1, 1974

2 — Aerial Photography completed. Information available from Western Mapping Center, U. S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025, or Map Information Office, U.S. Geological Survey, Washington, D.C. 20244.

3 — Basic horizontal and vertical control surveys completed. Descriptions and unadjusted coordinates and/or elevations are available. Price is 50 cents for each 15-minute quadrangle horizontal or vertical control list. See Notes.

4 — Prints of manuscripts compiled from aerial photographs are available at 75 cents each.

5 — Field mapping and checking completed. One-color unedited advance prints, with names and section corner data, are available for 75 cents each.

6 — Final drafting completed. Partially edited one-color advance prints available for 75 cents each. (If shaded, see explanation below).

Shaded areas indicate that maps have been published at 1:62,500-scale ONLY. However, 1:24,000-scale prints in 7.5-minute units, with appropriate accuracy and contour interval, are and will remain available. Each such print is 75 cents, or $3 for prints covering a complete 15-minute quadrangle.

NOTES:

1. Requests for all advance materials should be sent to Western Mapping Center, U. S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025. Payment in exact amount should accompany order and may be made by check or money order, payable to U. S. Geological Survey. Please do not send stamps. NO DISCOUNT ALLOWED.

2. In ordering materials or requesting information, mark the area of interest on this index and forward it with your order. A new copy of the index will be returned for your future use.

PUBLISHED MAPS

• — **Maps published since latest edition [NOV. 1973] of Sales Index to published maps.**

Sales Index available free. Published maps available at 75 cents each from U. S. Geological Survey, Denver Distribution Section, Federal Center, Bldg. 41, Denver, CO 80225, and Distribution Section, U. S. Geological Survey, 1200 South Eads St., Arlington, VA 22202. On an order amounting to $300 or more at the list price, a 30-percent discount is allowed; no other discount is applicable. Remittance may be made by check or money order payable to the U. S. Geological Survey.

Status of new topographic mapping in Washington, April 1, 1974

Department of Natural Resources
Division of Geology and Earth Resources
Olympia, WA 98504

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