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UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

COLUMBIA RIVER MAGNETITE SANDS
CLATSOP COUNTY, OREG., AND PACIFIC COUNTY, WASH.
HAMMOND AND McGOWAN DEPOSITS

BY

JAMES V. KELLY

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COLUMBIA RIVER MAGNETITE SANDS, CLATSOP COUNTY, OREGON, AND PACIFIC COUNTY, WASHINGTON HAMMOND AND McGOWAN DEPOSITS[1]

By James V. Kelly[2]

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INTRODUCTION

Several magnetite-bearing sand deposits near the mouth of the Columbia River in Oregon and Washington were investigated by the Bureau of Mines during 1944. The work was done as a part of a general wartime program to explore for potential new sources of iron and alloy metals for use in the war-expanded iron and steel industry in the United States. Such magnetite sands,

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 4011."

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if found in sufficiently large quantity and of satisfactory quality could be reduced in electric furnaces with the relatively cheap electric power available in the area.

Early in 1944, a preliminary exploration program was outlined to conduct hand-auger drilling in the several areas considered most likely to contain a high percentage of black sands. From June to August 1944, the Bureau completed 161 hand auger holes in the Hammond (figs. 1 and 2) and McGowan (figs. 1 and 3) areas. In addition, considerable random drilling was done, without success, to determine the possible existence of other magnetite-bearing sand deposits.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources, to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests.

The project was in charge of the author as project engineer under the supervision of H. G. Iverson, district engineer, Oregon District Office.

Samples were analyzed at the Reno Laboratories of the Bureau of Mines under the supervision of A. C. Rice, acting supervising engineer. Microscopic grain counts were made at the Salt Lake Laboratories of the Bureau under the supervision of S. M. Zimmerly, then regional engineer.

LOCATION AND ACCESSIBILITY

The Hammond deposit is in Oregon on the south bank of the Columbia River in the NW $\frac{1}{4}$, sec. 9, T. 8 N., R. 10 W., W.M. It is near the town of Hammond, approximately 10 miles west of Astoria, Ore. Astoria is the western terminus of U. S. Highway 30 and is served by a branch line of the Spokane-Portland & Seattle Railroad, which extends from Portland, 106 miles southeast of Astoria, to Seaside approximately 16 miles southwest of Astoria. A paved county road and the Spokane-Portland & Seattle Railroad are adjacent to the Hammond deposit (fig. 1).

The McGowan deposit is in Washington on the north bank of the Columbia River in the SW $\frac{1}{4}$, sec. 22, T. 9 N., R. 10 W., W.M., near the towns of Chinook and Ilwaco, 2.5 and 10 miles, respectively, northwest of the deposit. The McGowan deposit is approximately 4 miles northeast of the Hammond deposit, which distance is the width of the Columbia River at that point. Washington State Highway 12 (U. S. 101) is adjacent to the deposit. No railroad serves the area.

