Population Estimates for the Areas Within a 50-Mile Radius of Four Reference Points on the Hanford Site

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November 1981

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Richland, Washington 99352

SUMMARY

This report presents population distributions within a 50-mile radius of four locations on the Hanford Site. The results are based on the U.S. Bureau of Census 1980 population counts for Washington and Oregon. These results are documented in Tables 2-13 and 15-18 of this report.

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INTRODUCTION

This report was prepared by Pacific Northwest Laboratory (PNL)^(a) in response to the Hanford Defense Waste Environmental Impact Statement, the Environmental Impact Statement for the Operation of PUREX and Uranium Oxide Plant Facilities, and the Hanford Environmental Surveillance Program. Current U.S. Bureau of Census data^(b) are used in preparing population distribution data for preparing population dose assessments required by DOE Order 5480.1 Chg. 2.^(c)

Previous reports (Yandon 1976; Yandon and Landstrom 1980, Yandon, Burlison, and Rau 1980) have given population distributions within a 50-mile radius of a number of designated points on the Hanford Site along with projections of population distributions through time based on various assumptions. Due to recent immigration to the area surrounding the Hanford Site it was necessary to update the information in the aforementioned reports. The information presented in this report is based on the latest census data. This report is similar to these previous population distribution studies with the exception that only a 10-year population distribution forecast is presented in comparison to previous reports where projections were made much further into the future.

(a) PNL is operated for the U.S. Department of Energy by Battelle Memorial Institute.

(b) U.S. Bureau of Census. March 1981. Census of Population and Housing. Advance Report. PHC80-V-49, Washington. PHC80-V-39, Oregon.

(c) DOE Order 5480.1 Chg. 2, Environmental Protection, Safety, and Health Protection Program for DOE Operations, U.S. Department of Energy, Washington, D.C., April 29, 1981.

METHODOLOGY

Census maps for 1980 were obtained from the Washington State Department of Transportation for Adams, Benton, Chelan, Douglas, Franklin, Grant, Kittitas, Klickitat, Walla Walla and Yakima counties. Maps of Morrow and Umatilla counties were obtained from the Oregon Data Center. Typically, four to five maps make up one county. The areas analyzed in this report cover all or portions of the counties, county subdivisions, and incorporated cities listed in Table 1.

The census maps were then digitized into a computer where county subdivisions and incorporated city boundaries were delineated. The computer then produced a map at a scale of representative fraction (RF) 1:300,000. This "master" map included the area required for a 50-mile radius from four points (origins) on the Hanford Site: 100-N Reactor, 200 Area Hanford Meteorological Tower (622-R), Fast Flux Test Facility (FFTF), and the 300 Area (303-C). Figures 1-4 show these four areas respectively.

Next, a 16-sector compass grid was overlaid onto each origin with annular concentric rings every 10 miles extending out to 50 miles. The resulting "spider-web" overlay on each map was then used to distribute the populations of the county subdivisions over their respective areas. This distribution was done by measuring the area of each subdivision within the grid sector using a planimeter. The subdivision area within a grid sector divided by its total area gives the proportion of the subdivision within that grid sector. This proportion was multiplied by the subdivision population (assumed to be uniformly distributed), excluding the population of incorporated cities which were added separately. City populations were distributed directly to their corresponding grid sectors unless they had to be split among two or more grid sectors. If the city populations had to be split, the populations were distributed according to their percentage of land area within the grid sector(s) under analysis. The end result is a population count for each grid sector at each of the five radii. Tables 2-9 give the results of these calculations for the 1980 census as well as the projections for 1990. Tables 10-13 give the results of the population distribution for incorporated cities in each grid sector.

The forecasts for the 1990 population were derived in the same manner as the 1980 population distribution and assume that the population distribution remains the same. These forecasts were based on three population projection studies (Forecasting and Support Division 1981; U.S. Department of Energy 1979a; 1979b) by the Bonneville Power Administration and the State of Washington Office of Financial Management Forecasting and Support Division. Table 14 lists the aforementioned studies projected rate of change from 1980-1990 for each county and the selected rate of change used to derive the 1990 population for this study. In each case the higher of the two forecasts was used to be conservative.

Tables 15-18 list the grid sectors with the largest population densities (persons per square mile) for the 100-N Reactor, 200 Area Meteorological Tower, Fast Flux Test Facility and 300 Area, respectively for 1980 and 1990.

