PNL-7434
UC-000

17

The Hanford Site New Production Reactor (NPR) Economic and Demographic Baseline Forecasts

C. Cluett
D. C. Clark
D. B. Pittenger

August 1990

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

PNL-7434

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE MEMORIAL INSTITUTE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831;
prices available from (615) 576-8401. FTS 626-8401.

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

NTIS Price Codes, Microfiche A01

Printed Copy

Price Code	Page Range	Price Code	Page Range
A02	1- 10	A15	326-350
A03	11- 50	A16	351-375
A04	51- 75	A17	376-400
A05	76-100	A18	401-425
A06	101-125	A19	426-450
A07	126-150	A20	451-475
A08	151-175	A21	476-500
A09	176-200	A22	501-525
A10	201-225	A23	526-550
A11	226-250	A24	551-575
A12	251-275	A25	576-600
A13	276-300	A99	601-Up
A14	301-325		

3 3679 00054 9875

PNL-7434
UC-000

The Hanford Site New Production Reactor (NPR) Economic and Demographic Baseline Forecasts

Christopher Cluett[a]
David C. Clark[a]
Donald B. Pittenger[b]

August 1990

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

(a) Battelle Human Affairs Research Centers
(b) The Demographics Laboratory

Executive Summary

The objective of this study is to present baseline employment and population forecasts for Benton, Franklin, and Yakima Counties. These forecasts will be used in the socioeconomic analysis portion of the New Production Reactor Environmental Impact Statement. Aggregate population figures for the three counties in the study area were developed for high- and low-growth scenarios for the study period 1990 through 2040. Age-sex distributions for the three counties during the study period are also presented.

The high and low scenarios were developed using high and low employment projections for the Hanford site. Hanford site employment figures were used as input for the HARC-REMI Economic and Demographic (HED) model to produce baseline employment forecasts for the three counties. These results, in turn, provided input to an integrated three-county demographic model.

This model, a fairly standard cohort-component model, formalizes the relationship between employment and migration by using migration to equilibrate differences in labor supply and demand.

In the resulting population estimates, age-sex distributions for 1981 show the relatively large work force age groups in Benton County while Yakima County reflects higher proportions of the population in the retirement ages. The 2040 forecasts for all three counties reflect the age effects of relatively constant and low fertility and increased longevity, as well as the cumulative effects of the migration assumptions in the model. By 2040 the baby boom population will be 75 years and older, contributing to the higher proportion of population in the upper end age group. The low scenario age composition effects are similar.

Acknowledgments

Several persons provided significant assistance in the preparation of this baseline report. Carlyn Orians and Lynn Miranda of Battelle HARC prepared the study area map. Paul Klarin provided research assistance to the project and helped prepare several data tables. Sarah Marsh and Mike Scott of Battelle PNL and Ed Liebow of Battelle HARC provided review comments, and Susan Stream and Terri Koval provided editorial and secretarial support.

Table of Contents

Page

1.0 INTRODUCTION 1

2.0 EMPLOYMENT FORECASTS 3

2.1 Baseline Forecasts 3

2.2 Commuting Patterns 10

3.0 POPULATION FORECASTS 16

3.1 Linkage of Economic to Demographic Forecasts 16

3.2 Labor Force Participation Rates 17

3.3 Migration Rates 18

3.4 Fertility Rates 19

3.5 Mortality Rates 19

3.6 Baseline Population Size and Composition Forecasts 19

4.0 REFERENCES 23

5.0 APPENDICES

List of Tables

Page

Table 1 Employment Assumptions for the Low Employment Scenario 6

Table 2 Hanford Employment Forecasts Consistent with HED Model Default Forecasts 8

Table 3 County Baseline Employment 11

Table 4 1980 Commuting Patterns 13

Table 5 Percentage of Jobs Held by Residents 15

Table 6 1987 Commuting Matrix 16

Table 7 Unemployment Rates by County and Year 17

Table 8 Model USA Labor Force Participation Rates 18

Table 9 County Population Totals 21

List of Figures

Figure 1 1980 Population Density by Census Tracts Yakima, Benton and Franklin Counties, WA 2

Figure 2 Sector Employment Comparison with Hanford Site Employment Scenarios: 1969-1995 4

Figure 3 Historical and Projected Total Employment for Yakima, Benton and Franklin Counties (High and and Low Scenarios): 1969-2040 12

Figure 4 Residence Adjustments as a Percentage of Total Place-of-Work Earnings: Benton, Franklin, and Yakima Counties: 1969-1987 14

Figure 5 Projected Baseline High and Low Population Scenarios for Yakima, Benton and Franklin Counties: 1981-2040 22

1.0 INTRODUCTION

This report presents baseline employment and population forecasts for Benton, Franklin and Yakima Counties in Eastern Washington State. These counties account for most of the resident population lying within a fifty mile radius of a proposed New Production Reactor (NPR) facility on the Hanford Site. Figure 1 depicts the study area, the proposed NPR site and the areas in which the current population is predominantly settled. This baseline report presents current and projected future economic and demographic conditions in the vicinity of this proposed NPR site. It provides alternative baseline scenarios for the study area in the absence of the NPR facility.

For the purposes of this baseline study, aggregate population figures are developed for the three counties in the study area. However, as the map shown in Figure 1 indicates, population is not at all uniformly distributed within this three county study area.[1] In addition portions of several other counties that fall within a fifty-mile radius of the proposed NPR site are not included in the study area. Topography, land use, and highway networks in this region dramatically have influenced population settlement patterns. Although the population density reflected in Figure 1 is based on the 1980 U.S. Census, this general distributional pattern is expected to persist for many years to come. Analysis of sub-county distributional patterns will be important for a complete understanding of the dose effects of potential releases from the proposed NPR site. Population characteristics also vary at the sub-county level. For example, portions of two Indian reservations fall within the 50-mile radius.

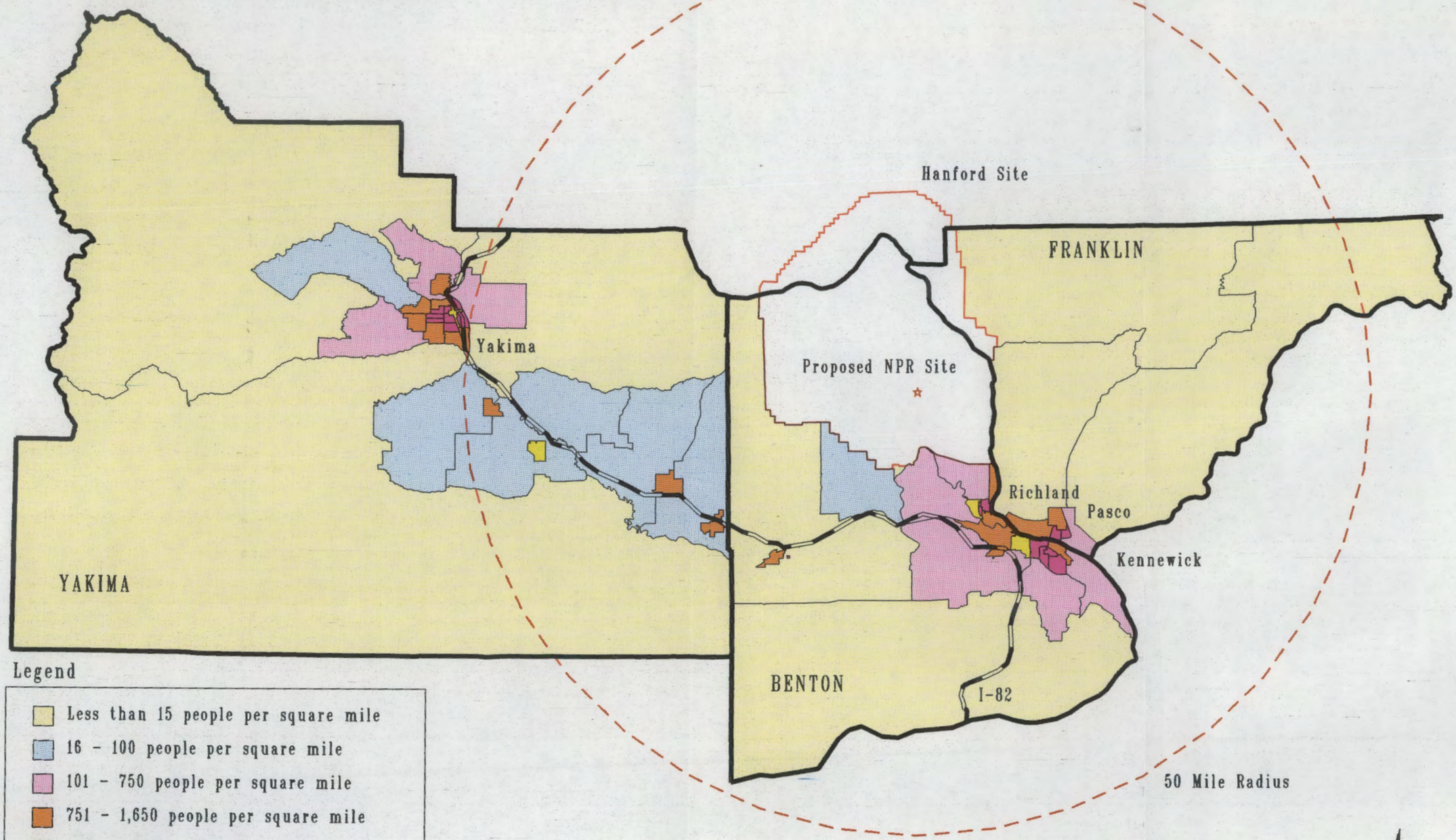
Two economic-demographic modeling systems were utilized to develop the employment forecasts and subsequently the demographic forecasts. This report discusses the models, methods and data that were used in this baseline study. Particular attention is paid to the key assumptions that were used in generating the forecasts. The first section of the report focuses on the economic and employment analysis, including labor force participation and commuting patterns in this region, and the second section focuses on the demographic analysis, including the population components of fertility, mortality and migration. The results are presented in tabular and graphic form, and the detailed demographic results of the baseline forecasts are included in an appendix.

