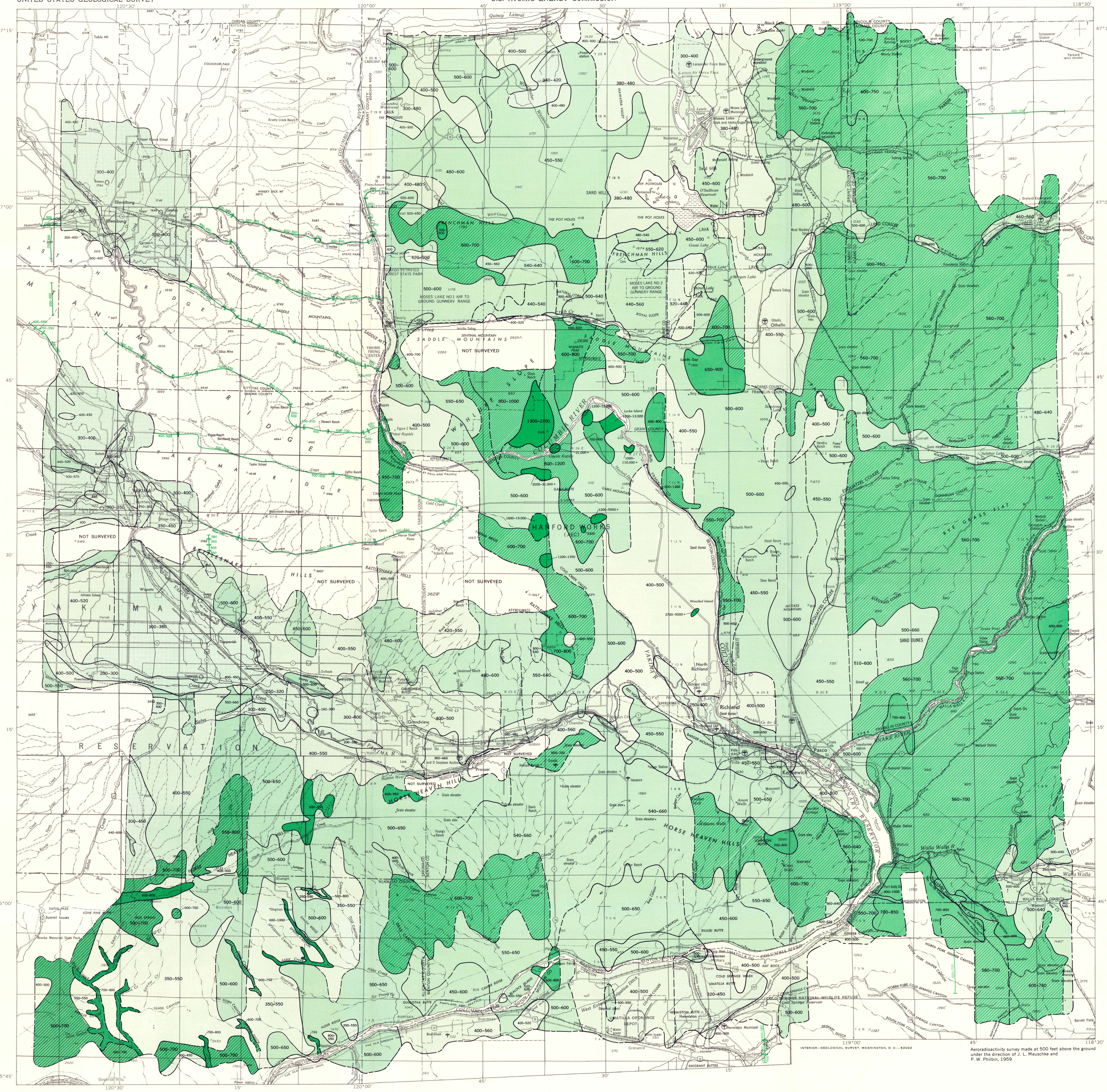
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
DIVISION OF BIOLOGY AND MEDICINE
U.S. ATOMIC ENERGY COMMISSION



