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Hanford Site Regional Population – 2010 Census

EL Hamilton
SF Snyder

August 2011



Pacific Northwest
NATIONAL LABORATORY

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

The U.S. Department of Energy (DOE) conducts radiological operations in south-central Washington State. Population dose estimates must be performed to provide a measure of the impact from site radiological releases. Results of the U.S. 2010 Census were used to determine counts and distributions for the residential population located within 50 miles of several operating areas of the Hanford Site. Year 2010 was the first census year that a 50-mile population of a Hanford Site operational area exceeded the half-million mark.

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1.0 Introduction

The newly available 2010 U.S. Census data were used to update 50-mile residential population data relative to five major operating areas of the Hanford Site in Washington State. This information updates Elliott et al. (2004), which provided data from the year 2000 Census. The 1990 Census data evaluation was published in Beck et al. (1991). For 2010, the population within 50-miles is provided for a radial grid of 160 segments centered on each of five operating areas. Figure 1.1 indicates the Hanford Site boundary and county borders with the 50-mile grid centered on the 200 Area Hanford Meteorological Station (HMS). Morrow and Umatilla Counties are in Oregon. All other counties are in Washington.

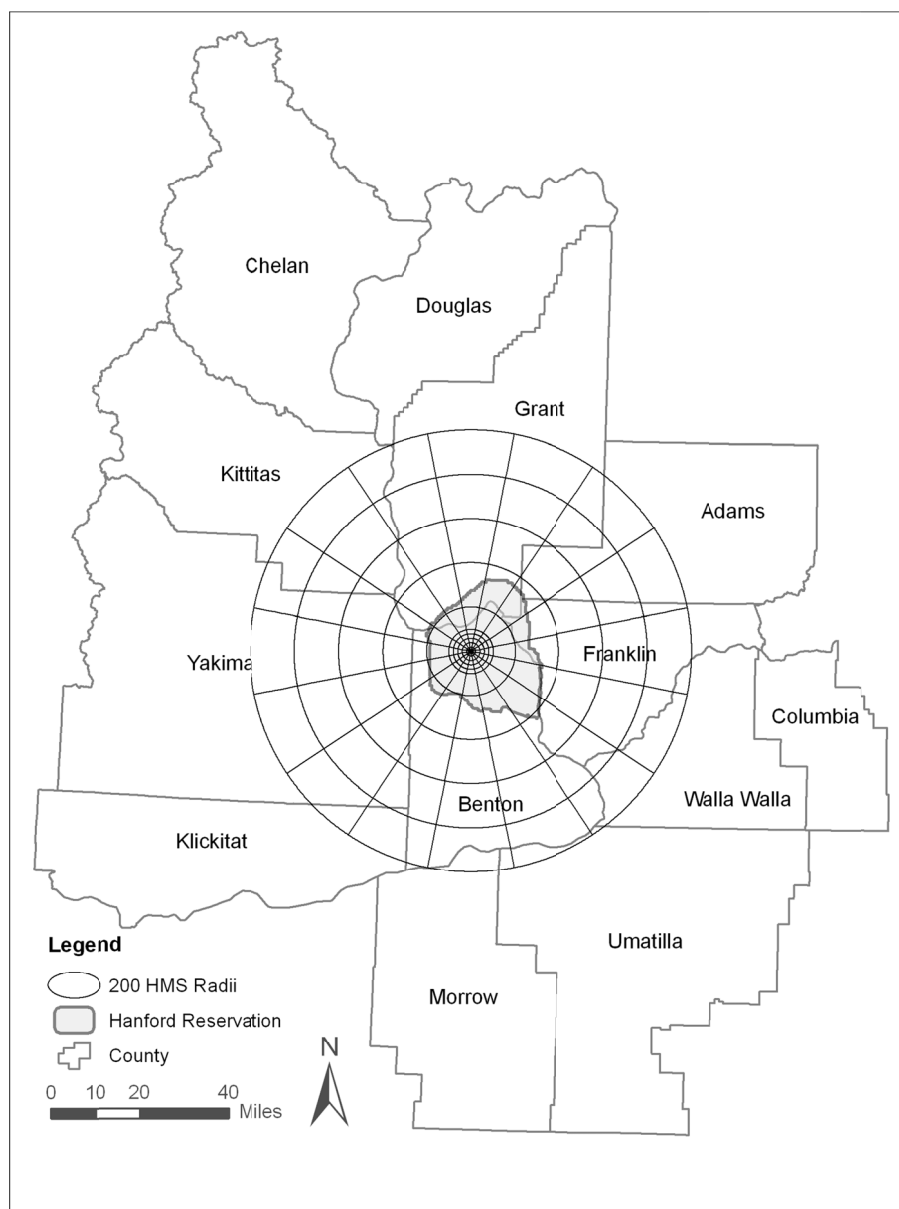


Figure 1.1. 200 HMS 50-mile Region and County Overlay

2.0 Data Evaluation

Geographic information system (GIS) software, ArcInfo 9.3.1 (ESRI 2009), was used to create direction- and distance-specific circular grids centered on each of five Hanford Site locations: 100 K Area, 200 Area Hanford Meteorological Station (HMS) located between the 200-West and 200-East Areas, 300 Area, 400 Area, and the Hanford Tank Waste Treatment and Immobilization Plant (WTP) site located east of the 200-East Area (Table 2.1; Figure 2.1). The grids contained concentric circles with radii of 1, 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles, expanding from the point of one of five Hanford locations. The 16 directional sectors of the grid were created using the four cardinal directions (N, E, S, W), the four ordinal directions (NE, SE, SW, NW), and the eight half-wind directions (NNE, ENE, ESE, SSE, SSW, WSW, WNW, NNW). The 10 concentric distance circles were then combined with the 16 directional sectors to create a circular grid with 160 sections (Figure 2.2 through Figure 2.6).

Table 2.1. Locations of Operating Areas

Operating Area	Longitude	Latitude
100K Area	-119.578	46.657
200 HMS	-119.599	46.563
300 Area	-119.286	46.364
400 Area	-119.360	46.430
WTP	-119.521	46.556

In order to determine the population totals for each circular grid section, Census 2010 Tiger/Line block-level shapefiles containing Census 2010 Redistricting population totals (Census 2010a, 2010b, 2010c) were brought into the GIS. The area was calculated for each block and the population was assumed to be evenly distributed within that area. Then the block-level boundaries were intersected with the circular grids. The area was again calculated for the newly intersected blocks. To calculate a new population for each of the 160 grid segments, the areas for the block portions within a grid were multiplied by their respective original average census block population densities, then summed and rounded to the nearest whole number. For example, if a circular grid section contained 40% of the original area of a block, then it was assumed that the section also contained 40% of the block's original population. This procedure was repeated for grids centered at each location of interest to create the 50-mile (80-km) population distribution based on the 2010 census data. See Figure 2.2 through Figure 2.6 for census block overlays with the 50-mile radial grid.