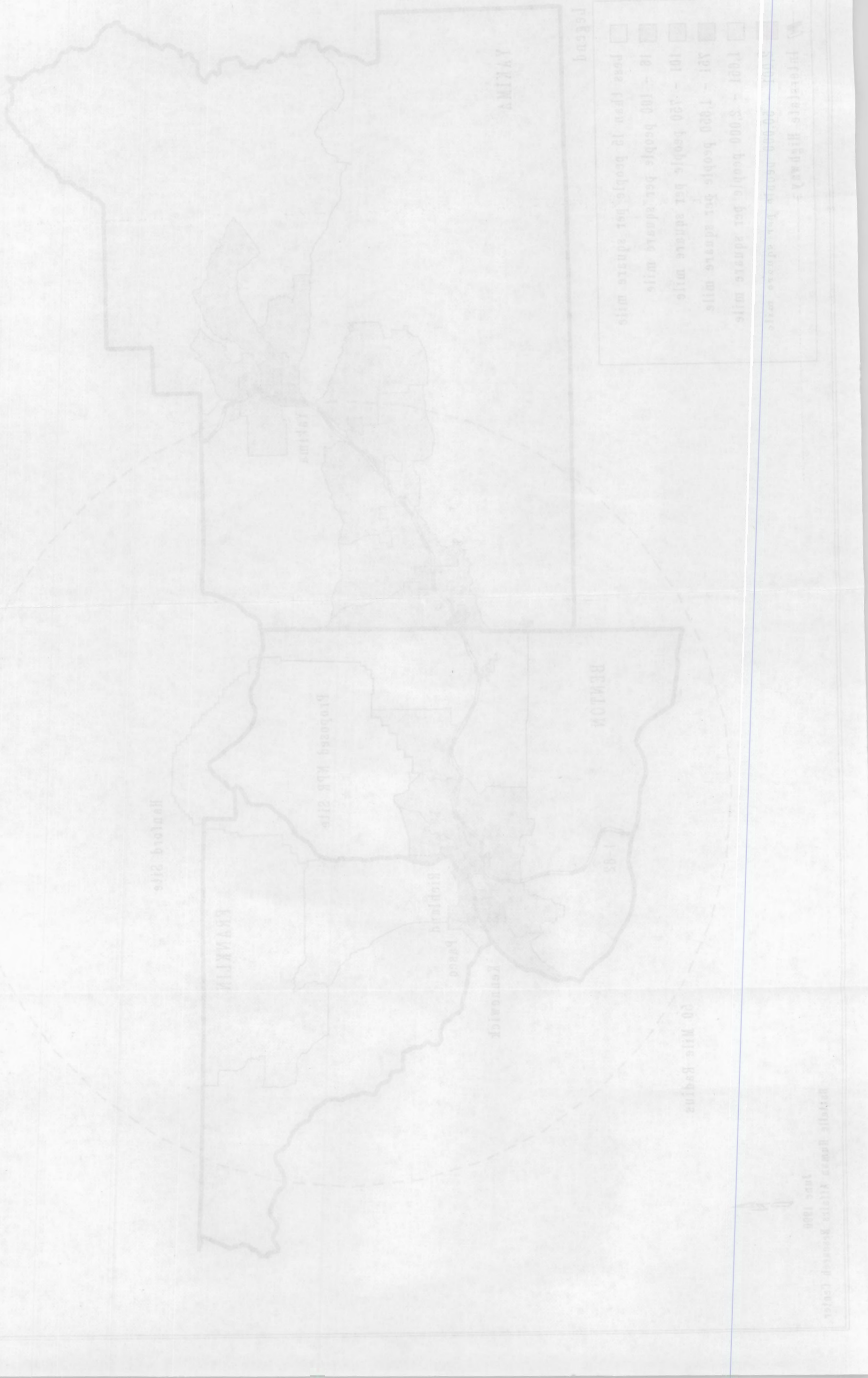
The baseline population forecasts were generated using an integrated economic-demographic model. The concept underlying the model is that population changes are closely linked with economic trends. If employment in an area grows faster than its labor force, people will migrate to that area to fill the excess jobs. The HARC-REMI Economic and Demographic (HED) model was used in the generation of baseline employment forecasts, which in turn were inputs to an integrated three-county demographic model.

---

[1] Figure 1 was created on Battelle HARC's ArcInfo Geographic Information System (GIS), utilizing the U.S. Bureau of the Census's TIGER file system and 1980 population data based on Census tracts.

Figure 1. 1980 Population Density by Census Tracts
Yakima, Benton and Franklin Counties, WA.





Traditional demographic practice typically does not formalize the relation between migration, which strongly influences an area's population, and employment. While it is widely recognized that migration is driven largely by employment opportunity, many demographic models require that the user stipulate migration but do not formally quantify the relationship between migration and employment. Using a model designed for this study, employment forecasts are compared to the labor supply in the study area, and migration is used to equilibrate differences in labor supply and demand.

There are several uncertainties in forecasting over such a long time horizon, including future employment, vital rates (births and deaths), labor force participation rates (used to estimate labor force from age and sex structures), the age and sex structure of migrating populations, and commuting patterns. How each of these elements is addressed in this study is discussed below.

2.0 EMPLOYMENT FORECASTS

2.1 Baseline Forecasts

Two baseline (without the NPR) employment forecasts were generated for the study area. The reason for two forecasts is that there is a high level of uncertainty over future employment levels at Hanford.

The high and low forecasts were produced based on employment projections for Hanford provided by the Westinghouse Hanford Company (WHC)[2]. However, since these forecasts only covered the period 1989-1995 (while the HED model forecasts to 2035), and did not include specific details by mission or by Standard Industrial Classification (SIC), the standard classification system used in employment research and in the HED model, a number of assumptions had to be developed to produce high and low forecasts. The procedures used to develop these forecasts are described below.

Employment forecasts were generated for Benton, Franklin, and Yakima counties using the HED model. The model produces detailed economic forecasts for the State of Washington, and for the combined Benton-Franklin County area, through the year 2035. The procedure for generating Yakima forecasts is discussed later. However, before the projections could be made, it was necessary to alter the HED model baseline forecasts to reflect the fact that the projected Hanford employment levels would represent a departure from historical trends. This adjustment was necessary because the forecasts of models with econometric components like HED assume that historical trends, in general, will continue into the future. In the case of Hanford employment, DOE forecasts do not call for a continuation of past trends, as is shown in Figure 2. Most Hanford employment has historically been classified as Miscellaneous Business Services or Chemicals Manufacturing, and until 1977, Hanford employment closely followed the combined employment in these two sectors.

[2]Memo from Larry Hafer to Sarah Marsh, Battelle PNL, November 10, 1989.

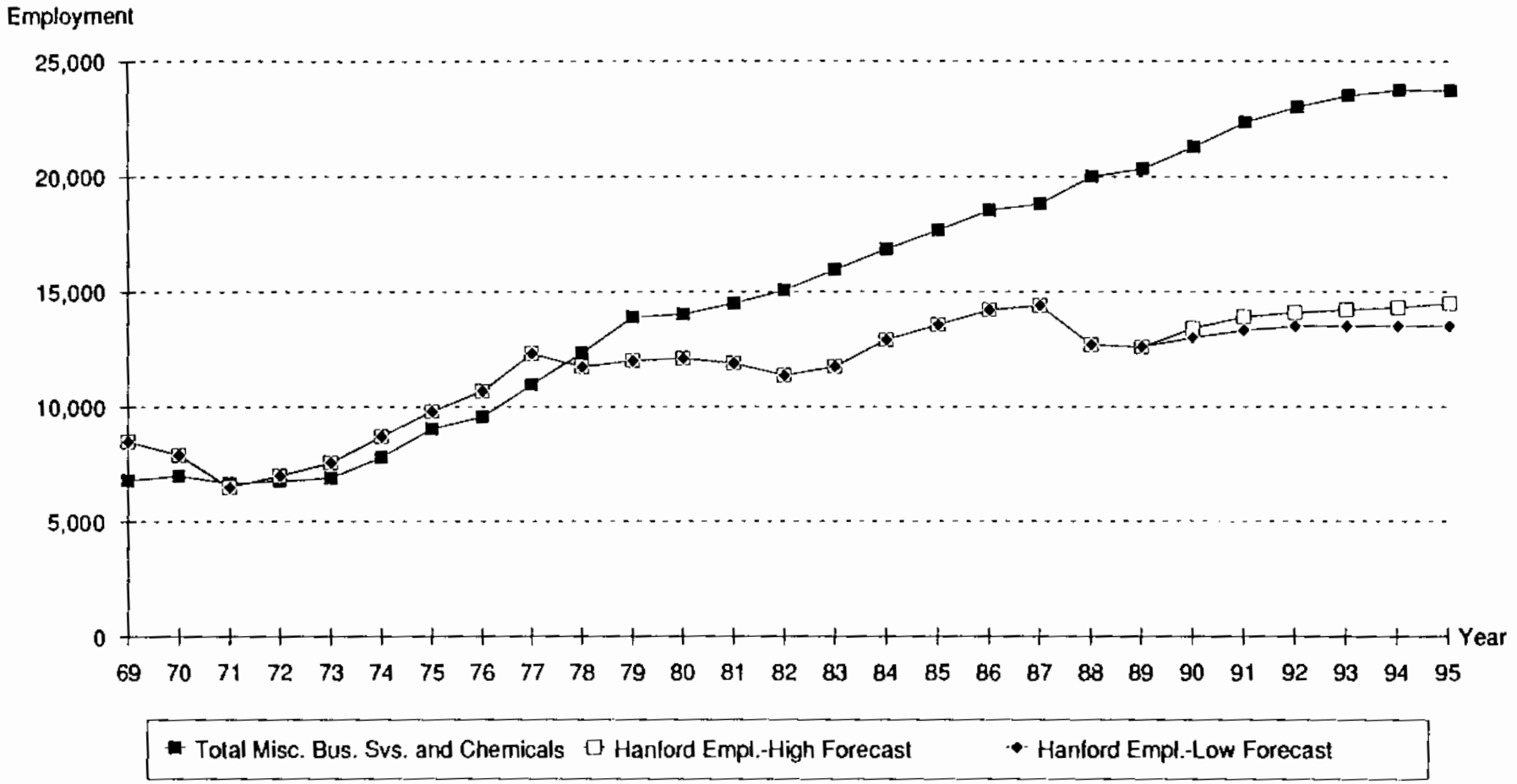


Figure 2. Sector Employment Comparison With Hanford Site Employment Scenarios: 1969-1995

After 1977, the Tri-Cities economy, particularly Business Services, experienced significant non-Hanford employment growth, but Hanford employment grew as well. After 1987 (the projection period for the HED model), however, Hanford employment fell, while the "default" HED projections, which assume continuation of past trends, show a continued increase in the Chemicals and Business Services sectors combined, and thus, in effect, assume a continuation of employment growth at Hanford. Since such growth is not expected, it was necessary to develop a way to adjust the HED forecasts to reflect the expected changes in Hanford employment.

First, however, it was necessary to use the 1989-1995 forecasts of Hanford employment provided by WHC to develop high and low scenarios out to the year 2035. In the case of the high forecast, it was assumed that the projected 1995 level of 14,500 represented not only near the historical maximum, but a reasonable high-side assumption. Although there are currently no Congressional initiatives that offer solid evidence that such a high level of employment is likely to persist, historically new missions have been instituted to replace older ones. It was assumed that about half the employment can be characterized as Miscellaneous Business Services, and half as Chemicals Manufacturing.

The low scenario was somewhat more difficult to construct, since it required assumptions regarding each of the missions currently in effect at the site. The general assumptions were a one percent annual increase in PNL's non-waste research efforts; a phase-out of nuclear energy and nuclear materials missions by the year 2000; and a rise in waste management employment to about 5,600, then a decline to zero over the years 2010 to 2020. The forecasts produced by these assumptions are tabulated in Table 1.

The next step was to estimate the level of Hanford employment implied by the default HED forecasts, so that this level could be adjusted according to the high and low Hanford employment forecasts. Since the HED model operates at the two-digit Standard Industrial Classification (SIC) level of detail, the implied level of Hanford employment had to be estimated at this level of disaggregation. This procedure assumed that the 1989 Hanford employment was evenly split between Chemicals and Miscellaneous Business Services, and that total Hanford employment would grow at the same rate as the rate projected for them by the HED model, adjusted by projecting the regressed share of total Hanford employment to Chemicals plus Miscellaneous Business Services employment over the 1980s (Hanford employment represented a declining proportion of total Chemicals and Miscellaneous Business Services over this period). Hanford Chemicals employment was assumed to follow the default HED projection for Chemicals Manufacturing, and Miscellaneous Business Services were estimated as the residual between total employment and Chemicals employment. The resulting implied Hanford projections are shown in Table 2.