TABLE 1. Study Area

<u>Counties</u>	<u>County Subdivisions</u>	<u>Incorporated Cities</u>
Adams	Lind-Washtucna Othello Ritzville	Hatton, Lind Othello Ritzville
Benton	Benton City Federal Reservation Northwest Benton Richland-Kennewick South Benton	Benton City Prosser Kennewick, Richland, West Richland
Chelan	Malaga	
Douglas	Waterville	
Franklin	Connell Kahlotus Pasco Pasco North	Connell, Mesa Kahlotus Pasco
Grant	Ephrata-Soap Lake George Floyd Moses Lake Quincy Southern Slopes Warden Wilson Creek	Ephrata, Soap Lake George Moses Lake Quincy Mattawa, Royal City Warden
Kittitas	Ellensburg Kittitas Manastash Naneum	Kittitas
Klickitat	Horse Heaven	
Morrow(a)	Boardman	Boardman, Irrigon
Umatilla(a)	Athena Northwest Umatilla Pendleton	Echo, Hermiston, Stanfield, Umatilla
Walla Walla	Burbank Eureka Flat Touchet Waitsburg Walla Walla-College Place	Prescott Waitsburg College Place, Walla Walla
Yakima	Mabton Northeast Yakima Northwest Yakima Southwest Yakima South Yakima Sunnyside Toppenish-Wapato Yakima	Mabton Moxee Naches Grandview, Granger, Sunnyside, Zillah Harrah, Toppenish, Wapato Selah, Union Gap, Yakima

(a) Oregon counties.

FIGURE 1. 50-Mile Radius from the 100-N Reactor

FIGURE 2. 50-Mile Radius from the 200 Area Hanford Meteorological Tower

FIGURE 4. 50-Mile Radius from the 300 Area

TABLE 2. Distribution of Population in 50-Mile Radius of the 100-N Reactor by Population Grid Sector for 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	36	953	420	1,492	7,583	10,484
NNE	5	285	561	18,531	1,350	20,732
NE	0	624	1,013	2,691	259	4,587
ENE	0	620	5,884	1,129	429	8,062
EAST	0	294	625	2,742	605	4,266
ESE	0	306	1,493	596	247	2,642
SE	0	54	2,113	28,922	5,001	36,090
SSE	0	0	35,127	50,292	3,354	88,773
SOUTH	0	127	4,592	2,041	176	6,936
SSW	0	258	1,676	12,603	625	15,162
SW	0	547	4,946	16,747	469	22,709
WSW	0	680	1,699	8,297	15,274	25,950
WEST	18	395	936	5,149	75,686	82,184
WNW	54	573	377	490	1,598	3,092
NW	74	277	425	515	683	1,974
NNW	<u>64</u>	<u>277</u>	<u>438</u>	<u>1,030</u>	<u>4,696</u>	<u>6,505</u>
TOTALS	251	6,270	62,325	153,267	118,035	340,148

TABLE 3. Distribution of Population within a 50-Mile Radius of the 100-N Reactor by Population Grid Sector for the Year 1990

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	42	1,119	493	1,752	8,901	12,307
NNE	6	336	659	21,755	1,585	24,341
NE	0	769	1,228	3,163	314	5,474
ENE	0	781	7,303	1,401	533	10,018
EAST	0	400	844	3,726	816	5,786
ESE	0	416	2,032	810	319	3,577
SE	0	73	2,841	38,742	6,087	47,743
SSE	0	0	45,015	64,621	4,300	113,936
SOUTH	0	163	5,886	2,617	225	8,891
SSW	0	331	2,118	15,238	734	18,421
SW	0	684	5,771	19,605	544	26,604
WSW	0	837	1,975	9,642	17,750	30,204
WEST	21	462	1,087	5,974	87,901	95,445
WNW	63	672	385	495	1,624	3,239
NW	87	325	478	532	689	2,111
NNW	<u>75</u>	<u>325</u>	<u>515</u>	<u>1,208</u>	<u>5,489</u>	<u>7,612</u>
TOTALS	294	7,693	78,630	191,281	137,811	415,709