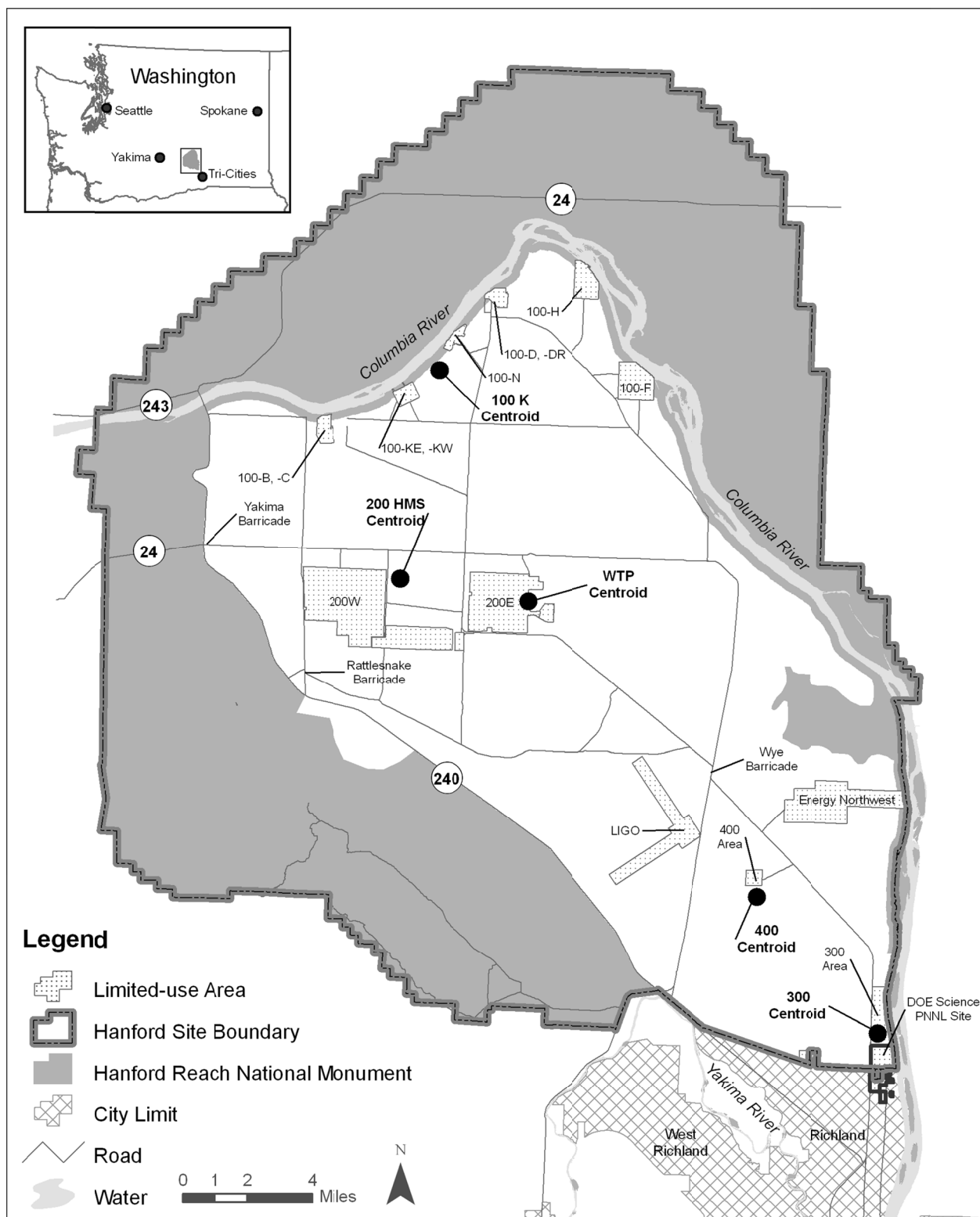


Figure 2.1. Centroid Locations for 50-mile Population Distributions

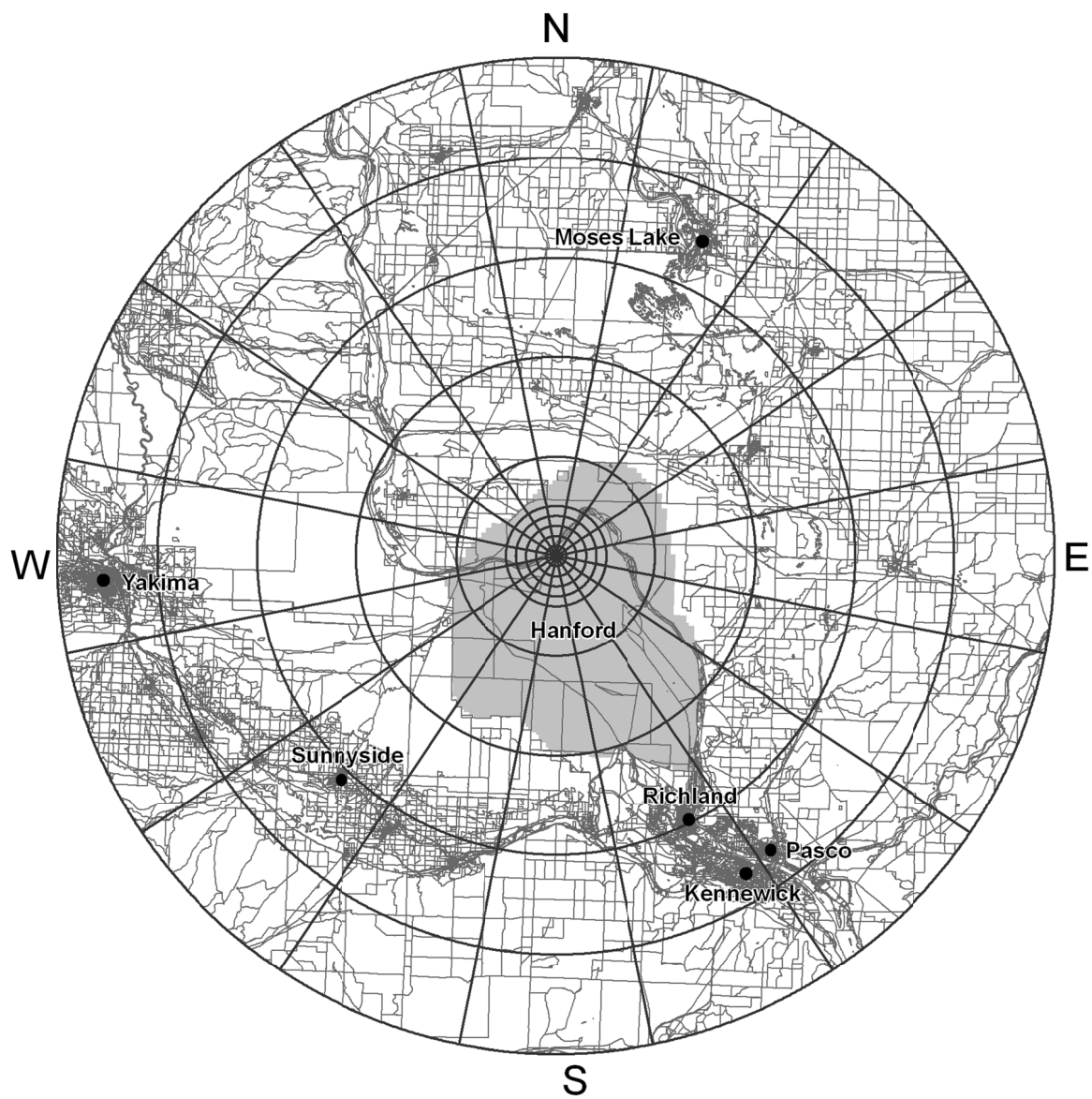


Figure 2.2. 100K Centroid 50-mile Region and Census Block Overlay

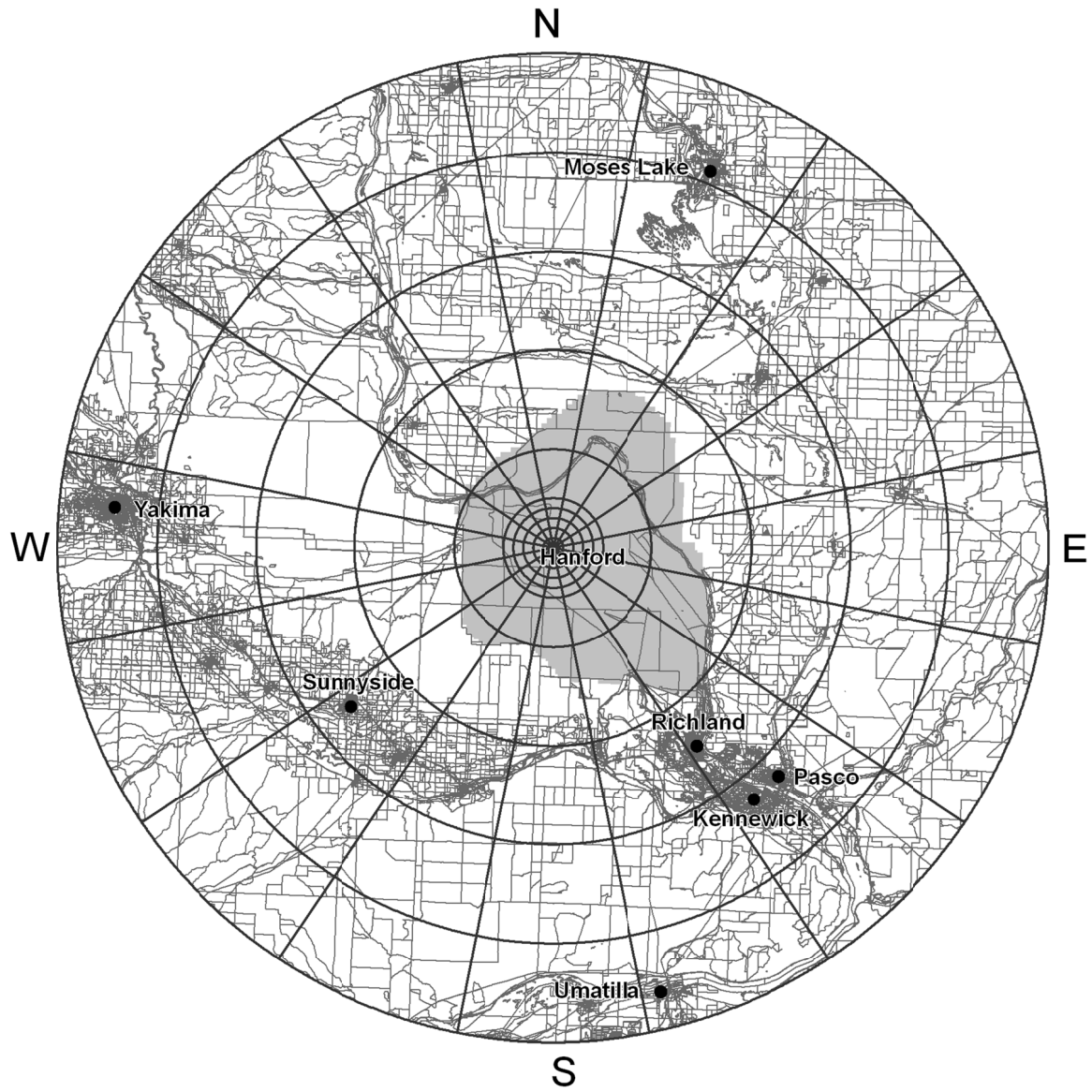


Figure 2.3. 200 Area HMS Centroid 50-mile Region and Census Block Overlay

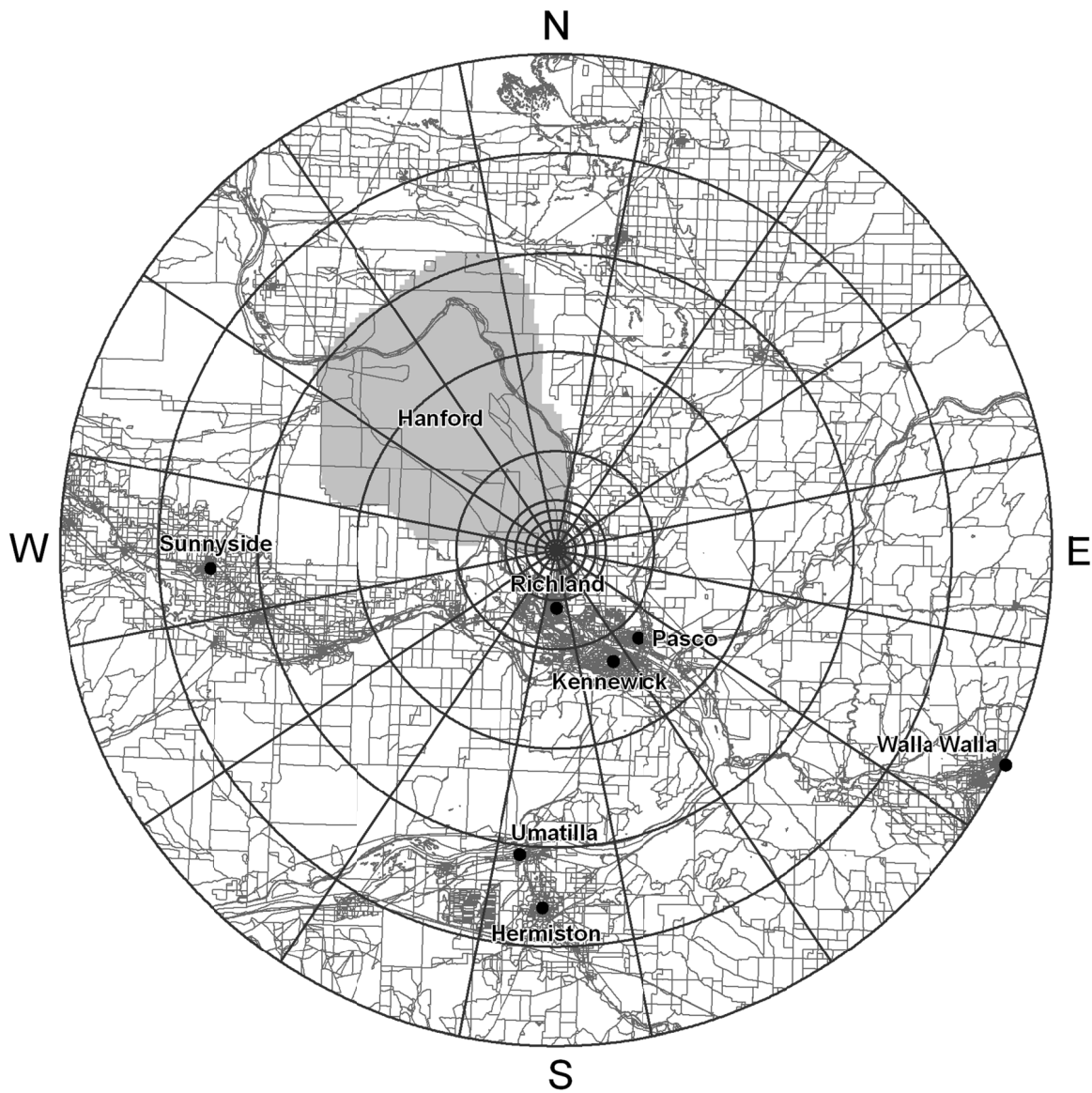