Table 1. Employment Assumptions for the Low Employment Scenario

Year	Total	PNL/Other	Nuclear Energy	Waste	Nuclear Materials
1969	8,500				
1970	7,900				
1971	6,500				
1972	7,000				
1973	7,570				
1974	8,700				
1975	9,800				
1976	10,680				
1977	12,300				
1978	11,750				
1979	12,000				
1980	12,100				
1981	11,880				
1982	11,357				
1983	11,740				
1984	12,891				
1985	13,570				
1986	14,200				
1987	14,400				
1988	12,700				
1989	12,600	2,900	1,500	3,600	4,600
1990	13,000	2,929	1,500	3,933	4,638
1991	13,300	2,958	1,540	4,267	4,535
1992	13,500	2,988	1,580	4,600	4,332
1993	13,500	3,018	1,620	4,933	3,929
1994	13,500	3,048	1,660	5,267	3,525
1995	13,500	3,078	1,700	5,600	3,122
1996	12,551	3,094	1,360	5,600	2,497
1997	11,602	3,109	1,020	5,600	1,873
1998	10,653	3,125	680	5,600	1,249
1999	9,705	3,140	340	5,600	624
2000	8,756	3,156	0	5,600	0
2001	8,772	3,172	0	5,600	0
2002	8,788	3,188	0	5,600	0
2003	8,804	3,204	0	5,600	0
2004	8,820	3,220	0	5,600	0
2005	8,836	3,236	0	5,600	0
2006	8,852	3,252	0	5,600	0
2007	8,868	3,268	0	5,600	0
2008	8,885	3,285	0	5,600	0
2009	8,901	3,301	0	5,600	0
2010	8,918	3,318	0	5,600	0

Table 1. Employment Assumptions for the Low Employment Scenario (Cont.)

Year	Total	PNL/Other	Nuclear Energy	Waste	Nuclear Materials
2011	8,374	3,334	0	5,040	0
2012	7,831	3,351	0	4,480	0
2013	7,288	3,368	0	3,920	0
2014	6,744	3,384	0	3,360	0
2015	6,201	3,401	0	2,800	0
2016	5,658	3,418	0	2,240	0
2017	5,115	3,435	0	1,680	0
2018	4,573	3,453	0	1,120	0
2019	4,030	3,470	0	560	0
2020	3,487	3,487	0	0	0
2021	3,505	3,505	0	0	0
2022	3,522	3,522	0	0	0
2023	3,540	3,540	0	0	0
2024	3,557	3,557	0	0	0
2025	3,575	3,575	0	0	0
2026	3,593	3,593	0	0	0
2027	3,611	3,611	0	0	0
2028	3,629	3,629	0	0	0
2029	3,647	3,647	0	0	0
2030	3,666	3,666	0	0	0
2031	3,684	3,684	0	0	0
2032	3,702	3,702	0	0	0
2033	3,721	3,721	0	0	0
2034	3,739	3,739	0	0	0
2035	3,758	3,758	0	0	0

Having estimated the implied level of Hanford employment, and established the high and low Hanford employment assumptions, the HED forecasts could readily be adjusted to produce consistency between the model forecasts and the high and low scenarios.

Since this study required individual county forecasts, additional analyses were undertaken to allocate HED's state and Benton-Franklin County employment forecasts to each of the three study area counties and extrapolate them to the year 2040. Historical employment data from the U.S. Bureau of Economic Analysis (BEA) are available for the years 1969-1987. These data include employment by major industry at the county level. The method used to develop forecasts for Benton and Franklin counties differed slightly from that used for Yakima County, but in both cases the historical BEA data and the HED model forecasts comprised the basic information used.

Table 2. Hanford Employment Forecasts Consistent with HED Model Default Forecasts

Year	Total	Chemicals	Misc. Business
1969	8,500		
1970	7,900		
1971	6,500		
1972	7,000		
1973	7,570		
1974	8,700		
1975	9,800		
1976	10,680		
1977	12,300		
1978	11,750		
1979	12,000		
1980	12,100		
1981	11,880		
1982	11,357		
1983	11,740		
1984	12,891		
1985	13,570		
1986	14,200		
1987	14,400		
1988	12,700		
1989	12,664	6,332	6,332
1990	13,259	6,748	6,511
1991	13,937	7,193	6,744
1992	14,346	7,633	6,713
1993	14,635	8,009	6,626
1994	14,739	8,425	6,314
1995	14,693	8,642	6,051
1996	14,633	8,484	6,149
1997	14,792	8,853	5,939
1998	14,894	9,067	5,826
1999	15,118	9,388	5,730
2000	15,462	9,311	6,152
2001	15,657	9,328	6,330
2002	15,864	9,335	6,529
2003	16,068	9,334	6,734
2004	16,273	9,326	6,947
2005	16,484	9,314	7,170
2006	16,594	9,219	7,374
2007	16,606	9,066	7,540
2008	16,602	8,903	7,699
2009	16,596	8,739	7,858
2010	16,593	8,575	8,018

Table 2. Hanford Employment Forecasts Consistent with HED Model Default Forecasts (Cont.)

Year	Total	Chemicals	Misc. Business
2011	16,639	8,436	8,203
2012	16,681	8,295	8,386
2013	16,718	8,150	8,567
2014	16,751	8,004	8,746
2015	16,778	7,857	8,921
2016	16,803	7,708	9,095
2017	16,825	7,559	9,266
2018	16,845	7,410	9,435
2019	16,864	7,262	9,602
2020	16,881	7,114	9,766
2021	16,943	6,986	9,957
2022	16,996	6,854	10,142
2023	17,040	6,719	10,321
2024	17,075	6,582	10,493
2025	17,089	6,438	10,651
2026	17,105	6,295	10,810
2027	17,117	6,152	10,965
2028	17,126	6,009	11,116
2029	17,129	5,866	11,263
2030	17,126	5,723	11,403
2031	17,115	5,580	11,535
2032	17,100	5,438	11,662
2033	17,081	5,297	11,785
2034	17,059	5,156	11,903
2035	17,034	5,017	12,017

For Benton and Franklin counties, historical shares of employment by industry represented by Benton County were calculated as a proportion of total two-county employment. In most cases, a trend in Benton County's share was evident during the 1969-1987 period. Regression analysis was used to quantify trends in Benton County's share of the total employment. The regression time frame used was adjusted for some industries if unusual periods appeared in the historical data. For some industries, extrapolation of the trend over the entire 50-year forecast period resulted in projected shares over 100 percent, or shares which for other reasons appeared unreasonable; in these cases, the typical treatment was to hold the county's projected share at the level forecasted for the year 2000, or at some judgmentally arrived at maximum or minimum level, for the remainder of the forecast period. These projected shares of total two-county employment were then applied to the HED model projections for the combined Benton-Franklin County area to derive separate employment forecasts for the two counties.

For example, Benton County comprised 86.72 percent of total two-county employment in manufacturing in 1987; regression analysis indicated that Benton County's share was increasing on average by 0.85 percent over the 1969-1987 period. Thus, the county's 1988 share was projected to be 87.57 percent (86.72% + 0.85%). With a HED model forecast of two-county manufacturing employment of 11,308 in 1988 under the high employment scenario, Benton County was predicted to have manufacturing employment of 9,902 (87.57% x 11,308).[3] However, extrapolating this regressed trend into the future quickly resulted in Benton County forecasts at over 100 percent of the two-county total. Therefore, the county's proportion was held constant at its 1991 level (90.12 percent) for the remainder of the projection period. The projected 2025-2035 trend in employment was then extrapolated linearly to the year 2040. All industry forecasts were summed to derive total employment projections for each year.

The procedure used for Yakima County was similar, but slightly different from that used for Benton and Franklin counties. The historical relationship between Yakima County employment and statewide employment was analyzed to derive year-to-year ratios of Yakima to statewide employment, for each industry, using BEA data. Regression analysis was used to derive the historical trend in those shares, and the trend was extrapolated to the year 2040. Yakima County employment forecasts were developed by applying those shares to the projected employment for Washington produced by the HED model. Both high and low scenario employment projections were developed for Yakima County because as Benton County employment changed under the high and low scenarios, so would employment in the rest of the state.

The resulting employment forecasts are shown in Table 3 and Figure 3.

2.2 Commuting Patterns

Commuting patterns are important in the projection model because it requires that employment projections be compared with labor force projections to produce "drivers" for migration. The employment forecasts discussed above are, like the data on which they are based, place-of-work estimates, but the labor force projections are on a place-of-residence basis. In order to compare the two, and thereby determine how much migration will be needed to create labor market equilibrium in each county, employment projections must be adjusted to a place-of-residence basis. This requires estimates of how many jobs in each county are held by residents of other counties.

[3]Washington State Employment Security Department (ESD) employment estimates for the combined Benton-Franklin County area show a 1987-1988 decline in total employment, caused primarily by a decline in Chemicals Manufacturing (ESD 1988 estimates are provisional). Thus, the procedure used for this report likely produced a 1988 "forecast" that is slightly on the high side. Further research should incorporate a method for using ESD estimates.

TABLE 3. COUNTY BASELINE EMPLOYMENT

COUNTY	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Benton Low	26,907	27,477	26,649	28,011	30,400	33,885	38,013	41,279	46,523	52,691	58,497
Franklin Low	12,001	12,743	13,194	13,336	13,958	14,560	15,528	16,868	16,713	17,840	18,480
Yakima Low	61,760	62,556	61,471	63,283	66,228	68,495	71,326	76,003	75,203	78,307	81,709
		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Benton High											54,903
Benton Low		58,925	63,473	59,157	56,281	53,469	54,409	55,326	56,333	54,484	55,505
Franklin High											17,836
Franklin Low		18,414	18,255	17,676	17,408	17,134	17,177	17,309	18,666	17,970	17,930
Yakima High											91,894
Yakima Low		82,024	81,068	80,022	82,080	83,745	84,284	85,971	90,127	91,689	91,937
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Benton High		56,603	58,345	59,629	60,521	61,254	61,965	63,613	64,279	65,335	66,239
Benton Low		56,734	58,210	59,446	60,130	60,651	61,035	61,272	60,568	60,282	59,895
Franklin High		18,027	18,183	18,422	18,557	18,621	18,661	18,941	18,956	19,068	19,148
Franklin Low		18,013	18,102	18,335	18,437	18,467	18,450	18,472	18,237	18,107	17,955
Yakima High		93,415	94,853	96,346	97,484	98,071	98,550	99,990	100,890	102,557	103,436
Yakima Low		93,394	94,845	96,341	97,490	98,091	98,588	100,105	101,079	102,821	103,771
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Benton High		66,865	67,507	68,282	69,102	69,974	70,904	71,746	72,361	72,941	73,510
Benton Low		59,237	60,061	61,040	62,035	63,042	64,066	64,943	65,544	66,075	66,565
Franklin High		19,150	19,320	19,525	19,742	19,973	20,220	20,439	20,602	20,756	20,910
Franklin Low		17,729	17,926	18,165	18,411	18,662	18,920	19,138	19,287	19,420	19,546
Yakima High		103,803	104,338	105,058	105,909	106,855	107,907	108,693	109,028	109,297	109,553
Yakima Low		103,396	103,937	104,667	105,527	106,480	107,537	108,323	108,656	108,922	109,173
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Benton High		74,073	74,753	75,399	76,017	76,613	77,171	77,717	78,245	78,751	79,240
Benton Low		67,032	66,872	66,664	66,444	66,214	65,959	65,699	65,425	65,134	64,828
Franklin High		21,064	21,250	21,429	21,604	21,772	21,932	22,089	22,241	22,388	22,531
Franklin Low		19,667	19,674	19,668	19,659	19,646	19,625	19,600	19,571	19,536	19,496
Yakima High		109,813	110,317	110,775	111,171	111,506	111,760	111,963	112,098	112,172	112,195
Yakima Low		109,426	109,889	110,305	110,659	110,954	111,169	111,335	111,432	111,469	111,455
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Benton High		79,714	80,305	80,857	81,372	81,855	82,274	82,689	83,087	83,479	83,853
Benton Low		64,507	65,052	65,554	65,989	66,359	66,638	66,891	67,105	67,299	67,463
Franklin High		22,671	22,843	23,006	23,160	23,307	23,438	23,570	23,697	23,823	23,945
Franklin Low		19,449	19,588	19,717	19,830	19,927	20,002	20,071	20,130	20,184	20,230
Yakima High		112,164	112,338	112,418	112,408	112,314	112,069	111,795	111,470	111,108	110,694
Yakima Low		111,389	111,560	111,637	111,623	111,523	111,272	110,991	110,658	110,286	109,864
		2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Benton High		84,212	84,558	84,932	85,333	85,756	86,195	86,611	87,032	87,457	87,888	88,324
Benton Low		67,604	67,722	67,864	68,027	68,205	68,393	68,585	68,780	68,979	69,180	69,385
Franklin High		24,064	24,179	24,307	24,442	24,582	24,726	24,866	25,013	25,162	25,314	25,470
Franklin Low		20,270	20,304	20,350	20,401	20,454	20,509	20,568	20,629	20,693	20,758	20,824
Yakima High		110,230	109,704	109,146	108,552	107,930	107,278	106,886	106,510	106,151	105,807	105,480
Yakima Low		109,390	108,855	108,288	107,686	107,055	106,395	105,995	105,611	105,244	104,892	104,557