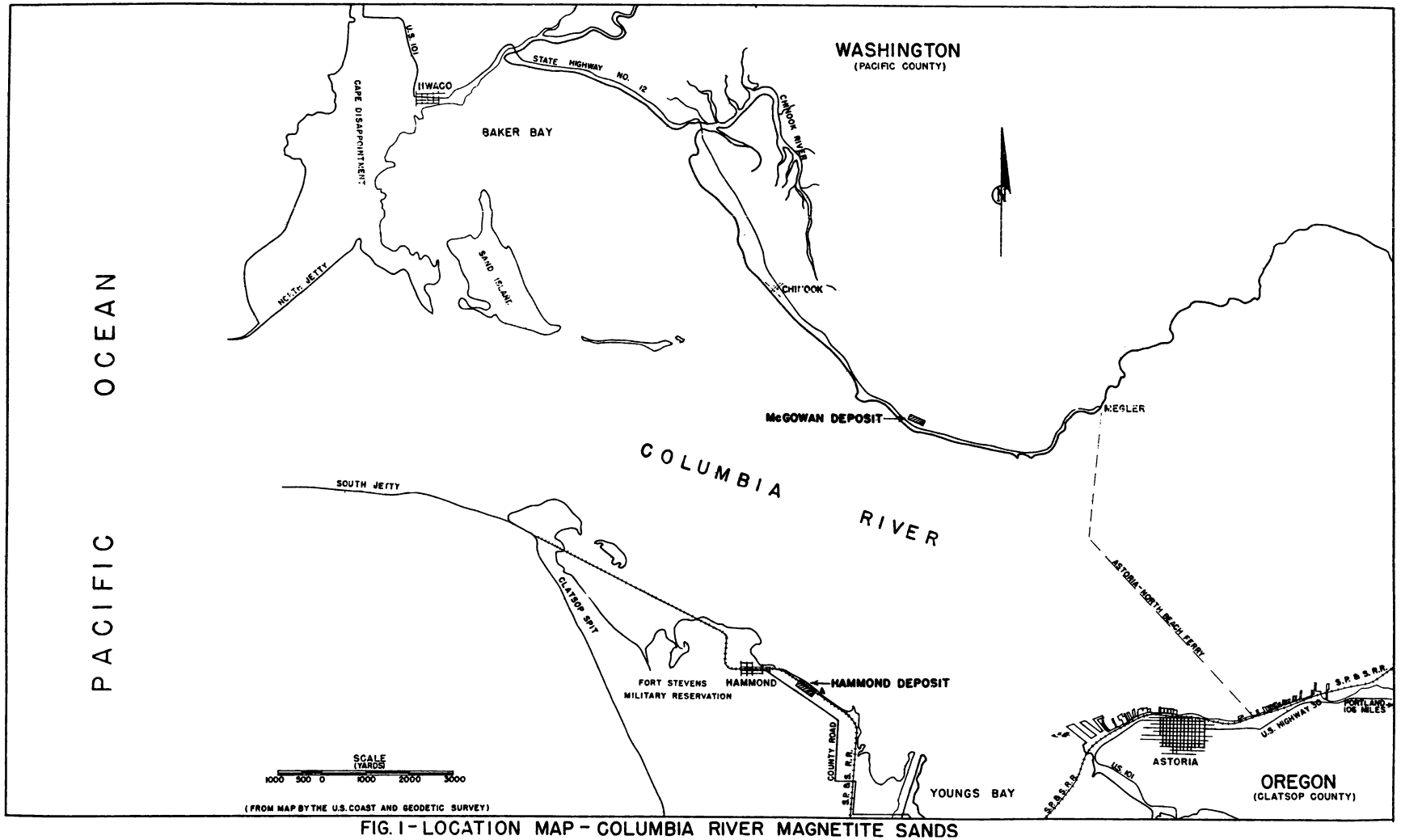

FIG. 1 - LOCATION MAP - COLUMBIA RIVER MAGNETITE SANDS

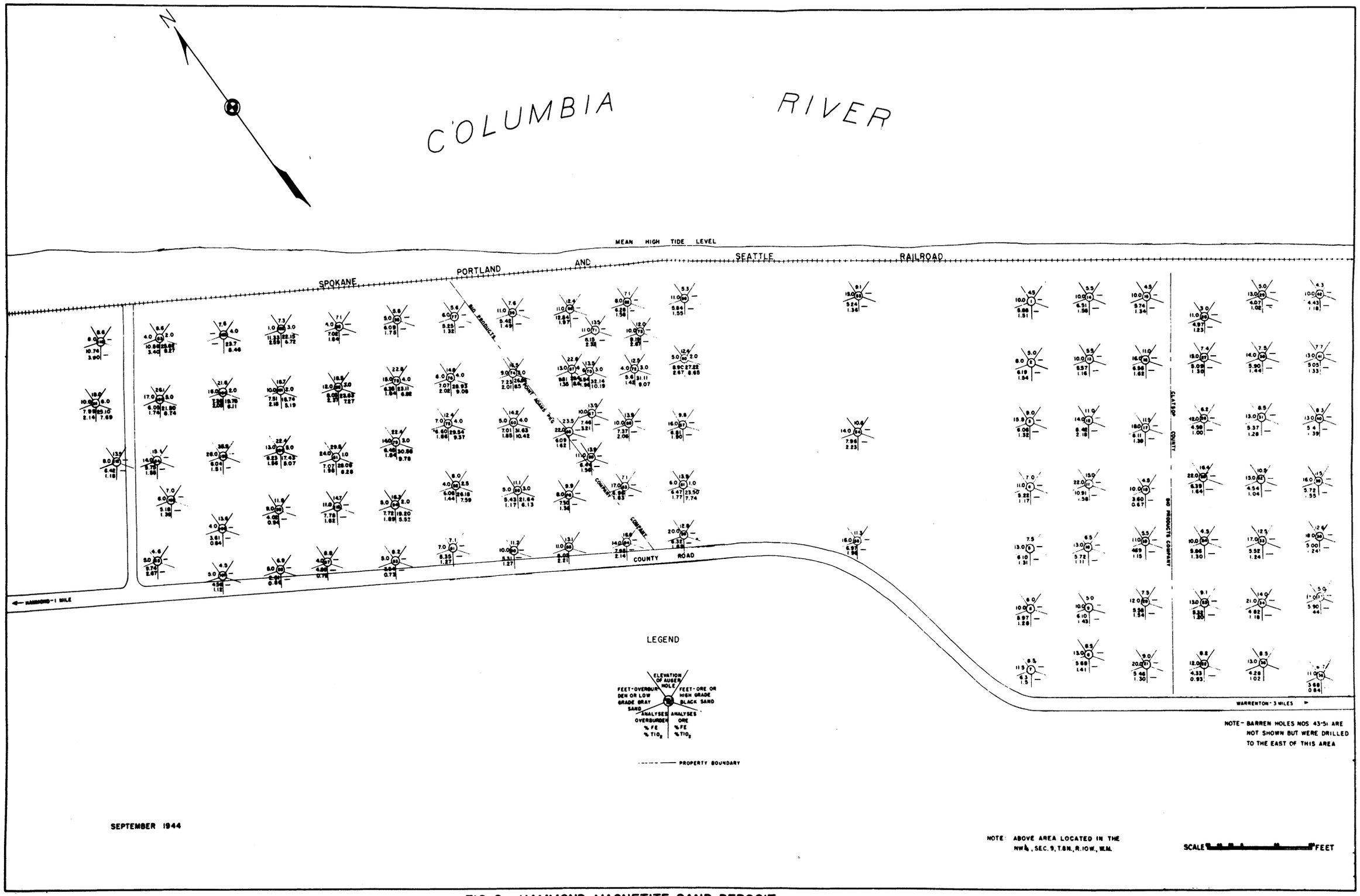

FIG. 2 HAMMOND MAGNETITE SAND DEPOSIT

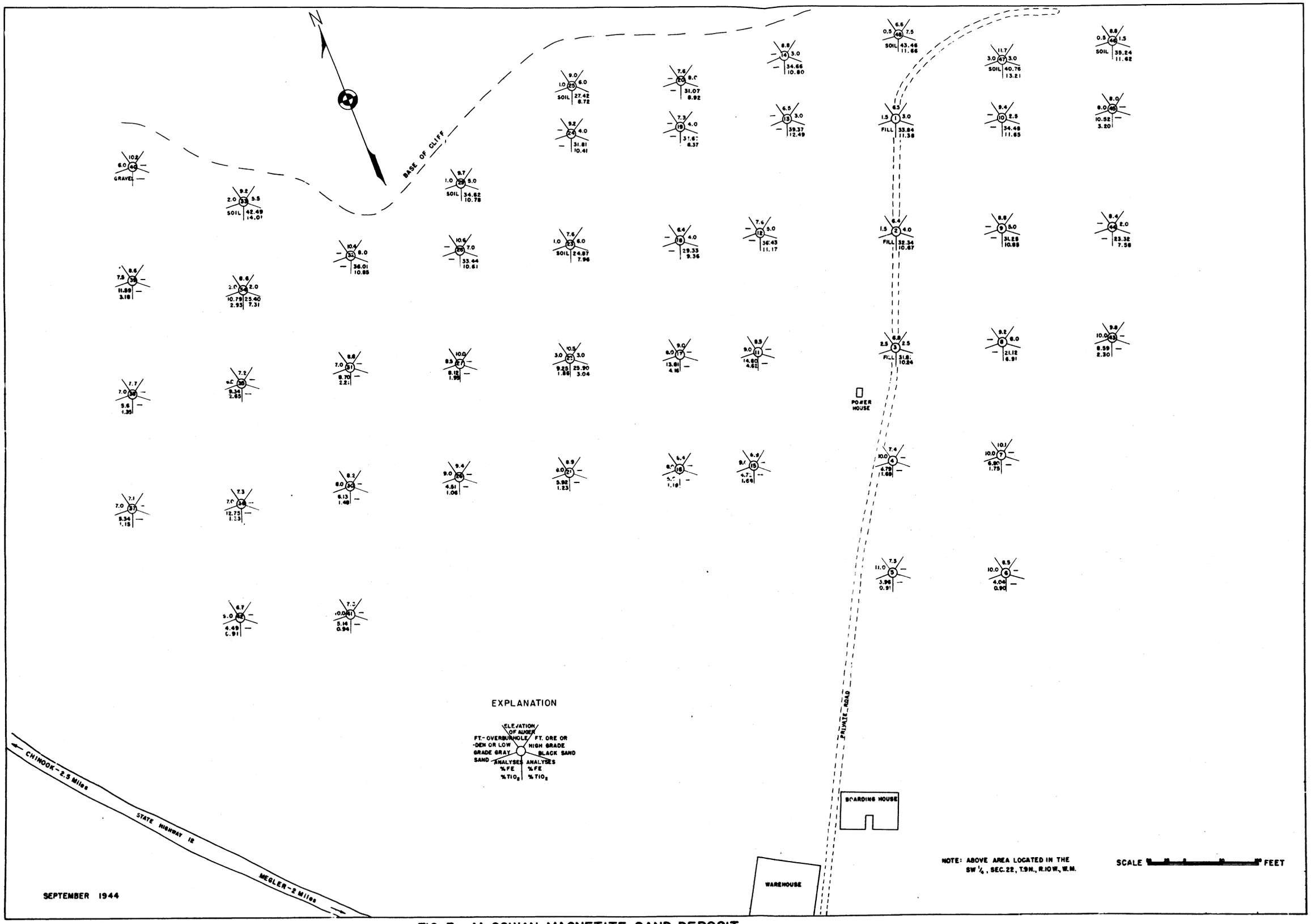

FIG. 3 McGOWAN MAGNETITE SAND DEPOSIT

HISTORY AND PRODUCTION

Black sands have been reported by many observers to occur in beach deposits along the Oregon, Washington, and California coasts. In many instances, the more recent deposits have been worked for their gold content, employing small-scale placer methods. During the war, black sands containing chromite were mined on the coast near Marshfield, Oreg., by the Humphreys Gold Dredging Co. and the Krome Corp. The deposits of chromite-bearing black sands in the Marshfield area are on terraces well above present sea level, whereas the Hammond and McGowan sands are near mean sea level, adjacent to the Columbia River. The Hammond and McGowan black-sand deposits have not been mined.

PHYSICAL FEATURES AND CLIMATE