Figure 2.4. 300 Area Centroid 50-mile Region and Census Block Overlay

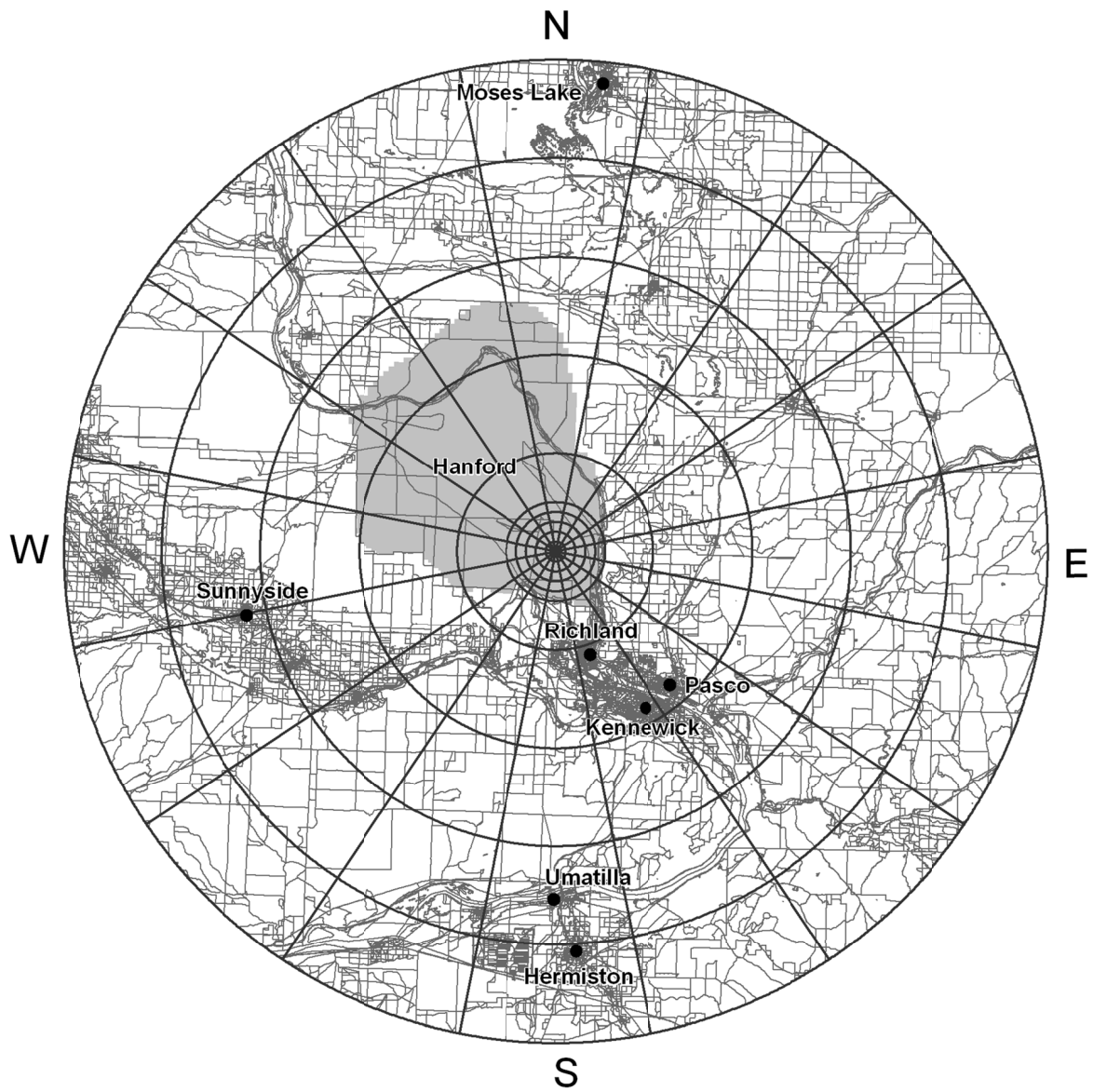


Figure 2.5. 400 Area Centroid 50-mile Region and Census Block Overlay

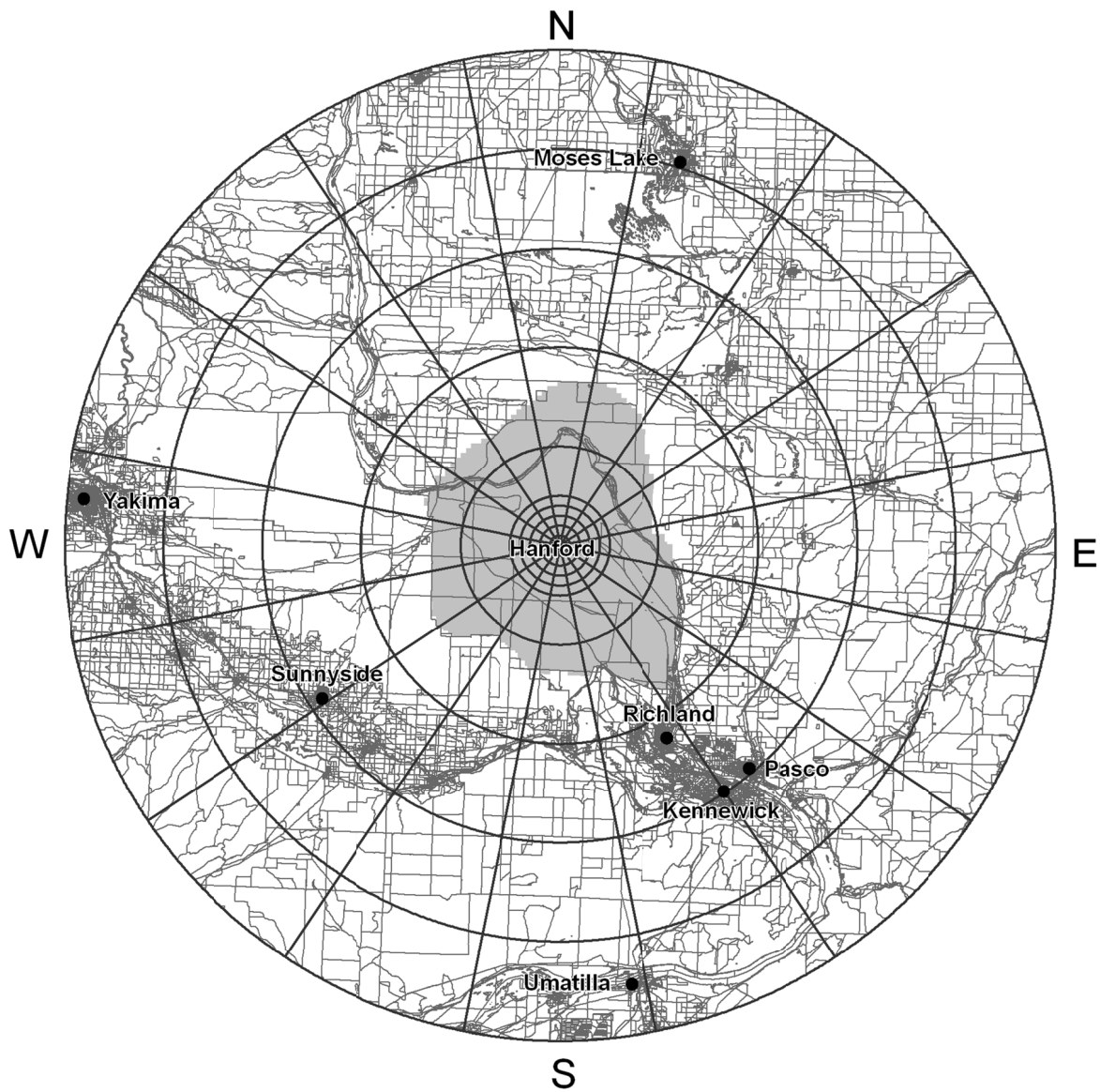


Figure 2.6. WTP Centroid 50-mile Region and Census Block Overlay

3.0 Data Graphics and Tables

The data resulting from the evaluation described in Section 2.0 are presented here in graphic and tabular form. The user can then format the population distributions as needed for a particular application. Figure 3.1 through Figure 3.5 indicate the 5-10 mile and additional 10 mile-increment populations in the larger grid, and the 1-mile increment populations in the smaller 0-5 mile inset. Grid directions follow the compass rose with the top center sectors as North. Table 3.1 through Table 3.5 present the data in tabular form.