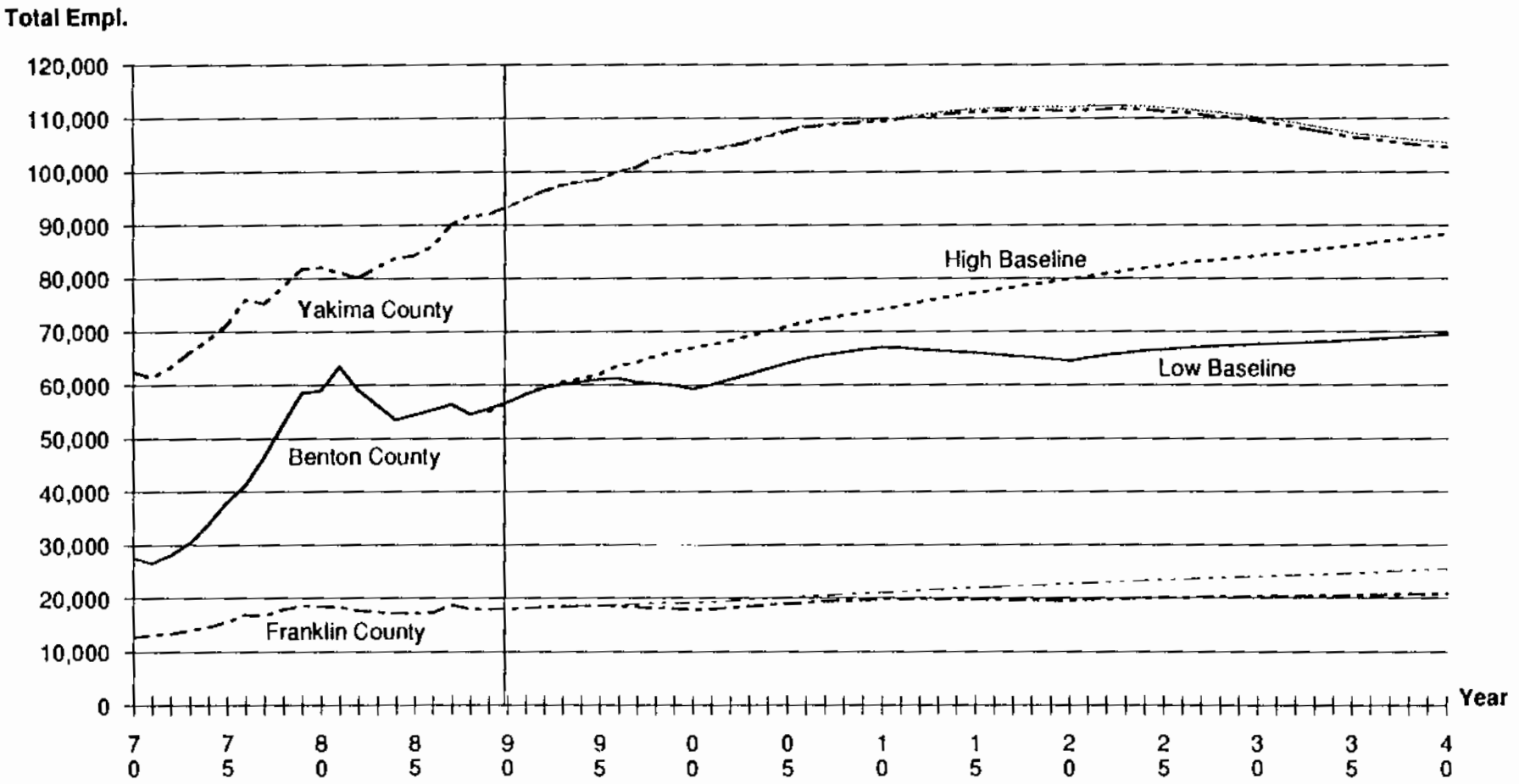


Figure 3. Historical and Projected Total Employment for Yakima, Benton and Franklin Counties (High and Low Scenarios): 1969-2040

Little is known about commuting patterns in the study area. The 1980 U.S. Census contains information on this subject, but changes in area employment and transportation improvements since that time have rendered those data obsolete. The 1980 Census data are shown in Table 4.

Table 4. 1980 Commuting Patterns*

	Reside in:			
Work at:	Benton	Franklin	Yakima	Other
Benton	83.11%	7.19%	6.02%	3.68%
Franklin	31.96	58.68	0.76	8.60
Yakima	0.96	0.00	97.00	2.04

*Source: U.S. Bureau of the Census

Two data sources can provide a basis for educated guesses about net commuting flows between the three study area counties: Survey data for the Hanford work force, and BEA income data, which include "residence adjustments" used to convert place-of-work earnings data to a place-of-residence basis.

Survey data indicate that as of November 1, 1986, approximately 7.5 percent of the $505.5 million in wages and salaries paid to Hanford employees went to jobholders in Franklin County, 84.6 percent to people living in Benton County, 6.1 percent to people residing in Yakima County, and 1.8 percent to people who lived elsewhere (Scott, et. al., 1987). On the basis of number of jobs, rather than income, of the 14,652 jobs at the Hanford Site, 84.7 percent were held by Benton County residents, 7.5 percent by Franklin County residents, 6.3 percent in Yakima County, and 1.7 percent by people living elsewhere. Although non-Hanford workers in Benton County may not have the same residence patterns as Hanford workers, Hanford employment represented about 26 percent of total Benton County employment in 1986, and on an income basis, 39 percent of total earnings in Benton County.

The BEA income data (U.S. Department of Commerce, 1989) also contain some information useful to the conversion of place-of-work employment to place-of-residence employment. Figure 4 shows the time trend for Benton, Franklin, and Yakima counties in terms of percentage of the residence adjustments out of total place-of-work earnings. If the residence adjustment for a county is negative, it means that more income was earned in that county by residents of other counties than the income earned in other counties by residents of that county. Typically, the residence adjustment is a function of commuting patterns, and a negative adjustment means that on average more people commute into that county than out of it.

Benton County had a generally positive residence adjustment in the early 1970s, but it turned negative once significant construction activity began to occur at the WPPSS nuclear plants. The negative adjustments indicate that

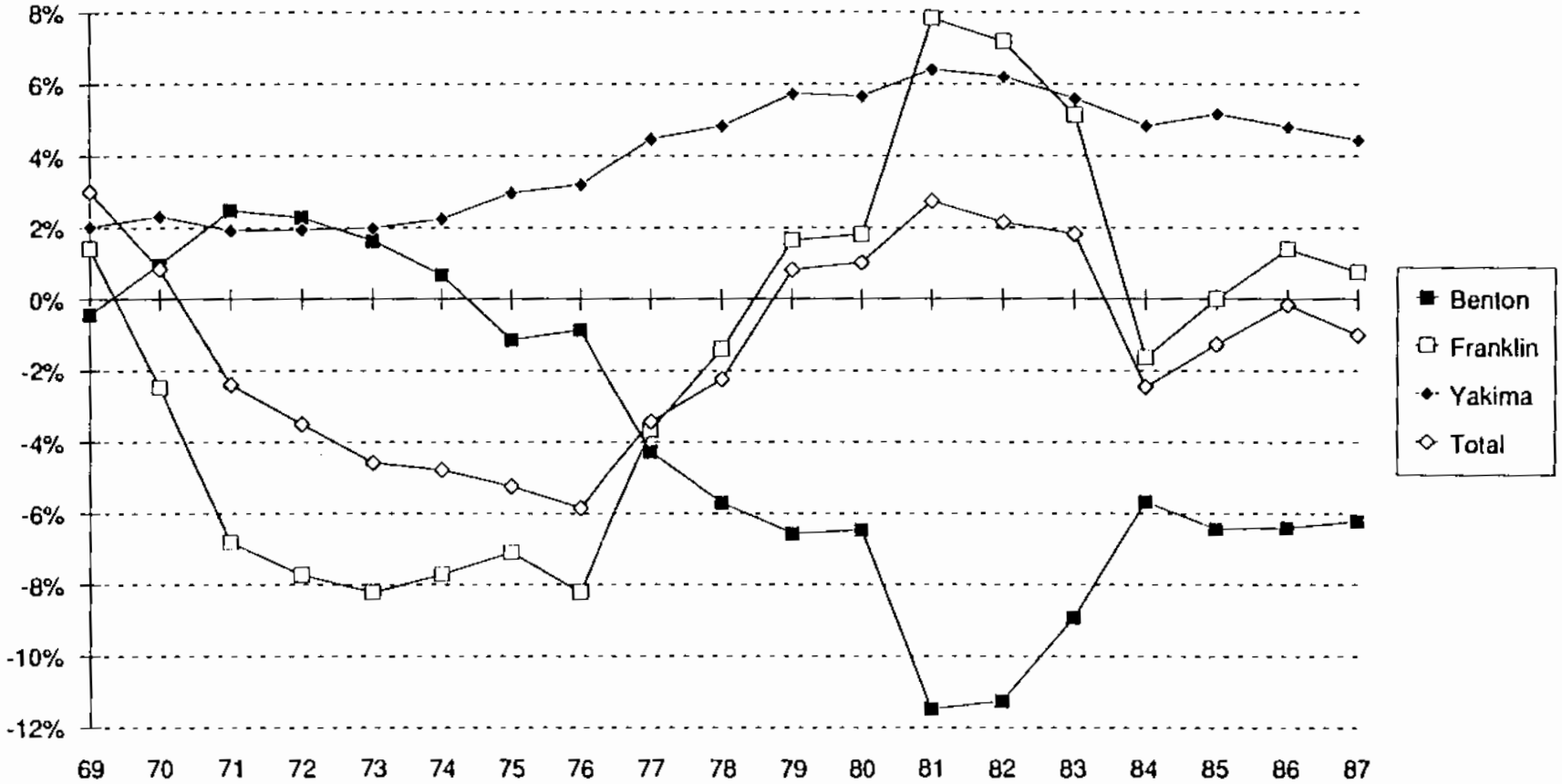


Figure 4. Residence Adjustments as a Percentage of Total Place-of-Work Earnings: Benton, Franklin, and Yakima Counties: 1969-1987

many workers either migrated temporarily to Hanford or commuted long distances to work there. After the rampdown of WPPSS construction in the early 1980s, including the termination of WNP-4 and the mothballing of WNP-1 in early 1982, the residence adjustment turned positive, and, as the county economy has recovered, the adjustment has stabilized at about minus 6 percent.