TABLE 4. Distribution of Population in 50-Mile Radius of the 200 Area Hanford Meteorological Tower by Population Grid Sector for 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	174	1,124	772	1,957	4,027
NNE	0	92	656	5,547	14,822	21,117
NE	0	262	5,930	2,963	596	9,751
ENE	0	235	773	2,366	435	3,809
EAST	0	340	1,329	1,659	588	3,916
ESE	0	283	1,374	230	652	2,539
SE	0	6,757	48,661	50,519	3,474	109,411
SSE	0	1,997	13,161	2,717	5,218	23,093
SOUTH	0	1,532	1,489	195	1,799	5,015
SSW	0	905	5,283	652	129	6,969
SW	0	1,190	19,786	2,182	459	23,617
WSW	5	1,840	5,063	15,088	4,573	26,569
WEST	32	648	949	6,874	78,635	87,138
WNW	73	444	802	833	2,833	4,985
NW	0	555	398	493	1,454	2,900
NNW	0	246	456	864	4,521	6,087
TOTALS	110	17,500	107,234	93,954	122,145	340,943

TABLE 5. Distribution of Population within a 50-Mile Radius of the 200 Area Hanford Meteorological Tower by Population Grid Sector for the Year 1990

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	202	1,320	907	2,298	4,727
NNE	0	108	790	6,448	17,482	24,828
NE	0	331	7,360	3,534	713	11,938
ENE	0	320	1,015	3,110	558	5,003
EAST	0	462	1,808	2,258	792	5,320
ESE	0	385	1,869	307	744	3,305
SE	0	8,664	62,866	66,306	4,094	141,930
SSE	0	2,561	16,873	3,483	6,243	29,160
SOUTH	0	1,962	1,909	251	2,114	6,236
SSW	0	1,160	6,757	787	157	8,861
SW	0	1,449	23,003	2,535	534	27,521
WSW	7	2,177	5,884	17,532	5,313	30,913
WEST	40	780	1,103	7,988	91,374	101,285
WNW	94	530	920	924	3,221	5,689
NW	0	652	430	499	1,467	3,048
NNW	0	289	536	1,013	5,268	7,106
TOTALS	141	22,032	134,443	117,882	142,372	416,870

TABLE 6. Distribution of Population in 50-Mile Radius of the FFTF by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	78	859	811	16,267	18,015
NNE	20	343	5,728	2,945	1,021	10,057
NE	114	377	760	1,033	217	2,501
ENE	211	1,041	2,644	492	451	4,839
EAST	229	600	183	169	183	1,364
ESE	229	442	544	292	1,060	2,567
SE	344	25,267	13,654	2,105	952	42,322
SSE	10,829	40,933	5,688	719	2,364	60,533
SOUTH	11,760	9,385	1,525	5,611	15,691	43,972
SSW	1,446	4,550	583	185	1,927	8,691
SW	179	1,538	5,234	535	239	7,725
WSW	0	1,206	7,748	14,956	481	24,391
WEST	0	190	3,339	6,089	17,171	26,789
WNW	0	0	932	1,221	3,176	5,329
NW	0	0	295	903	705	1,903
NNW	0	0	264	1,302	1,182	2,748
TOTALS	25,361	85,950	49,980	39,368	63,087	263,746

TABLE 7. Distribution of Population within a 50-Mile Radius of the FFTF by Population Grid Sector for the Year 1990

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	107	1,057	968	19,099	21,231
NNE	27	467	7,121	3,517	1,205	12,337
NE	156	513	997	1,293	270	3,229
ENE	288	1,415	3,598	671	611	6,583
EAST	312	817	249	211	208	1,797
ESE	312	602	634	324	1,176	3,048
SE	452	34,069	17,622	2,394	1,252	55,789
SSE	13,881	52,612	7,360	867	2,821	77,541
SOUTH	15,073	12,032	1,955	6,678	18,712	54,450
SSW	1,854	5,832	745	229	2,249	10,909
SW	228	1,971	6,709	638	279	9,825
WSW	0	1,546	9,109	17,380	559	28,594
WEST	0	244	3,946	7,076	19,951	31,217
WNW	0	0	1,149	1,416	3,659	6,224
NW	0	0	346	1,045	750	2,141
NNW	0	0	310	1,528	1,386	3,224
TOTALS	32,583	112,227	62,907	46,235	74,187	328,139