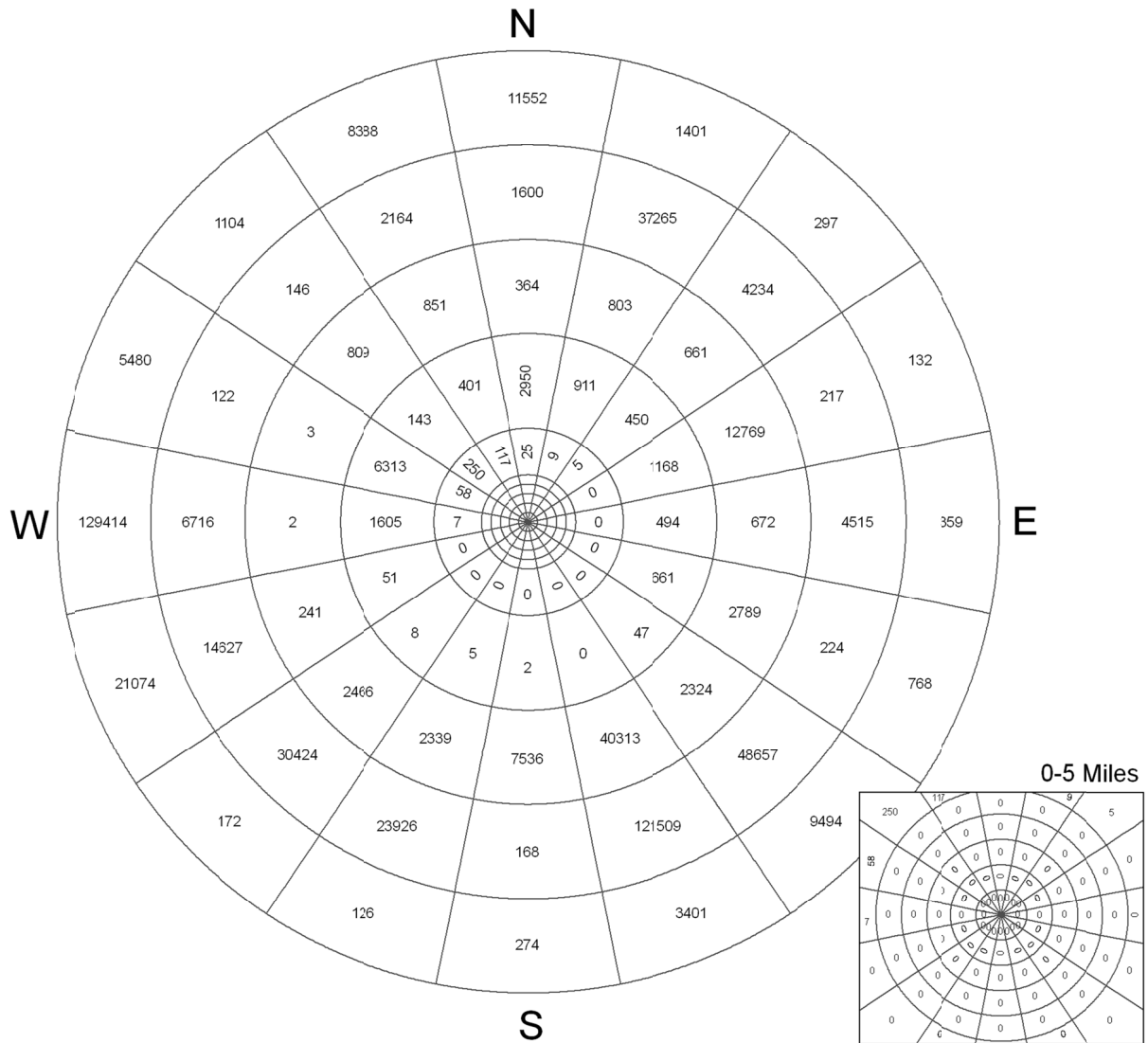


Figure 3.1. 100K 50-mile Population

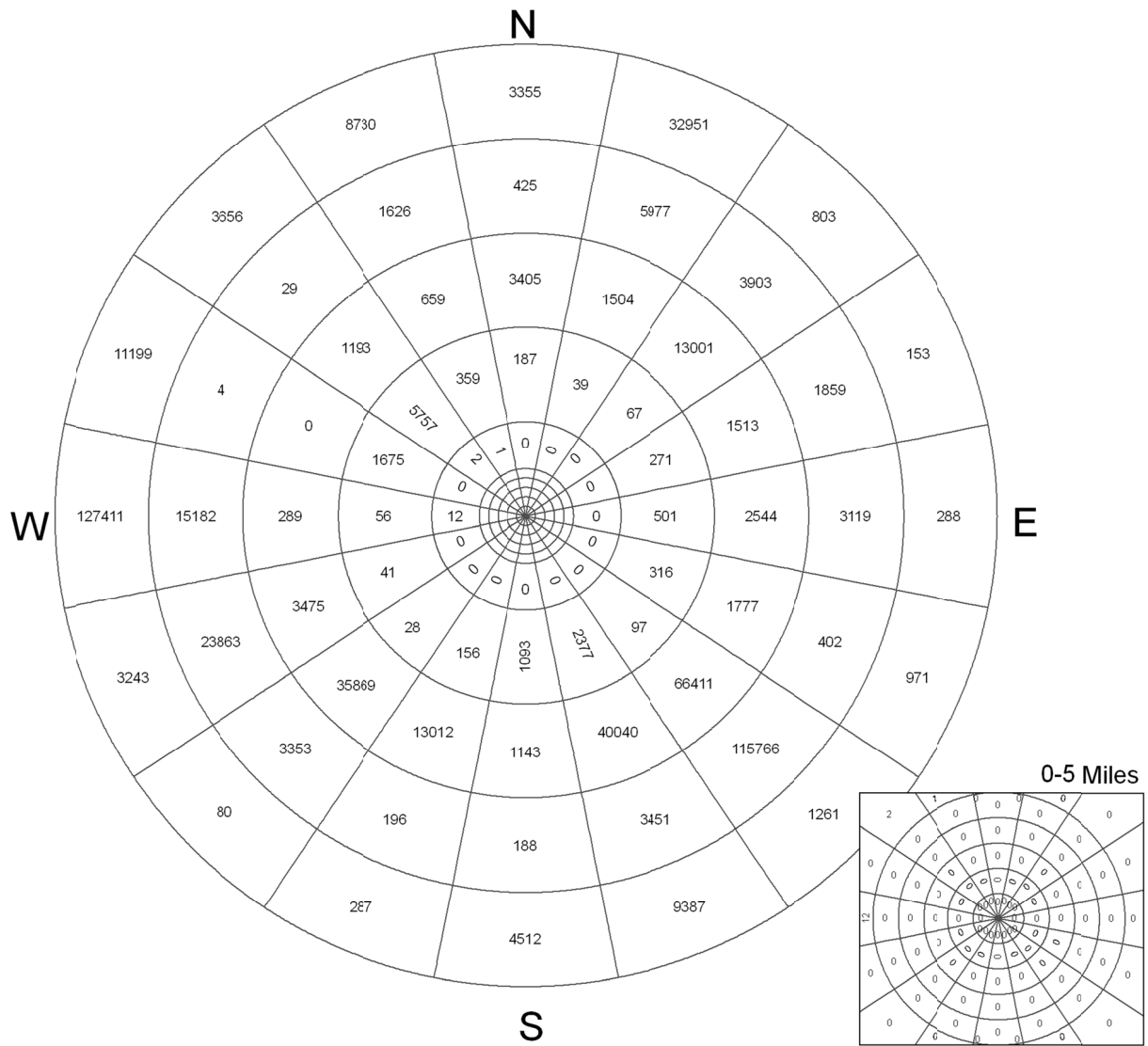


Figure 3.2. 200 HMS 50-mile Population

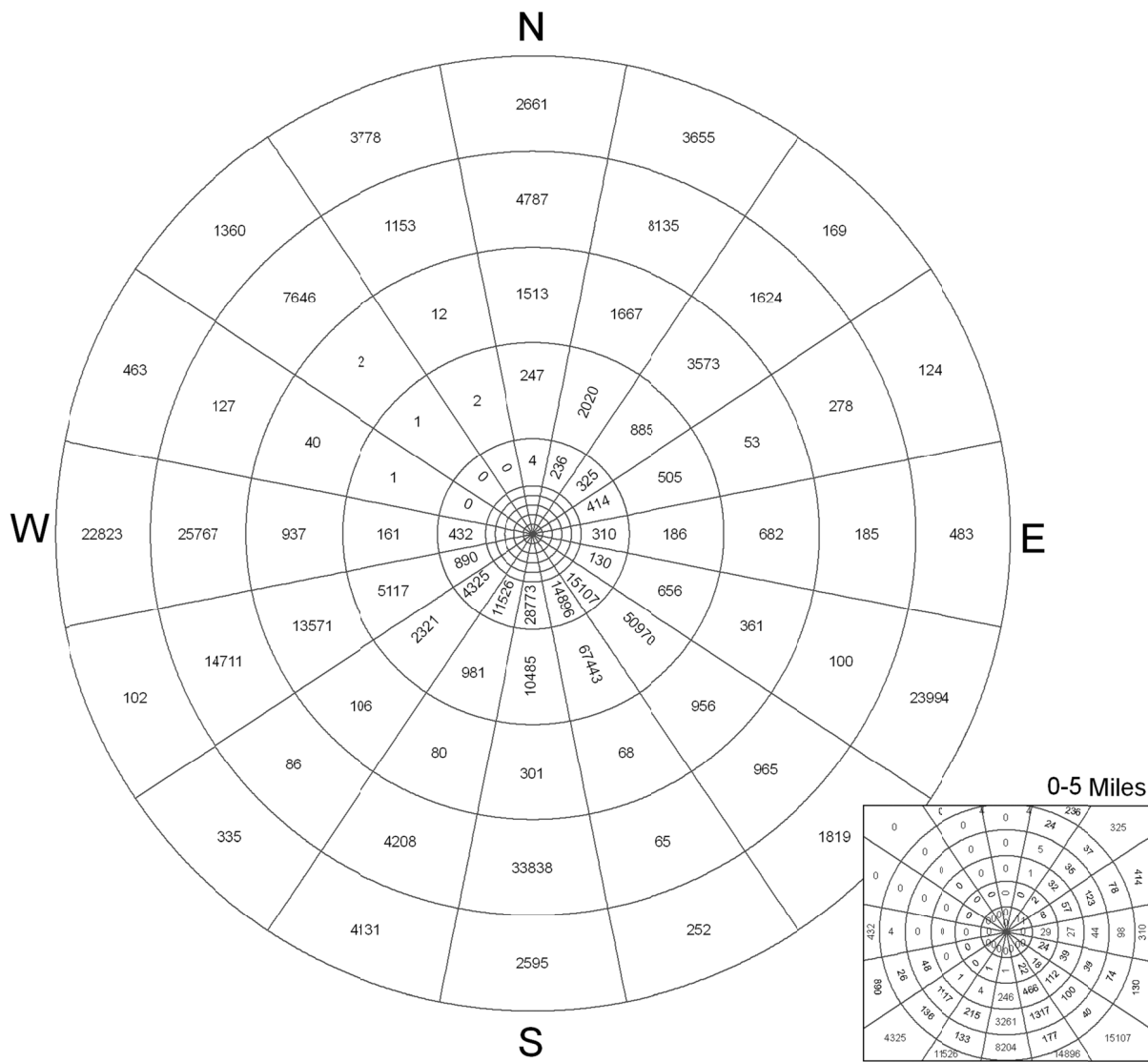


Figure 3.3. 300 Area 50-mile Population

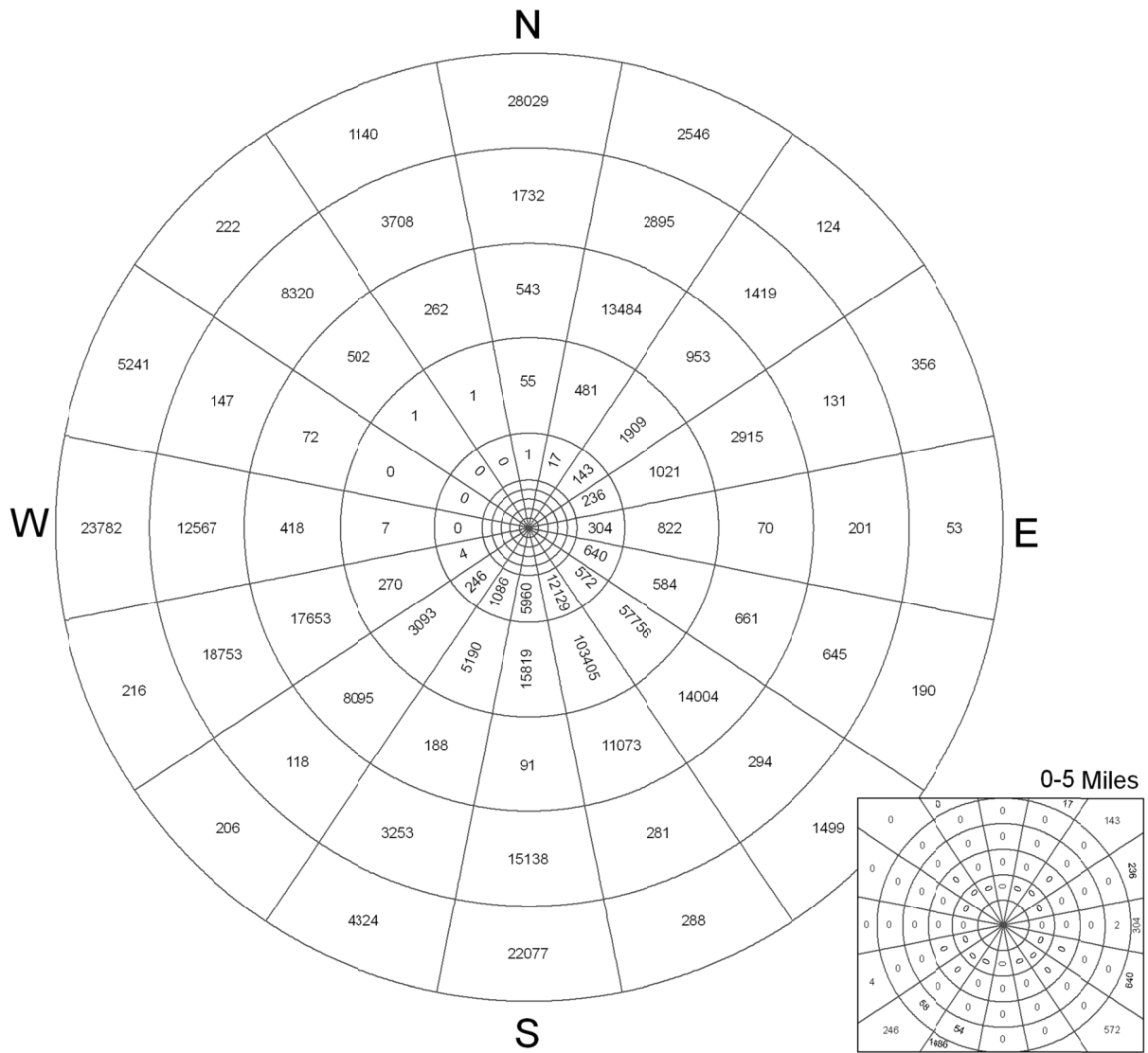


Figure 3.4. 400 Area 50-mile Population

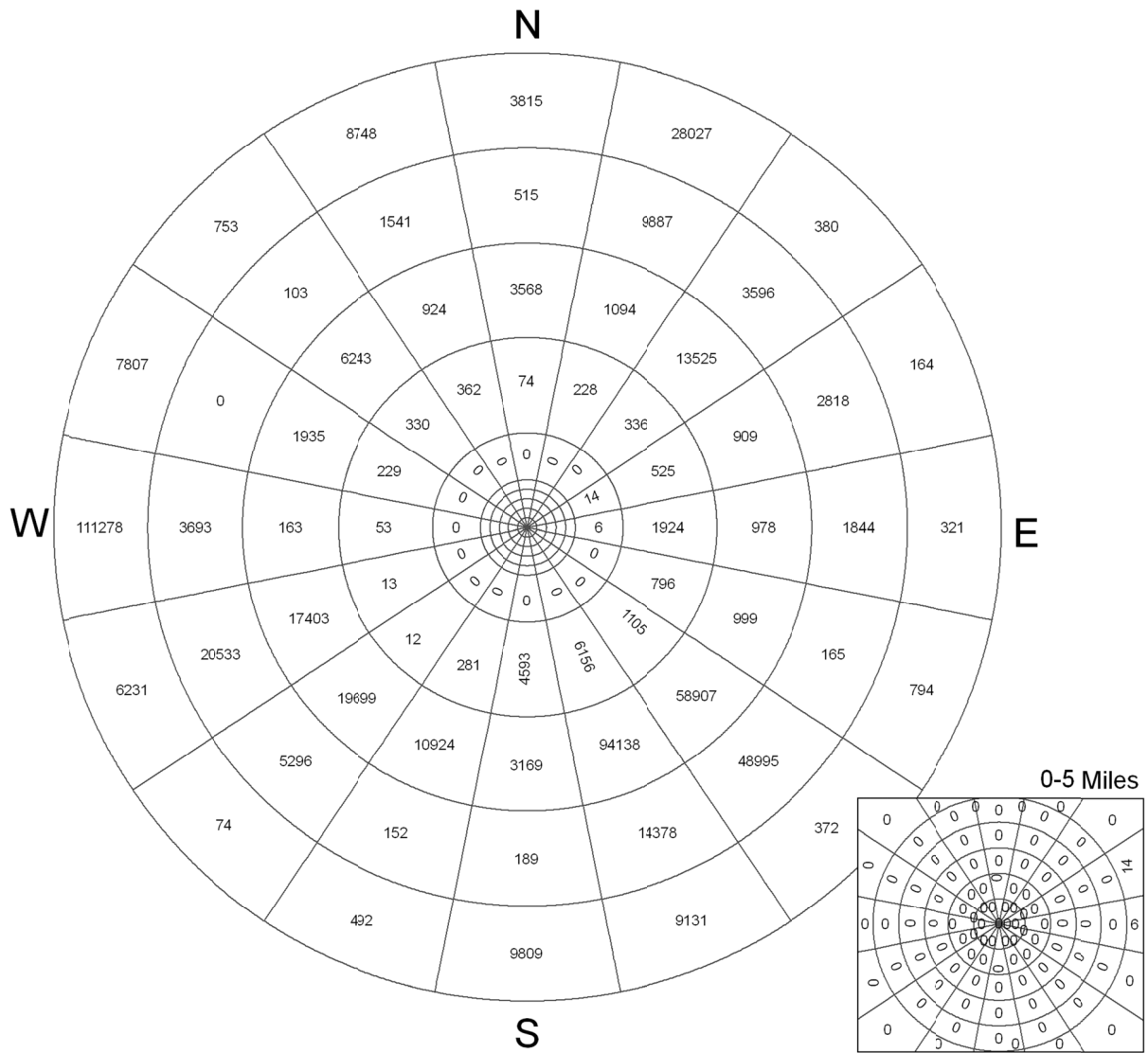


Figure 3.5. WTP 50-mile Population

Table 3.1. 100K 50-mile Population

Distance (mi)	Direction																Total
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	25	9	5	0	0	0	0	0	0	0	0	0	7	58	250	117	471
10-20	2950	911	450	1168	494	661	47	0	2	5	8	51	1605	6313	143	401	15209
20-30	364	803	661	12769	672	2789	2324	40313	7536	2339	2466	241	2	3	809	851	74942
30-40	1600	37265	4234	217	4515	224	48657	121509	168	23926	30424	14627	6716	122	146	2164	296514
40-50	11552	1401	297	132	359	768	9494	3401	274	126	172	21074	129414	5480	1104	8388	193436
Total	16491	40389	5647	14286	6040	4442	60522	165223	7980	26396	33070	35993	137744	11976	2452	11921	580572

Table 3.2. 200 HMS 50-mile Population

Distance (mi)	Direction																Total
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	12	0	2	1	15
10-20	187	39	67	271	501	316	97	2377	1093	156	28	41	56	1675	5757	359	13020
20-30	3405	1504	13001	1513	2544	1777	66411	40040	1143	13012	35869	3475	289	0	1193	659	185835
30-40	425	5977	3903	1859	3119	402	115766	3451	188	196	3353	23863	15182	4	29	1626	179343