Franklin County's residence adjustment almost mirrors that of Benton County, with negative values in the 1970s, then positive values during most of the 1980s. In recent years the adjustment has been generally close to zero, but positive, indicating that in the net, the county's place-of-work employment approximately matches its place-of-residence employed population (i.e., commuting into Franklin County is about equal to commuting out of the county).

Yakima County's adjustment has been far less volatile than Benton's or Franklin's, ranging from plus 2 percent to plus 6 percent over the period from 1969 to 1987. This indicates that on balance, more people commute to other counties to work than the number of workers from other counties who commute into Yakima County for their jobs. In recent years the net adjustment has remained at about plus 5 percent.

Although the above information is not conclusive, since it indicates only net flows of income between counties rather than jobs, and those net flows probably involve counties other than the three study area counties, it is notable that the percentage of residence adjustments for the three counties typically add up to close to zero. Adjacent counties are all quite small, and therefore it seems reasonable to assume that the study area forms a fairly self-contained labor market area, and net out-flows from Benton County are equal to the sum of net in-flows to Franklin and Yakima counties. The "commuting matrix," if it is based on the most recent (1987) BEA data and information from the Hanford survey, would be as follows in Table 5.

Table 5. Percentage of Jobs Held by Residents

	Reside in:		
Work at:	Benton	Franklin	Yakima
Benton	85%	8%	6%
Franklin	6%	93%	0%
Yakima	1%	0%	98%

The reader may notice that the BEA and Hanford survey information, if interpreted as discussed above, only describes the first row of the matrix. However, other elements of the matrix can be filled in with some ease. First, it is doubtful that any noticeable commuting between Franklin and Yakima counties takes place due to the great distance involved (hence the zero entries in the matrix). Second, the constantly positive residence adjustment for Yakima

County, and negative one for Benton County, implies that very few Yakima County jobs are held by Benton County residents (one percent is the assumption used above). It has also been assumed that since the study area appears largely self-contained in terms of commuting flows, that only one percent of the jobs in any county are held by people living outside the study area (therefore, the rows all sum to 99 percent).

As a check on the reasonableness of these commuting estimates, an algorithm was developed to estimate year-by-year changes in the 1980 Census-based matrix cells for Benton and Franklin counties, based on the BEA data (the Yakima County commuting matrix was held constant, since the BEA data show that no appreciable changes occurred). The forecasts for 1987 are shown in Table 6. It appears evident that the estimates shown in Table 5 may be in error for Franklin County, but appear reasonable for Benton County.

Table 6. 1987 Commuting Matrix

	Reside in:			
Work at:	Benton	Franklin	Yakima	Other
Benton	83.14%	7.16%	6.02%	3.68%
Franklin	31.97%	57.80%	0.76%	9.47%
Yakima	0.96%	0.00%	97.00%	2.04%

The commuting matrix shown above and earlier from the U.S. Census, as well as the extrapolated matrices for the intervening years, were used to distribute jobholders among counties under each baseline scenario.

3.0 POPULATION FORECASTS

3.1 Linkage of Economic to Demographic Forecasts

Output from the HED economic model provides jobs by place of work. The demographic model is based on Census Bureau concepts, the relevant one being that population data are tabulated by place of residence. Thus, as discussed in Section 2.2, some workers enumerated in Franklin County have jobs in Benton County and vice-versa. The 1980 data on commuting (place of work, place of residence), unlike nearly all other published census data, are not adjusted for non-response. In the study area the non-response rate was around 10 percent. Numbers of non-respondents are tabulated by place of residence. Therefore, it was not possible to get a complete census count of people working in each of the three counties for comparison with 1980 BEA job counts. We could only use the place-of-residence shares for respondents to allocate the BEA data. Having done this allocation, it was found that the presumed jobholders by place of residence did not agree with the census count of employed persons. Multiple jobholding, which averages about 5 percent of the

labor force nationally, is one factor that can account for this difference. Another could be that the census is taken as of April 1, while BEA numbers are annual averages. Therefore, correction factors were calculated and held constant for the period 1981-2040. These are:

Benton	.925
Franklin	.958
Yakima	.840

The remainder of the linkage from jobs to labor force is the unemployment rate. April Employment Security data (except for 1989, revised numbers--but not seasonally adjusted--from the publication of Washington Labor Market) were used as the basis for 1981-1989 calibration. Benton County rates were unchanged, but Franklin and Yakima numbers were altered in a few cases so that resulting population estimates generally agreed with Office of Financial Management estimates. These unemployment rates are shown in Table 7. Jobs derived from the HED model were inflated using unemployment rates to produce the target labor force participation rates, as discussed below.

Table 7. Unemployment Rates by County and Year

Year	Benton	Franklin	Yakima
1980*	.056	.074	.092
1981	.067	.080	.118
1982	.111	.120	.150
1983	.130	.140	.150
1984	.117	.141	.150
1985	.099	.109	.150
1986	.091	.101	.140
1987	.084	.103	.110
1988	.077	.084	.110
1989	.071	.110	.120
1990	.060	.080	.095

*Census data

3.2 Labor Force Participation Rates

Labor force participation rates (Table 8) were based on five age group tabulations in the Washington State 1980 census report, with five-year age group detail filled in using Spokane MSA as a proxy. These were trended to year 1995 using post-1980 national Current Population Survey data; male rates tended to drop slightly, and female rates tended to increase. Following 1995, rates were held stationary.

Table 8. Model USA Labor Force Participation Rates						
	Males			Females		
Ages	1980	1990	1995	1980	1990	1995
16-19	.524	.510	.500	.458	.465	.480
20-24	.827	.820	.815	.678	.728	.750
25-29	.918	.910	.905	.663	.730	.780
30-34	.940	.940	.940	.632	.750	.800
35-39	.945	.945	.945	.644	.750	.800
40-44	.937	.940	.940	.650	.750	.800
45-49	.920	.920	.920	.615	.750	.800
50-54	.885	.885	.885	.563	.730	.760
55-59	.806	.800	.800	.484	.520	.550
60-64	.604	.540	.500	.340	.335	.330
65-69	.292	.210	.175	.150	.135	.125
70-74	.183	.150	.120	.078	.070	.065
75+	.091	.085	.075	.032	.028	.026

3.3 Migration Rates

Because no single year data for migration into and out of counties are available that reflect actual, current migration behavior, a complex process was undertaken to approximate these actual migration patterns by age and sex for the three counties. The general process involved starting with high and low model migration rate patterns for single years of age that could reasonably be expected to bracket the actual patterns for in and out migration flows for males and for females. Sets of model patterns also were developed for the retirement age population. Migration rates for the population under age 18 were those used for females one generation older, where a generation equals 26 years. These model patterns were calibrated using 1970-1980 estimated net migration by five-year age group as target values. Net migration was calculated as a residual based on Census survival rates to give a "best estimate" of the pattern of net migration. The in and out migration flow patterns were adjusted based on an examination of historical State Economic Area data for 1950, 1960 and 1970 and on the 1975-1980 county migration data contained on special tape files. The Current Population Survey one year (1980-1981) and five year (1980-1985) rates were examined to establish reasonable scalar relationships. The scalars adjust the overall volume of in and out migration flows, and separate patterns for the directional flows were developed. A judgmental process was used to iterate toward an appropriate migration pattern that involved weighted average rates between the high and low model patterns and interpolation or smoothing across the full single year age distribution, given target rates at three

selected ages in the distribution. The model was run using trial parameter values and comparing net migration results to historical target patterns. Trial parameters were adjusted to achieve a reasonably close match. At this point, the shapes of the rate patterns remained fixed, but the scalars that control the overall levels of migration flows were allowed to vary until population numbers were attained that, when multiplied by labor force participation rates, yielded labor force numbers that closely agreed with target county total labor force values described above (within about one-half of one percent).

3.4 Fertility Rates

1980 age-specific fertility rates were calculated from vital statistics data and population size data by age and sex from the Census for counties, and these rates were used without change throughout the study period, with one exception. Comparison of model births and reported births (Health Department) from 1981 through 1987 indicated that the Yakima County Total Fertility Rate[4] (used as a scalar in the model) be raised from 2.395 in 1980 to 2.5 in 1990.

3.5 Mortality Rates

The derivation of appropriate mortality rates presents a different problem. The counties in the study area are small enough that reliable life tables might be difficult to construct. Therefore 1979-1981 Washington State life tables were used as a proxy, using the "all races" tables. Life table death rates for selected ages were ratioed to the U.S. rates for the equivalent ages, by sex, and these relationships were held constant to future death rates based on the U.S. Census Bureau's most recent "middle series" national projections.[5]

3.6 Baseline Population Size and Composition Forecasts

Aside from the use of directional migration flows by age and sex (which, in theory, is more accurate where migration levels and directions change--as was the case for Benton-Franklin in the early 1980s), the demographic model is a fairly typical cohort-component model. Population is aged, mortality rates applied, iterative migration routines are used to converge the population to the labor force targets, and fertility rates are applied to yield births--with an adjustment for migration. The age-sex composition of the population is a by-product of the process discussed above and of the model applied to the data. Detailed data tables showing the age-sex composition of each county's population, under both the high and low scenarios, and covering each decade year are contained in the Appendix. Population pyramids also are included in

---

[4]The Total Fertility Rate (TFR) is the sum through all ages of the age-specific fertility rates, or the total number of children that would be born to a woman who experienced those age-specific rates throughout her reproductive life.

[5]Gregory Spencer, Projections of the Population of the United States, by Age, Sex, and Race: 1988 to 2080, Current Population Reports, Series P-25, No. 1018, January, 1989.

the Appendix to show graphically a comparison of age composition between the three counties and changes in age composition over time. These population pyramids display the proportion that each 5-year age group for males and females constitutes of each county's population in 1981 and in 2040. Briefly, in 1981 Benton County's pyramid reflects a "bulge" in the work force age groups and Yakima County reflects higher proportions of the population in the retirement ages. The 2040 forecasts for all three counties reflect the age effects of relatively constant, low fertility and increased longevity, as well as the cumulative effects of the migration assumptions in the model. In addition, by 2040 the baby boom population falls in the 75 years and older category, contributing to the higher proportions in that upper end age group. The low scenario age composition effects are similar. The population forecasts for the three counties, under the high and low employment scenarios, are shown in Table 9 and Figure 5.