TABLE 8. Distribution of Population in 50-Mile Radius of 300 Area
by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	289	241	989	5,655	5,317	12,491
NNE	307	475	841	1,950	2,269	5,842
NE	18	966	2,583	562	205	4,334
ENE	307	465	349	470	238	1,829
EAST	291	114	137	174	687	1,403
ESE	338	288	863	594	17,891	19,974
SE	2,549	26,150	2,922	877	1,235	33,733
SSE	7,161	30,357	1,114	1,117	1,113	40,862
SOUTH	15,561	6,651	96	17,223	5,127	44,658
SSW	11,124	4,034	99	1,209	2,038	18,504
SW	10,066	3,931	706	182	181	15,066
WSW	4,429	1,810	5,531	8,988	621	21,379
WEST	294	984	2,226	16,878	16,293	36,675
WNW	0	0	692	1,543	1,679	3,914
NW	0	0	74	923	785	1,782
NNW	0	0	8	875	1,212	2,095
TOTALS	52,734	76,466	19,230	59,220	56,891	264,541

TABLE 9. Distribution of Population within a 50-Mile Radius of the
300 Area by Population Grid Sector for the Year 1990

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	393	328	1,252	6,995	6,243	15,211
NNE	417	647	1,092	2,415	2,681	7,252
NE	24	1,314	3,515	738	256	5,847
ENE	417	634	476	631	305	2,463
EAST	395	155	180	194	764	1,688
ESE	459	370	963	659	19,882	22,333
SE	3,469	35,104	3,469	988	1,471	44,501
SSE	9,310	38,936	1,425	1,333	1,328	52,332
SOUTH	19,951	8,526	123	20,548	6,117	55,265
SSW	14,260	5,173	128	1,418	2,373	23,352
SW	12,904	5,040	905	229	215	19,293
WSW	5,679	2,319	7,067	10,460	722	26,247
WEST	377	1,261	2,718	19,611	18,932	42,899
WNW	0	0	868	1,815	1,945	4,628
NW	0	0	95	1,084	876	2,055
NNW	0	0	9	1,028	1,422	2,459
TOTALS	68,055	99,807	24,285	70,146	65,532	327,825

TABLE 10. Distribution of Population of Incorporated Cities within a 50-Mile Radius of the 100-N Reactor by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	676	0	0	5,479	6,155
NNE	0	0	106	10,523	0	10,629
NE	0	0	0	1,479	0	1,479
ENE	0	0	4,454	77	227	4,758
EAST	0	0	0	1,985	203	2,188
ESE	0	0	278	0	0	278
SE	0	0	437	22,581	0	23,018
SSE	0	0	28,323	37,648	0	65,971
SOUTH	0	0	1,980	0	0	1,980
SSW	0	0	0	10,385	0	10,385
SW	0	0	0	11,411	0	11,411
WSW	0	0	0	3,228	8,196	11,424
WEST	0	0	0	687	57,382	58,069
WNW	0	299	0	0	782	1,081
NW	0	0	0	0	0	0
NNW	0	0	0	261	3,525	3,786
TOTALS	0	975	35,578	100,265	75,794	212,612

TABLE 11. Distribution of Population of Incorporated Cities within a 50-Mile Radius of the 200 Area Hanford Meteorological Tower by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	0	676	0	0	676
NNE	0	0	0	4,092	6,537	10,629
NE	0	0	4,454	1,479	0	5,933
ENE	0	0	0	1,171	0	1,171
EAST	0	0	278	891	193	1,362
ESE	0	0	0	0	0	0
SE	0	6,010	39,504	39,571	0	85,085
SSE	0	0	5,587	0	3,199	8,786
SOUTH	0	0	0	0	1,204	1,204
SSW	0	0	3,896	0	0	3,896
SW	0	0	14,838	1,248	0	16,086
WSW	0	0	0	9,928	0	9,928
WEST	0	0	0	687	60,689	61,376
WNW	0	0	0	0	0	0
NW	0	299	0	0	782	1,081
NNW	0	0	0	261	3,525	3,786
TOTALS	0	6,309	69,233	59,328	76,129	210,999

TABLE 12. Distribution of Population of Incorporated Cities within a 50-Mile Radius of the FFTF by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	0	0	0	10,629	10,629
NNE	0	0	4,454	1,479	0	5,933
NE	0	0	0	81	0	81
ENE	0	278	1,981	0	203	2,462
EAST	0	0	0	0	0	0
ESE	0	0	0	0	0	0
SE	201	19,850	7,966	0	0	28,017
SSE	10,829	34,890	447	0	0	46,166
SOUTH	10,632	4,042	0	3,899	11,600	30,173
SSW	0	1,980	0	1,261	0	3,241
SW	0	0	3,896	0	0	3,896
WSW	0	0	4,773	11,315	0	16,088
WEST	0	0	0	544	10,071	10,615
WNW	0	0	0	0	0	0
NW	0	0	0	299	0	299
NNW	0	0	0	676	261	937
TOTALS	21,622	61,040	23,517	19,554	32,764	158,537