The Columbia River is a drowned or estuarine channel with numerous bays and inlets (fig. 1). Uplifts and depressions have resulted in many wave-cut platforms, beaches, and sea cliffs. Altitudes range from mean sea level to over 1,000 feet within a distance of 4 to 5 miles inland. Prevailing northwesterly winds during the spring and summer months and southeasterly winds during the fall and winter months are characteristic. These winds produce north (spring and summer) and south (fall and winter) littorals, which carry the river sands north and south along the coast to form long, narrow beaches. Numerous active and fixed dunes also have resulted from wind action.

Typical coastal climate prevails, with moderate temperatures and winds. Rainfall is prevalent during the fall, winter, and spring months; sporadic showers occur in July and August. Snow and freezing temperatures are exceptional.

LABOR SUPPLY AND LIVING CONDITIONS

Adequate labor was available to conduct the Bureau's exploration program. The local communities are mainly engaged in seasonal work such as fishing, logging, and summer-resort operation. Some labor is therefore available during the off seasons. Civilian personnel employed at military installations during the war reduce available living accommodations to a minimum.

PROPERTY AND OWNERSHIP

In the selection of drilling sites, it was necessary to limit drilling to areas that contained neither dwellings nor manufacturing plants, as the magnetite sands, if found, would not be of sufficient value to offset the costs of moving or demolishing existing structures. In the Hammond area, therefore, drilling was confined to property involving three ownerships - Clatsop County, Bio-Products Laboratories, and the Point Adams Packing Co.

The McGowan property is owned in its entirety by C. A. McGowan.

Random drilling was done in several other areas through verbal permission of the many owners living there.