TABLE 9. COUNTY POPULATION TOTALS

COUNTY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Benton High	114,257	113,130	108,991	104,375	103,512	104,658	107,686	103,947	104,928	108,079
Benton Low	114,257	113,130	108,991	104,375	103,512	104,658	107,686	103,947	105,876	108,158
Franklin High	36,045	35,999	35,141	32,545	32,726	33,178	35,005	34,171	34,201	34,768
Franklin Low	36,045	35,999	35,141	32,545	32,726	33,178	35,005	34,171	34,420	34,703
Yakima High	174,416	175,083	178,000	180,427	181,108	182,061	184,599	185,764	187,827	190,338
Yakima Low	174,416	175,083	178,000	180,427	181,108	182,061	184,599	185,764	187,973	190,258
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Benton High	111,012	113,680	115,161	116,646	117,704	120,248	120,844	122,184	123,246	123,673
Benton Low	110,766	113,350	114,478	115,601	116,105	116,091	114,292	113,631	112,244	110,471
Franklin High	35,078	35,588	35,739	35,737	35,713	36,221	36,092	36,197	36,270	36,153
Franklin Low	34,937	35,438	35,507	35,437	35,292	35,186	34,508	34,173	33,687	33,073
Yakima High	192,362	194,567	195,820	196,112	196,071	197,728	198,067	199,937	200,659	199,635
Yakima Low	192,353	194,554	195,761	195,988	195,886	197,062	197,175	198,887	199,225	197,867
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Benton High	124,656	126,001	127,603	129,206	130,998	132,788	134,375	136,002	137,615	139,223
Benton Low	111,791	113,423	115,267	117,078	119,056	120,892	122,472	124,042	125,594	127,081
Franklin High	36,368	36,689	37,104	37,524	38,057	38,540	38,964	39,416	39,862	40,339
Franklin Low	33,369	33,743	34,223	34,697	35,256	35,776	36,169	36,597	37,022	37,467
Yakima High	199,926	200,735	202,102	203,823	205,790	207,382	208,476	209,703	210,987	212,292
Yakima Low	198,361	199,201	200,615	202,367	204,350	205,950	207,048	208,269	209,546	210,821
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Benton High	141,042	142,969	144,873	146,753	148,505	150,196	151,776	153,250	154,575	155,798
Benton Low	127,620	128,102	128,558	128,990	129,271	129,441	129,531	129,510	129,343	129,029
Franklin High	40,873	41,413	41,978	42,511	43,023	43,519	43,958	44,383	44,754	45,084
Franklin Low	37,674	37,843	38,037	38,188	38,331	38,438	38,504	38,540	38,521	38,470
Yakima High	214,103	215,979	217,921	219,730	221,321	222,858	224,180	225,447	227,010	227,299
Yakima Low	212,477	214,184	215,957	217,609	219,025	220,395	221,543	222,643	223,523	224,126
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Benton High	157,120	158,325	159,351	160,221	160,953	161,580	162,183	162,727	163,296	163,905
Benton Low	130,080	131,083	131,878	132,475	132,898	133,222	133,458	133,628	133,801	134,007
Franklin High	45,480	45,814	46,116	46,367	46,591	46,811	46,985	47,179	47,331	47,507
Franklin Low	38,756	39,015	39,239	39,384	39,492	39,607	39,684	39,761	39,798	39,835
Yakima High	228,377	229,227	229,926	230,351	230,333	230,141	229,754	229,271	228,688	227,912
Yakima Low	225,197	226,024	226,703	227,092	227,026	226,801	226,368	225,853	225,217	224,399
	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Benton High	164,471	165,094	165,662	166,363	167,180	167,997	168,823	169,568	170,426	171,393
Benton Low	134,140	134,317	134,462	134,685	134,989	135,314	135,668	135,960	134,825	136,681
Franklin High	47,687	47,867	48,083	48,280	48,535	48,752	48,985	49,262	49,501	49,819
Franklin Low	39,876	39,926	40,001	40,044	40,133	40,215	40,291	40,393	40,334	40,615
Yakima High	227,033	225,952	224,733	223,479	222,212	221,450	220,700	219,962	219,278	218,794
Yakima Low	223,486	222,353	221,078	219,774	218,460	217,665	216,872	216,082	215,236	214,810

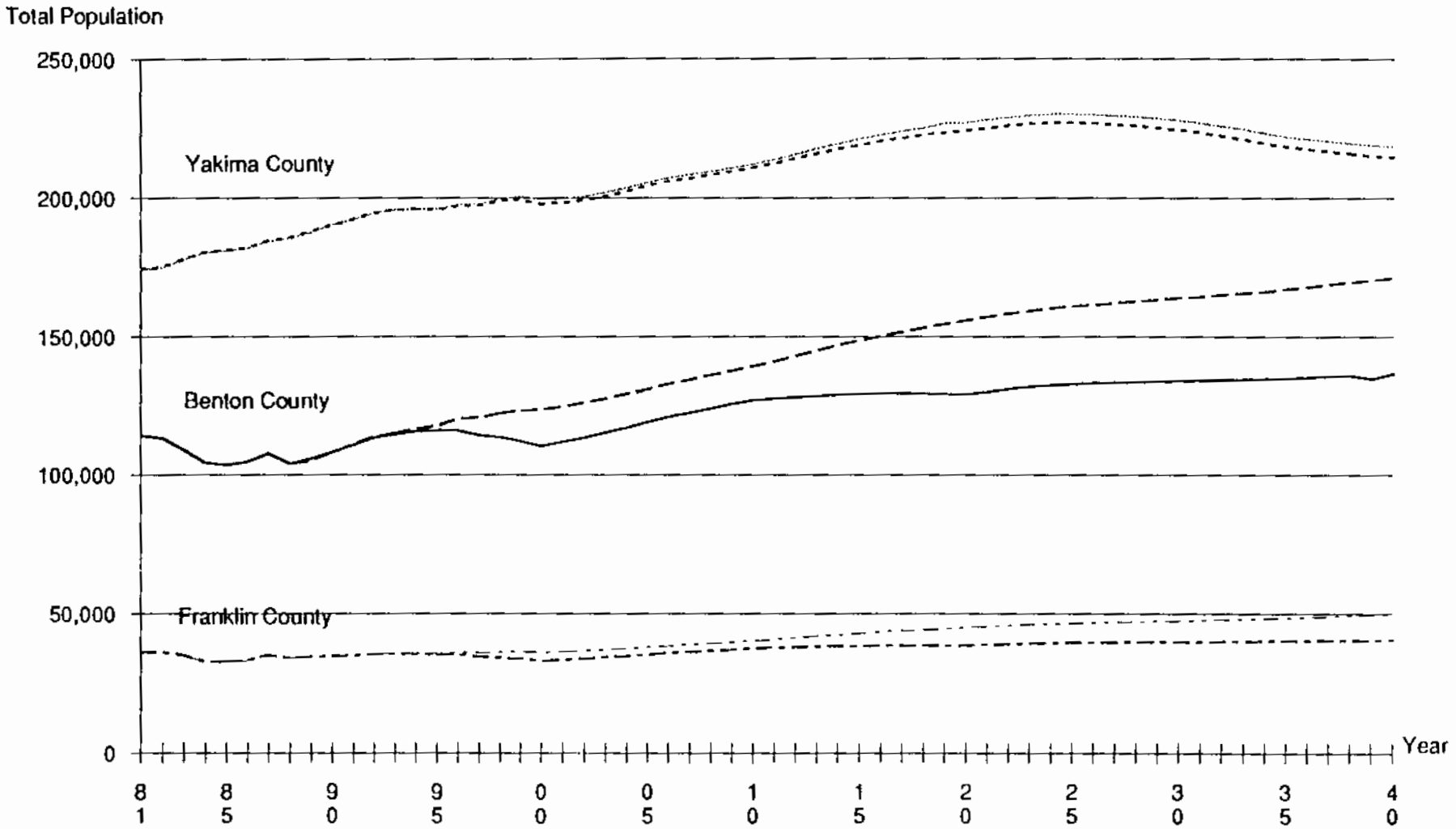


Figure 5. Projected Baseline High and Low Population Scenarios for Yakima, Benton and Franklin Counties: 1981-2040

4.0 REFERENCES

Department of Social and Health Services. 1980. Vital Statistics Summary: Washington State 1980. Center for Health Statistics, Division of Health. Table 5.

Nonagricultural Employment by Industry. Labor Force Data and Area Population: Richland-Kennewick-Pasco MSA. 1976-1988. Data Provided by Dean Schau, Employment Security Department, Kennewick, WA.

Scott, M.J., D.B. Belzer, D.C. Clark, R.J. Nesse, R.W. Schultz, and P.A. Stokowski. 1987. The Economic and Community Impacts of Closing Hanford's N Reactor and Nuclear Materials Production Facilities. Prepared for the U.S. Department of Energy under Contract DE-AC06-76RLO1830. Battelle Pacific Northwest Laboratory. PNL-6295/UC-2. Richland, WA. (August).

U.S. Bureau of the Census. 1960 Census of Population. Final Report PC(2)-2B. 1972. Subject Reports. "Mobility for States and State Economic Areas." Table 37. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1970 Census of Population. Subject Report PC(2)-2E. 1972. "Migration Between State Economic Areas." Table 2. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1980 Census of Population. General Population Characteristics. Volume B49. Table 45. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1980 Census of Population. Vol. 1 Characteristics of Population. Chapter C: General Social and Economic Characteristics. Part 49: Washington. PC80-1-C49. August 1983. Table 176 for 5-year Labor Force Data. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1980 Census of Population. Vol. 1 Characteristics of Population. Chapter D: Detailed Population Characteristics. Part 49: Washington. PC80-1-D49. November 1983. Table 213: Spokane Metropolitan Statistical Area. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1980 Census of Population. Vol. 2 Subject Reports. Part 6D, Journey to Work: Characteristics of Workers in Metropolitan Areas. Section 3. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. "Population Profile of the United States: 1985." Current Population Reports. P-23 Series. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. Unpublished U.S. Bureau of the Census Data Tape Provided by the Washington State Office of Financial Management. U.S. Government Printing Office. Washington, D.C.

U.S. Department of Commerce. 1989. Bureau of Economic Analysis, Regional Economic Information System. Full-Time and Part-Time Employees by Major Industry. April.

Washington Labor Market. Labor Market and Economic Analysis Branch, Washington State Employment Security. State of Washington. Statistical Series Issued Monthly.

5.0 APPENDICES

- Benton County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.
- Benton County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.
- Franklin County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.
- Franklin County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.
- Yakima County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.
- Yakima County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040.