TABLE 13. Distribution of Population of Incorporated Cities within a 50-Mile Radius of the 300 Area by Population Grid Sector for the Year 1980

Compass Direction	Number of People					Totals
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	
NORTH	0	0	134	4,231	3,274	7,639
NNE	0	0	0	89	1,479	1,568
NE	0	278	1,981	81	0	2,340
ENE	0	0	0	203	0	203
EAST	0	0	0	0	341	341
ESE	0	0	0	0	13,434	13,434
SE	0	20,524	0	0	0	20,524
SSE	5,000	25,729	0	0	0	30,729
SOUTH	13,739	3,199	0	12,607	2,192	31,737
SSW	9,482	0	0	700	1,261	11,443
SW	8,399	1,980	0	0	0	10,379
WSW	2,787	0	3,896	6,863	0	13,546
WEST	0	0	0	9,225	9,928	19,153
WNW	0	0	0	0	0	0
NW	0	0	0	299	0	299
NNW	0	0	0	270	406	676
TOTALS	39,407	51,710	6,011	34,568	32,315	164,011

TABLE 14. Projected Rate of Population Change Between
1980 and 1990

<u>Counties</u>	<u>OFM Study</u>	<u>BPA Study</u>	<u>Highest Projected Increase</u>
Adams	11.5%	24.1%	24.1%
Benton	28.3%	27.3%	28.3%
Chelan	10.4%	7.8%	10.4%
Douglas	21.1%	21.1%	21.1%
Franklin	36.1%	26.0%	36.1%
Grant	17.4%	15.9%	17.4%
Kittitas	-0.4%	0.8%	0.8%
Klickitat	17.1%	15.4%	17.1%
Morrow	--	16.4%	16.4%
Umatilla	--	19.3%	19.3%
Walla Walla	11.0%	7.2%	11.0%
Yakima	16.2%	11.0%	16.2%

TABLE 15. Highest Population Densities for Grid Sectors
Within a 50-Mile Radius of the 100-N Reactor

Population Density (persons/square mile)

<u>Grid Sector</u>	<u>1980</u>	<u>1990</u>
W 40-50	421.9	490.0
SSE 30-40	373.9	480.5
SSE 20-30	360.3	461.7
SE 30-40	215.0	288.0
NNE 30-40	137.8	161.7
SW 30-40	124.5	145.8
SSW 30-40	93.7	113.3
WSW 40-50	85.1	98.9

TABLE 16. Highest Population Densities for Grid Sectors
Within a 50-Mile Radius of the 200 Area Hanford
Meteorological Tower

Population Density (persons/square mile)

<u>Grid Sector</u>	<u>1980</u>	<u>1990</u>
SE 20-30	499.1	644.8
W 40-50	438.3	509.3
SE 30-40	375.6	493.0
SW 20-30	202.9	235.9
SSE 20-30	135.0	173.1
SE 10-20	115.9	148.6
WSW 30-40	112.2	130.3
NNE 40-50	82.6	97.4

TABLE 17. Highest Population Densities for Grid Sectors
Within a 50-Miles Radius of the
Fast Flux Test Facility

Population Density (persons/square mile)

<u>Grid Sector</u>	<u>1980</u>	<u>1990</u>
SSE 10-20	702.1	902.4
S 0-10	552.1	707.7
SSE 0-10	508.4	651.7
SE 10-20	433.4	584.4
S 10-20	161.0	206.4
SE 20-30	140.0	180.7
WSW 30-40	111.2	129.2
W 40-50	95.7	111.2

TABLE 18. Highest Population Densities for Grid Sectors
Within a 50-Mile Radius of the 300 Area

Population Density (persons/square mile)

<u>Grid Sector</u>	<u>1980</u>	<u>1990</u>
S 0-10	730.6	936.7
SSW 0-10	522.3	669.5
SSE 10-20	520.7	667.9
SW 0-10	472.6	605.8
SE 10-20	448.5	602.1
SSE 0-10	336.2	437.1
WSW 0-10	207.9	266.6
S 30-40	128.1	152.8
SE 0-10	119.7	162.9

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