DESCRIPTION OF THE DEPOSITS

General Geology

The mountainous areas adjacent to the coast are composed of Tertiary bedded shales, volcanic tuffs, and basaltic lava flows. Uplifts and depressions have produced a series of wave-cut platforms, beaches, and sea cliffs, which stand at various altitudes to 1,000 feet above sea level. The most recent coastal depression probably was in the nature of a westward tilt, as the drowned valley of the Columbia River extends for a considerable distance out to sea. As a result, materials derived from the erosion of the tertiary rocks lie mostly on the sea floor. The present river sands, including those explored, which contain relatively large quantities of magnetite, are apparently largely derived from erosion of rock formations from sources up the Columbia River. This material was transported downstream when the water was high and was deposited along the river and at or near the estuarial mouth. Successive floods, along with tidal action, effected a sorting whereby the black-sand deposits under consideration were deposited in their present form and position.

The sands from many of the drill holes were angular and exhibit a freshness characteristic of recently eroded material. The sands are characteristic products of erosion from areas containing andesitic, rhyolitic, and granitic rocks. The rhyolitic and granitic rocks occurred only in the upper reaches of the Columbia River gorge.

The Hammond Deposit

The Hammond deposit is an irregularly shaped body of magnetite-bearing sand approximately 1,130 feet long and 300 feet in average width. The long axis of the sand body is parallel to the south bank of the Columbia River, which flows in a northwesterly direction at this point. Surface elevations range from 7.3 to 29.5 feet above mean sea level, the average being 16.4 feet. The overburden, consisting of a light-gray dune sand, increases in thickness toward thw southwestern parts of the deposit. It ranges from less than 1 inch to a maximum thickness of 24 feet, averaging 9 feet. The black or magnetite-bearing sands are 1 to 6 feet thick; the average thickness is 3.2 feet. The ratio of overburden to the magnetite-bearing sand stratum is approximately 3 to 1. The magnetite sands are comparatively flat-lying at altitudes of 5 to 10 feet above mean sea level. Stratification with gray sand and cross-bedding are characteristic of the deposit.

The Hammond Sands

A sample of comparatively high-grade black sand, representing a 3-foot sand thickness, was obtained near hole 72; microscopic determination by grain count revealed the following minerals:

	Percent
Magnetite	40
Hornblende	16
Ilmenite	19
Quartz-feldspar	15
Garnet	7
Zircon, rutile, biotite, and olivine	3
	100

By chemical analysis, the Fe and TiO_2 in this sample were determined to be 33.3 and 10.2 percent, respectively; the moisture content was 5 percent. Specific gravity of the sands, moisture-free, was determined by several measured and weighed samples to be approximately 2.5, or about 13 cubic feet to a short ton.

The minerals comprising the black sands are characteristically angular, fine-grained, and fresh or unaltered. This is also true of the gray sand overburden, composed principally of quartz and feldspar.

The McGowan Deposit

The McGowan deposit is similar to the Hammond deposit in size and shape; it has a length of 2,400 feet and is 400 feet wide. The long axis of the sand body is parallel to the Columbia River. Surface elevations range from 6.4 feet to 11.7 feet above mean sea level. Overburden, consisting of soil and humus, is virtually lacking, but ranges to a maximum thickness of 2.5 feet.

The magnetite-bearing sands are 1.5 to 8 feet in thickness, the average being 4.5 feet. These sands are also flat-lying.

The McGowan Sands

A high-grade sample of the McGowan sands, taken by hand-auger drilling near hole 32 and representing a 4-foot sampled section, gave the following mineralogical content by microscopic grain count:

	Percent
Magnetite	53
Ilmenite	18
Quartz	14
Garnet	13
Zircon	1
Feldspar-mica	1
	100

The Fe and TiO_2 contents of this sample by chemical analysis were reported to be 44.66 and 14.84 percent, respectively. The moisture content was determined to be 11.5 percent.

The McGowan sands are slightly finer-grained and contain a higher percentage of heavy minerals than the Hammond sands. From several measured and weighed samples, moisture-free, the specific gravity of the McGowan sands was determined to be approximately 2.8, or about 11 cubic feet to a short ton. The minerals in the McGowan sands are angular, fine-grained, and fresh unaltered, like those of the Hammond sands.

Other Areas

Random drilling the Chinook, Baker Bay, and Sand Island areas was unsuccessful in locating other magnetite-bearing sand deposits.