40-50	3355	32951	803	153	288	971	1261	9387	4512	287	80	3243	127411	11199	3656	8730	208287
Total	7372	40471	17774	3796	6452	3466	183535	55255	6936	13651	39330	30622	142950	12878	10637	11375	586500

Table 3.3. 300 Area 50-mile Population

Distance (mi)	Direction																Total
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
1-2	0	0	2	8	29	24	18	22	1	1	0	0	0	0	0	0	105
2-3	0	1	32	57	27	39	112	466	246	4	1	0	0	0	0	0	985
3-4	0	5	35	123	44	39	100	1317	3261	215	1117	48	0	0	0	0	6304
4-5	0	24	37	78	98	74	40	177	8204	133	136	26	4	0	0	0	9031
5-10	4	236	325	414	310	130	15107	14896	28773	11526	4325	890	432	0	0	0	77368
10-20	247	2020	885	505	186	656	50970	67443	10485	981	2321	5117	161	1	1	2	141981
20-30	1513	1667	3573	53	682	361	956	68	301	80	106	13571	937	40	2	12	23922
30-40	4787	8135	1624	278	185	100	965	65	33838	4208	86	14711	25767	127	7646	1153	103675
40-50	2661	3655	169	124	483	23994	1819	252	2595	4131	335	102	22823	463	1360	3778	68744
Total	9212	15743	6683	1641	2044	25417	70087	84706	87704	21279	8427	34465	50124	631	9009	4945	432117

Table 3.4. 400 Area 50-mile Population

Distance (mi)	Direction																Total
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-5	0	0	0	0	2	0	0	0	0	54	58	0	0	0	0	0	114
5-10	1	17	143	236	304	640	572	12129	5960	1086	246	4	0	0	0	0	21338
10-20	55	481	1909	1021	822	584	57756	103405	15819	5190	3093	270	7	0	1	1	190414