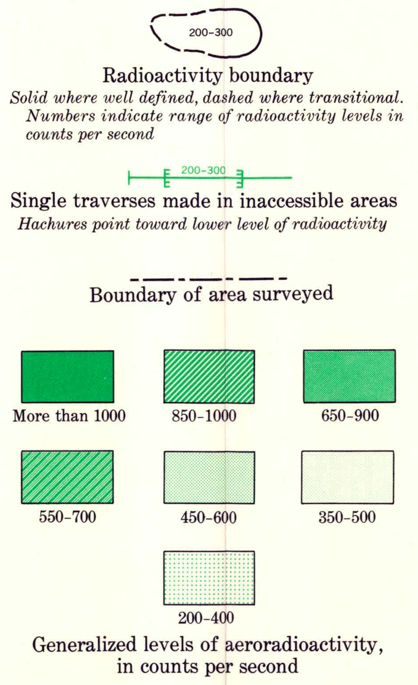
Base from Army Map Service, Corps of Engineers, 1:250 000-scale topographic maps, Pendleton, Ritzville, The Dalles, Walla Walla, Wenatchee, Yakima sheets

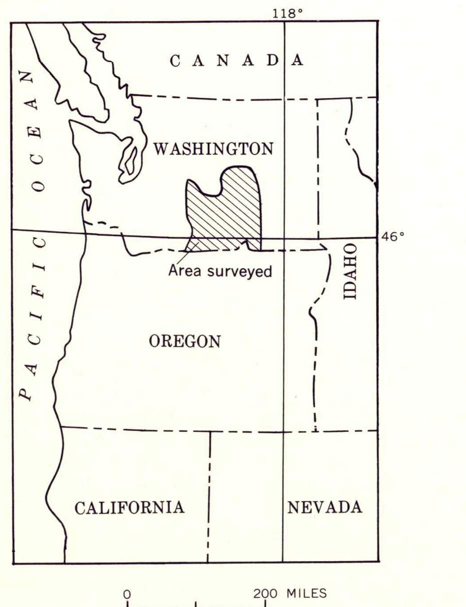
MAGNETIC NORTH DEVIATES FROM 20°30′E TO 22°30′E WITHIN MAP AREA

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—62022

Aeroradioactivity survey made at 500 feet above the ground under the direction of J. L. Meuschke and P. W. Philbin, 1959

EXPLANATION





INDEX MAP

The survey was made with scintillation-detection equipment (Davis and Reinhardt, 1957 1/) installed in a twin-engine aircraft. Parallel north-south flight traverses spaced at one-mile intervals were flown at a nominal elevation of 500 feet above the ground. Single traverses were made in inaccessible areas. The flight path of the aircraft was recorded by a gyrostabilized continuous-strip-film camera. The radioactivity data were compensated for deviations from the 500-foot surveying elevation, and for the cosmic-ray component.

The effective area of response of the scintillation equipment at an elevation of 500 feet is approximately 1,000 feet in diameter, and the radiation recorded is an average of the radiation received from within the area. The scintillation equipment accepts only pulses originating from gamma radiation with energies greater than 50 Kev (thousand electron volts). A cesium-137 source is used during periodic calibrations to assure uniformity of equipment response.

The gamma-ray flux at 500 feet above the ground has three principal sources: cosmic radiation, radionuclides in the air (mostly radon daughter products), and radionuclides in the surficial layer of the ground. The cosmic component is determined twice daily by calibrations at 2,000 feet above the ground, and is removed from the radiation data.

The component due to radionuclides in the air at 500 feet above the ground is difficult to evaluate. It is affected by meteorological conditions, and a tenfold change in radon concentration is not unusual under conditions of extreme temperature inversion. However, if inversion conditions are avoided, the air component may be considered to be fairly uniform on a given day in a particular area, and will not affect the discrimination of the radioactivity levels that reflect changes in the ground component.

The ground component comes from the approximate upper 6 inches of the ground. It consists of gamma rays from natural radionuclides, principally members of the uranium and thorium radioactive decay series and potassium-40, and fallout of radioactive nuclear fission products. Locally the amount of fallout, if present, must be small, as the lowest total radiation measured is 160 counts per second (cps) in areas not affected by absorption of gamma energy by water. The distribution of fallout in the area surveyed is assumed to be uniform.