Benton County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	57,733	56,524	53,399	54,680	59,716	63,957	66,196	73,027	73,398	82,400	76,471	87,434	79,589	91,804
0-4	5,516	5,149	4,651	4,445	5,064	4,838	6,098	5,826	6,548	6,255	6,834	6,527	7,235	6,907
5-9	4,768	4,650	5,545	5,304	5,476	5,232	6,424	6,139	7,258	6,930	7,313	6,987	7,776	7,428
10-14	4,960	4,789	5,070	4,717	5,978	5,722	6,283	6,008	7,465	7,139	7,594	7,258	7,866	7,516
15-19	5,017	4,764	4,040	4,096	5,885	5,785	5,658	5,555	6,581	6,456	7,114	6,977	7,130	6,998
20-24	4,715	4,916	2,999	3,103	3,795	3,869	4,398	4,619	4,542	4,764	5,128	5,365	5,218	5,464
25-29	6,262	6,012	3,182	3,387	3,581	4,055	5,061	5,551	4,752	5,203	5,115	5,579	5,524	6,027
30-34	5,662	5,219	4,638	4,951	3,957	4,279	4,784	5,090	5,475	5,978	5,242	5,722	5,852	6,379
35-39	4,142	3,938	5,519	5,134	3,921	4,172	4,245	4,776	5,931	6,472	5,256	5,740	5,611	6,108
40-44	3,284	3,053	4,048	4,051	4,489	5,115	3,787	4,329	4,539	5,101	4,934	5,722	4,702	5,453
45-49	2,814	2,669	2,776	3,025	4,557	4,839	3,178	3,845	3,410	4,363	4,598	5,724	4,060	5,063
50-54	2,769	2,662	2,341	2,428	3,378	3,817	3,723	4,750	3,106	3,988	3,613	4,569	3,928	5,124
55-59	2,493	2,427	2,102	2,244	2,415	2,901	3,947	4,576	2,743	3,620	2,873	4,016	3,868	5,269
60-64	2,039	1,999	2,112	2,246	2,003	2,287	2,896	3,566	3,177	4,417	2,608	3,650	3,036	4,182
65-69	1,448	1,622	1,809	1,971	1,698	2,031	1,971	2,617	3,222	4,130	2,212	3,217	2,319	3,570
70-74	954	1,125	1,278	1,503	1,542	1,903	1,483	1,944	2,164	3,038	2,336	3,707	1,943	3,083
75+	890	1,530	1,289	2,075	1,977	3,112	2,260	3,836	2,485	4,546	3,701	6,674	3,521	7,233

Benton County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	57,733	56,524	53,439	54,719	53,251	57,220	60,343	66,738	60,596	68,433	62,327	71,680	63,325	73,356
0-4	5,516	5,149	4,656	4,450	4,334	4,141	5,578	5,329	5,205	4,970	5,529	5,280	5,690	5,436
5-9	4,768	4,650	5,551	5,309	4,697	4,491	5,783	5,526	5,833	5,575	5,841	5,578	6,151	5,877
10-14	4,960	4,789	5,074	4,721	5,311	5,082	5,605	5,358	6,123	5,858	6,050	5,784	6,234	5,951
15-19	5,017	4,764	4,039	4,092	5,337	5,237	5,007	4,915	5,431	5,329	5,722	5,614	5,612	5,500
20-24	4,715	4,916	3,000	3,105	3,258	3,288	4,026	4,234	3,648	3,800	4,195	4,385	4,080	4,266
25-29	6,262	6,012	3,188	3,393	2,928	3,294	4,812	5,281	3,619	3,933	4,212	4,595	4,316	4,702
30-34	5,662	5,219	4,645	4,958	3,344	3,620	4,340	4,576	4,317	4,717	4,213	4,577	4,651	5,063
35-39	4,142	3,938	5,525	5,139	3,450	3,680	3,623	4,057	5,019	5,486	4,014	4,349	4,523	4,916
40-44	3,284	3,053	4,052	4,055	4,063	4,649	3,309	3,783	3,760	4,196	3,891	4,520	3,717	4,290
45-49	2,814	2,669	2,778	3,025	4,194	4,470	2,874	3,478	2,708	3,459	3,898	4,857	3,054	3,781
50-54	2,769	2,662	2,343	2,431	3,149	3,572	3,445	4,403	2,555	3,287	2,997	3,762	3,064	4,005
55-59	2,493	2,427	2,101	2,245	2,279	2,735	3,701	4,301	2,355	3,115	2,282	3,188	3,246	4,426
60-64	2,039	1,999	2,113	2,245	1,902	2,183	2,743	3,390	2,818	3,928	2,145	3,010	2,496	3,416
65-69	1,448	1,622	1,809	1,971	1,623	1,947	1,882	2,502	2,910	3,739	1,898	2,771	1,829	2,816
70-74	954	1,125	1,278	1,502	1,480	1,830	1,426	1,879	1,982	2,795	2,070	3,295	1,589	2,525
75+	890	1,530	1,287	2,078	1,902	3,001	2,189	3,726	2,313	4,246	3,370	6,115	3,073	6,386

Franklin County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	57,733	56,524	53,399	54,680	59,716	63,957	66,196	73,027	73,398	82,400	76,471	87,434	79,589	91,804
0-4	5,516	5,149	4,651	4,445	5,064	4,838	6,098	5,826	6,548	6,255	6,834	6,527	7,235	6,907
5-9	4,768	4,650	5,545	5,304	5,476	5,232	6,424	6,139	7,258	6,930	7,313	6,987	7,776	7,428
10-14	4,960	4,789	5,070	4,717	5,978	5,722	6,283	6,008	7,465	7,139	7,594	7,258	7,866	7,516
15-19	5,017	4,764	4,040	4,096	5,885	5,785	5,658	5,555	6,581	6,456	7,114	6,977	7,130	6,998
20-24	4,715	4,916	2,999	3,103	3,795	3,869	4,398	4,619	4,542	4,764	5,128	5,365	5,218	5,464
25-29	6,262	6,012	3,182	3,387	3,581	4,055	5,061	5,551	4,752	5,203	5,115	5,579	5,524	6,027
30-34	5,662	5,219	4,638	4,951	3,957	4,279	4,784	5,090	5,475	5,978	5,242	5,722	5,852	6,379
35-39	4,142	3,938	5,519	5,134	3,921	4,172	4,245	4,776	5,931	6,472	5,256	5,740	5,611	6,108
40-44	3,284	3,053	4,048	4,051	4,489	5,115	3,787	4,329	4,539	5,101	4,934	5,722	4,702	5,453
45-49	2,814	2,669	2,776	3,025	4,557	4,839	3,178	3,845	3,410	4,363	4,598	5,724	4,060	5,063
50-54	2,769	2,662	2,341	2,428	3,378	3,817	3,723	4,750	3,106	3,988	3,613	4,569	3,928	5,124
55-59	2,493	2,427	2,102	2,244	2,415	2,901	3,947	4,576	2,743	3,620	2,873	4,016	3,868	5,269
60-64	2,039	1,999	2,112	2,246	2,003	2,287	2,896	3,566	3,177	4,417	2,608	3,650	3,036	4,182
65-69	1,448	1,622	1,809	1,971	1,698	2,031	1,971	2,617	3,222	4,130	2,212	3,217	2,319	3,570
70-74	954	1,125	1,278	1,503	1,542	1,903	1,483	1,944	2,164	3,038	2,336	3,707	1,943	3,083
75+	890	1,530	1,289	2,075	1,977	3,112	2,260	3,836	2,485	4,546	3,701	6,674	3,521	7,233

Franklin County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	18,299	17,746	17,502	17,201	16,586	16,487	18,753	18,714	19,247	19,223	19,828	20,007	20,138	20,477
0-4	2,136	2,059	1,852	1,771	1,635	1,563	2,082	1,988	1,978	1,888	2,131	2,034	2,167	2,068
5-9	1,701	1,594	1,979	1,894	1,527	1,461	1,909	1,823	1,933	1,848	1,961	1,871	2,061	1,964
10-14	1,441	1,410	1,582	1,545	1,549	1,485	1,635	1,565	1,866	1,782	1,809	1,730	1,901	1,817
15-19	1,531	1,412	1,345	1,273	1,601	1,548	1,435	1,387	1,641	1,585	1,687	1,629	1,689	1,623
20-24	1,662	1,672	988	991	1,029	1,059	1,258	1,285	1,187	1,204	1,374	1,392	1,323	1,346
25-29	1,929	1,760	1,099	1,110	906	934	1,453	1,527	1,108	1,157	1,295	1,357	1,310	1,367
30-34	1,581	1,401	1,367	1,392	822	851	1,110	1,172	1,165	1,220	1,125	1,176	1,265	1,316
35-39	1,055	912	1,474	1,319	905	898	909	912	1,291	1,328	1,006	1,024	1,145	1,180
40-44	761	739	1,152	979	1,117	1,101	788	781	967	980	1,026	1,039	974	983
45-49	748	752	808	720	1,241	1,082	863	826	810	786	1,160	1,158	894	880
50-54	804	874	645	627	1,026	866	1,106	1,071	734	712	911	906	960	957
55-59	917	911	702	706	737	659	1,242	1,083	825	780	784	758	1,105	1,105
60-64	803	697	721	814	568	570	986	847	1,017	1,005	683	679	845	854
65-69	533	545	743	747	579	616	661	623	1,074	987	720	714	686	695
70-74	342	396	541	553	531	669	454	500	775	726	804	869	544	590
75+	355	612	504	760	813	1,125	862	1,324	876	1,235	1,352	1,671	1,269	1,732

Yakima County High Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	86,376	88,040	95,145	95,193	101,101	98,534	108,935	103,357	117,502	109,797	118,125	109,787	113,512	105,282
0-4	7,837	7,553	8,565	8,184	8,058	7,700	8,877	8,483	9,036	8,628	8,900	8,495	8,474	8,090
5-9	6,974	6,554	9,065	8,667	8,287	7,923	8,771	8,381	9,334	8,919	8,916	8,518	8,557	8,171
10-14	7,647	7,144	8,039	7,746	8,813	8,429	8,416	8,043	9,409	8,991	9,010	8,608	8,521	8,144
15-19	8,236	7,661	7,049	6,615	8,775	8,346	8,130	7,731	8,717	8,284	8,812	8,380	8,161	7,762
20-24	7,284	6,596	6,287	5,849	6,349	6,086	7,133	6,784	6,868	6,530	7,198	6,823	6,732	6,389
25-29	7,088	7,322	7,444	6,732	5,818	5,409	7,488	7,043	7,027	6,612	6,873	6,457	6,671	6,261
30-34	6,740	6,778	7,849	7,374	6,473	5,929	6,676	6,283	7,665	7,166	6,794	6,353	6,748	6,287
35-39	5,313	5,447	7,561	7,616	7,761	6,901	6,177	5,622	8,080	7,446	7,117	6,563	6,673	6,149
40-44	4,324	4,316	6,719	6,549	8,158	7,297	6,836	5,942	7,143	6,392	7,793	6,924	6,685	5,948
45-49	3,890	3,923	5,397	5,215	7,740	7,274	8,075	6,662	6,498	5,482	8,153	6,977	6,997	5,996
50-54	4,052	4,206	4,124	3,956	6,549	6,068	8,088	6,821	6,845	5,612	6,909	5,843	7,367	6,198
55-59	3,917	4,413	3,640	3,646	4,999	4,732	7,299	6,664	7,682	6,156	6,003	4,927	7,405	6,171
60-64	3,787	4,282	3,563	3,884	3,631	3,522	5,889	5,461	7,338	6,180	6,064	4,974	6,049	5,112
65-69	3,490	3,870	3,246	3,887	2,992	3,136	4,210	4,129	6,212	5,859	6,417	5,309	4,971	4,208
70-74	2,630	3,081	2,763	3,392	2,622	3,141	2,764	2,905	4,547	4,548	5,584	5,056	4,596	4,043
75+	3,167	4,894	3,834	5,881	4,076	6,641	4,106	6,403	5,101	6,992	7,582	9,580	8,905	10,353

Yakima County Low Scenario Baseline Age-Sex Distribution for Selected Dates: 1981-2040