WORK BY THE BUREAU OF MINES

From June to August 1944, the Bureau of Mines completed 186 hand-augur holes in the Columbia River area. Of these, 113 holes with a combined length of 1,450 feet were completed in the Hammond area in Clatsop County, Oregon; 48 holes with a combined length of 390 feet were in the McGowan area in Pacific County, Washington. Random drilling of 25 holes for a total of 184 feet was done in the Chinook, Baker Bay, and Sand Island areas, Pacific County, Washington.

Sampling and Analyses

Nine hundred and twenty-three samples were taken for analyses. Total Fe and TiO_2 determinations were made of each sample.

The determination of total iron was considered sufficiently indicative of the magnetite content of the sands for the purpose of the work. It should be noted, however, that other iron-bearing minerals are present, and in order to determine the exact magnetite content, magnetic separation of the magnetite from the associated minerals would be necessary.

Analyses of the black sands in the Hammond and McGowan deposits are given in the following tabulation. Surface elevations and thickness of overburden and the black sands also are given.

TABLE 1

Hammond Deposit

Hole No.	Elevation at surface	Thickness, feet		Percent Fe	Percent TiO_2
		Overburden	Magnetite-bearing sands		
111.....	18.0	10.0	6.0	25.10	7.69
63.....	8.6	4.0	2.0	25.82	8.27
109.....	26.1	17.0	5.0	21.50	6.74
103.....	7.6	-	4.0	23.70	8.46
104.....	21.6	16.0	2.0	19.78	6.11
102.....	7.3	1.0	3.0	22.15	6.72
101.....	18.7	10.0	2.0	16.74	5.19
100.....	22.4	13.0	5.0	17.43	5.07
96.....	18.5	12.0	3.0	23.63	7.27
61.....	29.5	24.0	1.0	28.08	8.28
78.....	22.8	15.0	4.0	23.11	6.82
79.....	22.4	14.0	3.0	30.58	9.78
94.....	16.3	5.0	2.0	19.20	5.52
76.....	14.8	8.0	4.0	28.93	9.08
75.....	12.4	7.0	4.0	29.54	9.37
92.....	8.0	4.0	2.5	26.18	7.59
74.....	16.5	9.0	3.0	26.86	8.50
60.....	14.2	5.0	4.0	31.63	10.42
89.....	11.1	5.0	3.0	21.64	6.13

TABLE 1 (Continued)

Hammond Deposit (Continued)

Hole No.	Elevation at surface	Thickness, feet. Overburden	Thickness, feet. Magnetite-bearing sands	Percent Fe	Percent TiO_2
87.....	22.6	13.0	4.0	29.4	8.6
70.....	13.5	6.0	3.0	32.14	10.19
80.....	12.4	5.0	2.0	27.22	8.65
72.....	12.5	4.0	3.0	31.11	9.07

McGowan Deposit

33.....	9.2	2.0	5.5	42.49	14.01
34.....	8.6	2.0	2.0	25.40	7.31
32.....	10.4	0.0	8.0	36.01	10.85
29.....	9.7	1.0	5.0	34.62	10.78
28.....	10.6	0.0	7.0	33.44	10.61
25.....	9.0	1.0	6.0	27.42	8.72
24.....	9.2	0.0	4.0	31.81	10.41
23.....	7.6	1.0	6.0	24.87	7.96
22.....	10.5	3.0	3.0	25.90	3.04
20.....	7.6	0.0	8.0	31.07	8.92
19.....	7.3	0.0	4.0	31.67	8.37
18.....	6.4	0.0	4.0	29.33	9.36
14.....	8.8	0.0	3.0	34.66	10.80
13.....	6.5	0.0	3.0	39.37	12.49
12.....	7.6	0.0	5.0	36.43	11.17
48.....	6.6	0.5	7.5	43.46	11.66
1.....	6.5	1.5	3.0	33.84	11.38
2.....	6.4	1.5	4.0	32.34	10.67
3.....	6.8	2.5	2.5	31.81	10.24
47.....	11.7	3.0	3.0	40.76	13.21
10.....	9.4	0.0	2.5	34.48	11.65
9.....	8.8	0.0	5.0	31.25	10.85
8.....	9.2	0.0	8.0	21.12	6.91
46.....	8.8	0.5	1.5	35.24	11.62
44.....	8.4	0.0	2.0	23.32	7.58