1/ Davis, F. J., and Reinhardt, P. W., 1957, Instrumentation in aircraft for radiation measurements: Nuclear Sci. and Eng., v. 2, no. 6, p. 713-727.

The natural gamma radiation measured in the Hanford Plant area has a moderate range (160 to 900 cps) and is generally related to the type of rock or soil at the surface. Bedrock is of Cretaceous to Recent age, mostly Miocene to Recent, and is extensively mantled by Pleistocene and Recent eolian deposits. Generally, lake- and stream-deposited strata are associated with low to moderate radiation (200 to 600 cps) and plateau basalt and loess with moderate radiation (400 to 800 cps). In the eastern part of the area surveyed, aeroradiation of 560 to 700 cps is generally related to loess; in the western part, along the Yakima River, aeroradiation of 200 to 400 cps is generally related to Recent alluvium.

It is believed that in this area measured radiation of more than 1,000 cps is not related to natural effects, but is due to activities within the Hanford AEC reservation.

Routine surveying disclosed anomalous aeroradioactivity of 1,000 to 2,700 cps over the Columbia River within the Hanford AEC reservation. This aeroradiation could not be due to natural effects, as only a few inches of water will completely absorb the natural radioactivity of soil and rock. Therefore, the aeroradiation appears to originate from radioisotopes in the water resulting from activities of the Hanford Plant. Normally, the altitude- and cosmic-energy compensated circuit of the Geological Survey equipment will read zero cps over large bodies of water. Quite often levels recorded over streams are from 50 to 200 cps owing to the response from land areas bordering the streams and included within the area of response.

A special traverse of 110 miles was made over the river on July 8, 1959, to further check these measurements. The traverse was made at 100 feet above the river surface rather than the normal survey elevation of 500 feet, in order to nullify the ground radioactivity component of the adjoining river shores.

The Columbia River traverse began approximately at the western boundary of the Hanford AEC reservation and was flown downstream past Umatilla, Oreg. The aeroradiation measured during this traverse is as follows:

Radiation of 350 to 1,000 cps was first recorded about 6 miles west of Coyote Rapids. From Coyote Rapids past Locke Island and to about 4 miles southeast of White Bluffs, radiation ranged from 1,500 to 6,000 cps. Radiation from the river then steadily decreased from 1,500 cps southeast of White Bluffs to 800 cps at North Richland and to 450 cps just northwest of the Columbia-Snake River junction. At the junction, a definite interface of 350 cps was measured (Columbia, 350 cps; Snake, 0 cps), and was detectable downstream across McNary Reservoir. A 150 cps interface was then measured at the Columbia-Walla Walla River junction (Columbia, 150 cps, Walla Walla, 0 cps). From this junction to Umatilla, Oreg., radiation from the river gradually diminished until zero cps levels were measured at Umatilla. The influx of the Snake and Walla Walla Rivers undoubtedly diluted the radioactive substances in the Columbia water sufficiently to reach the normal zero cps level. Analyses of the Columbia water indicate that " .... the concentrations of these radioisotopes are well below the maximum permissible concentrations recommended for the protection of the general public" 1/.

Detailed information on the aeroradioactivity survey of the Hanford Plant area is contained in another report 2/.

1/Rostenbach, Royal E., 1959, Radioactivity levels and temperature variations of the Columbia River: Nuclear Engineering, Part V, Chemical Engineering Progress Symposium Series, vol. 55, no. 22, p. 37-43.

2/Schmidt, R. G., 1961 Aeroradioactivity survey and areal geology of the Hanford Plant area, Washington and Oregon, U. S. A.E.C. Report CEX-59.4.11, available from Office of Technical Services, Department of Commerce, Washington 25, D. C.

AERORADIOACTIVITY OF THE HANFORD PLANT AREA, WASHINGTON AND OREGON

By
Robert G. Schmidt

SCALE 1:250 000
4 2 0 4 8 12 16 20 MILES

1961