20-30	543	13484	953	2915	70	661	14004	11073	91	188	8095	17653	418	72	502	262	70984
30-40	1732	2895	1419	131	201	645	294	281	15138	3253	118	18753	12567	147	8320	3708	69602
40-50	28029	2546	124	356	53	190	1499	288	22077	4324	206	216	23782	5241	222	1140	90293
Total	30360	19423	4548	4659	1452	2720	74125	127176	59085	14095	11816	36896	36774	5460	9045	5111	442745

Table 3.5. WTP 50-mile Population

Distance (mi)	Direction																Total
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	14	6	0	0	0	0	0	0	0	0	0	0	0	20
10-20	74	228	336	525	1924	796	1105	6156	4593	281	12	13	53	229	330	362	17017
20-30	3568	1094	13525	909	978	999	58907	94138	3169	10924	19699	17403	163	1935	6243	924	234578
30-40	515	9887	3596	2818	1844	165	48995	14378	189	152	5296	20533	3693	0	103	1541	113705
40-50	3815	28027	380	164	321	794	372	9131	9809	492	74	6231	111278	7807	753	8748	188196
Total	7972	39236	17837	4430	5073	2754	109379	123803	17760	11849	25081	44180	115187	9971	7429	11575	553516

4.0 Notes on Data Use

The data presented in this report strictly follow the evaluation procedure described, and no additional verification has been performed. The process of averaging populations over the census block area may indicate the presence of a residential individual where none exists, or no individuals where one does exist. In addition, census data may not be complete for some census blocks due to collection issues within the U.S. Census. These are important factors to consider, especially for dose calculations at distances in closer proximity to an emission source.

5.0 Multi-year Population Summary

The 50-mile populations have been evaluated from 1990 (Beck et al. 1991), 2000 (Elliott et al. 2004), and the current 2010 U.S. Census data. Table 5.1 summarizes these total population data for the operational areas evaluated. The operational areas evaluated changed over time to reflect the locations of major radiological activities. As indicated in the table, the population change continues an upward trend and has remained rather stable (about 20-30%) over each decade. Year 2010 was the first census year that a 50-mile population of the Hanford Site exceeded the half-million mark for any operational area centroid location.

Table 5.1. 50-mile Populations – 1990, 2000, and 2010 Census^a

Centroid	1990 Census	2000 Census	2010 Census	Year 1990 to 2000 Change		Year 2000 to 2010 Change
100F	303,022	382,206	N/A	26%	increase	N/A
100K	N/A	481,857	580,572	N/A		20% increase
100N	375,249	N/A	N/A	N/A		N/A
200HMS	375,860	486,294	586,500	29%	increase	21% increase
200W (PFP)	381,936	N/A	N/A	N/A		N/A
300 Area	281,586	349,067	432,117	24%	increase	24% increase
400 Area	283,228	353,712	442,745	25%	increase	25% increase
WTP	N/A	N/A	553,516	N/A		N/A

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