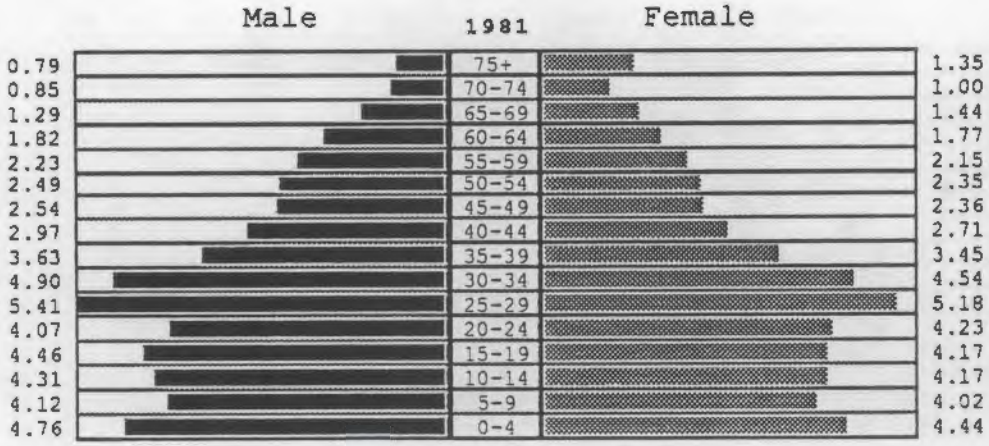
Ages	1981M	1981F	1990M	1990F	2000M	2000F	2010M	2010F	2020M	2020F	2030M	2030F	2040M	2040F
Total	86,376	88,040	95,108	95,150	100,193	97,674	108,175	102,646	115,853	108,273	116,285	108,114	111,411	103,399
0-4	7,837	7,553	8,560	8,179	7,964	7,611	8,816	8,426	8,880	8,483	8,754	8,361	8,308	7,930
5-9	6,974	6,554	9,060	8,663	8,189	7,829	8,702	8,315	9,182	8,772	8,764	8,370	8,392	8,016
10-14	7,647	7,144	8,037	7,742	8,730	8,352	8,340	7,980	9,265	8,863	8,849	8,457	8,362	7,991
15-19	8,236	7,661	7,047	6,612	8,700	8,276	8,054	7,663	8,591	8,170	8,663	8,236	8,006	7,607
20-24	7,284	6,596	6,282	5,843	6,275	6,012	7,084	6,737	6,752	6,419	7,078	6,720	6,595	6,259
25-29	7,088	7,322	7,440	6,730	5,728	5,322	7,452	7,010	6,884	6,479	6,767	6,360	6,533	6,135
30-34	6,740	6,778	7,847	7,372	6,393	5,853	6,628	6,235	7,533	7,039	6,675	6,235	6,609	6,171
35-39	5,313	5,447	7,557	7,612	7,684	6,839	6,105	5,553	7,976	7,353	6,968	6,426	6,549	6,040
40-44	4,324	4,316	6,716	6,549	8,089	7,240	6,772	5,883	7,042	6,295	7,650	6,796	6,559	5,827
45-49	3,890	3,923	5,396	5,213	7,686	7,220	8,017	6,615	6,381	5,388	8,045	6,889	6,832	5,861
50-54	4,052	4,206	4,121	3,954	6,512	6,034	8,036	6,781	6,750	5,531	6,805	5,752	7,219	6,075
55-59	3,917	4,413	3,642	3,644	4,973	4,710	7,257	6,623	7,595	6,093	5,893	4,843	7,296	6,088
60-64	3,787	4,282	3,561	3,884	3,612	3,499	5,868	5,434	7,269	6,122	5,976	4,902	5,951	5,029
65-69	3,490	3,870	3,247	3,886	2,982	3,125	4,195	4,116	6,162	5,802	6,342	5,256	4,874	4,132
70-74	2,630	3,081	2,763	3,389	2,614	3,132	2,749	2,888	4,520	4,517	5,531	5,012	4,526	3,985
75+	3,167	4,894	3,832	5,878	4,062	6,620	4,100	6,387	5,071	6,947	7,525	9,499	8,800	10,253

Age Composition Comparisons: 1981

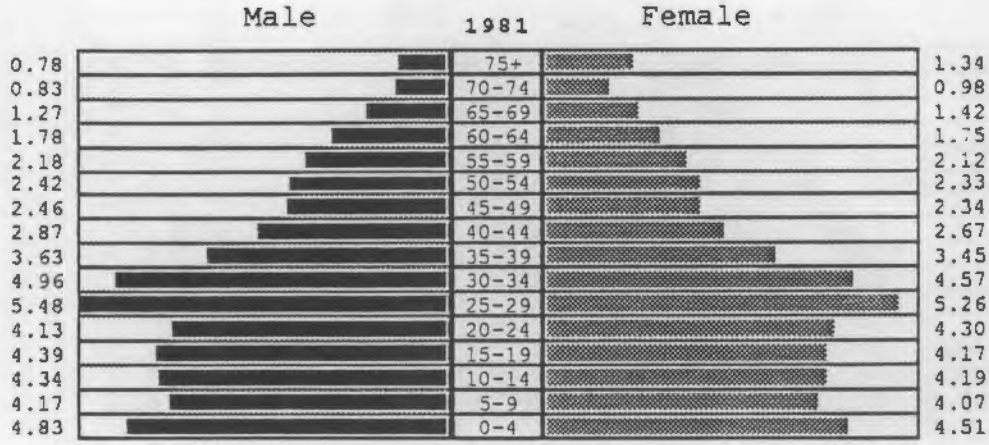
Percent Distribution by Age

High Scenario

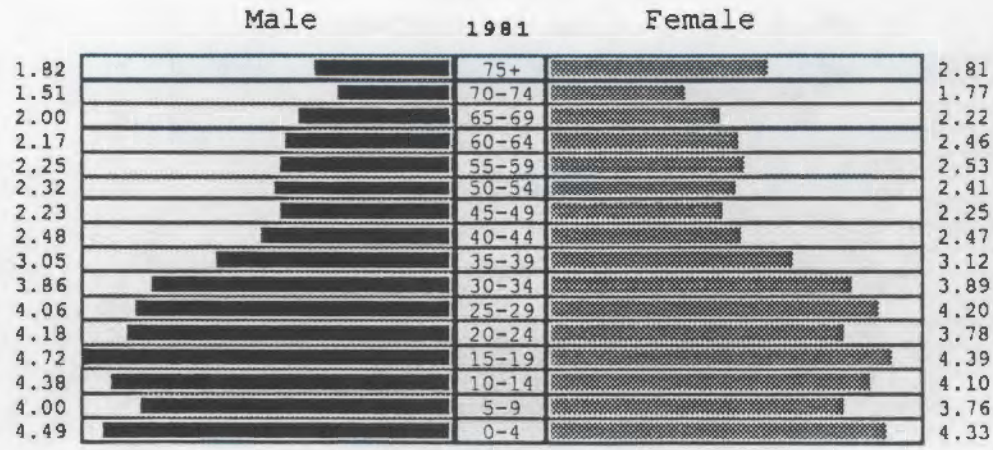
Benton County Baseline



Franklin County Baseline



Yakima County Baseline

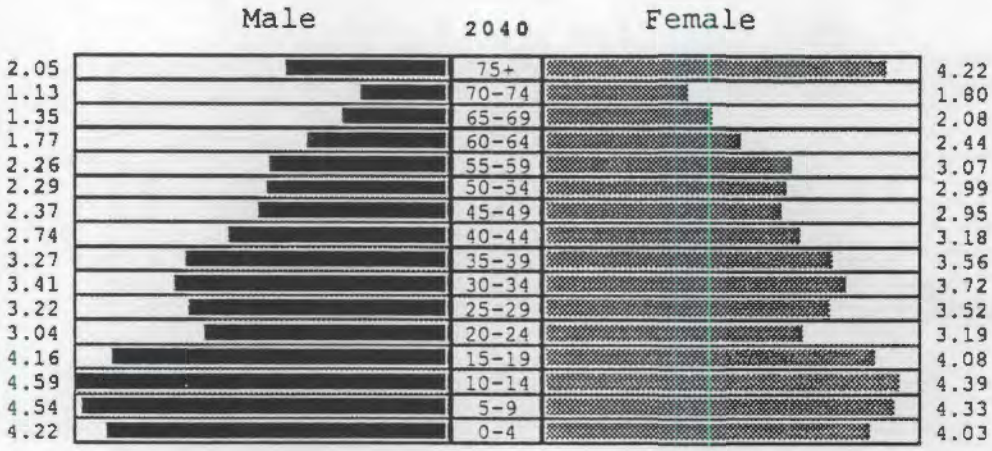


Age Composition Comparisons: 2040

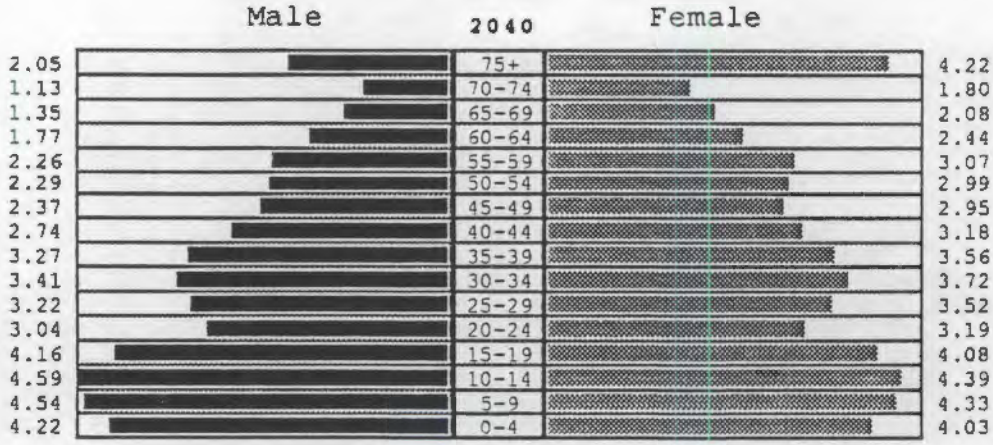
Percent Distribution by Age

High Scenario

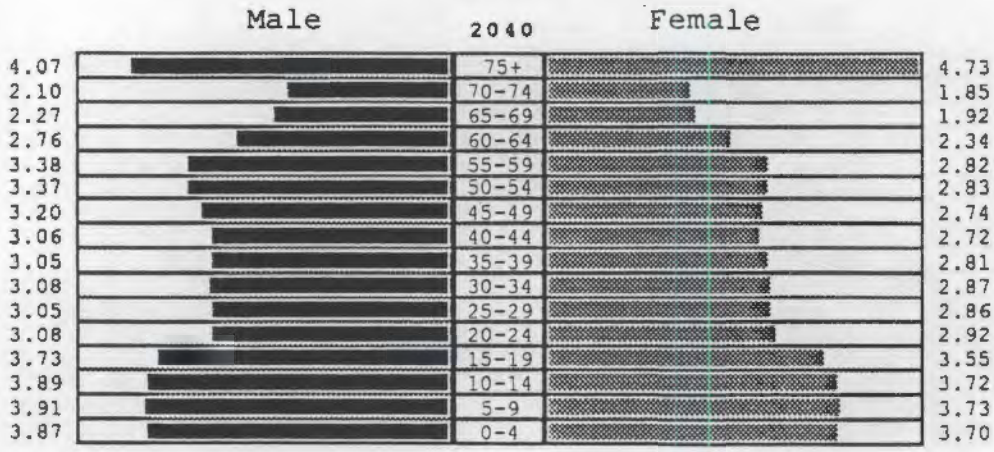
Benton County Baseline



Franklin County Baseline



Yakima County Baseline



DISTRIBUTION

No. of Copies

OFFSITE

2 DOE/Office of Scientific and Technical Information

8 C. Cluett
Battelle
Human Affairs Research Center
4000 N.E. 41st St.
Seattle, Washington 98105

S. Flaim
Argonne National Laboratory - Denver
1075 S. Yukon
Lakewood, CO 80226

R. Hemphill
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439-4815

D. Pittenger
Demographics Laboratory
2065 Lakemoor Dr. S.W.
Olympia, WA 98502

L. Stull
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439-4815

No. of Copies

ONSITE

DOE Richland Operations

L. D. Romine

13 Pacific Northwest Laboratory

S. Marsh, K6-58
I. C. Nelson, K3-54
M. Scott, K6-57 (5)
Publishing Coordination
Technical Report Files (5)