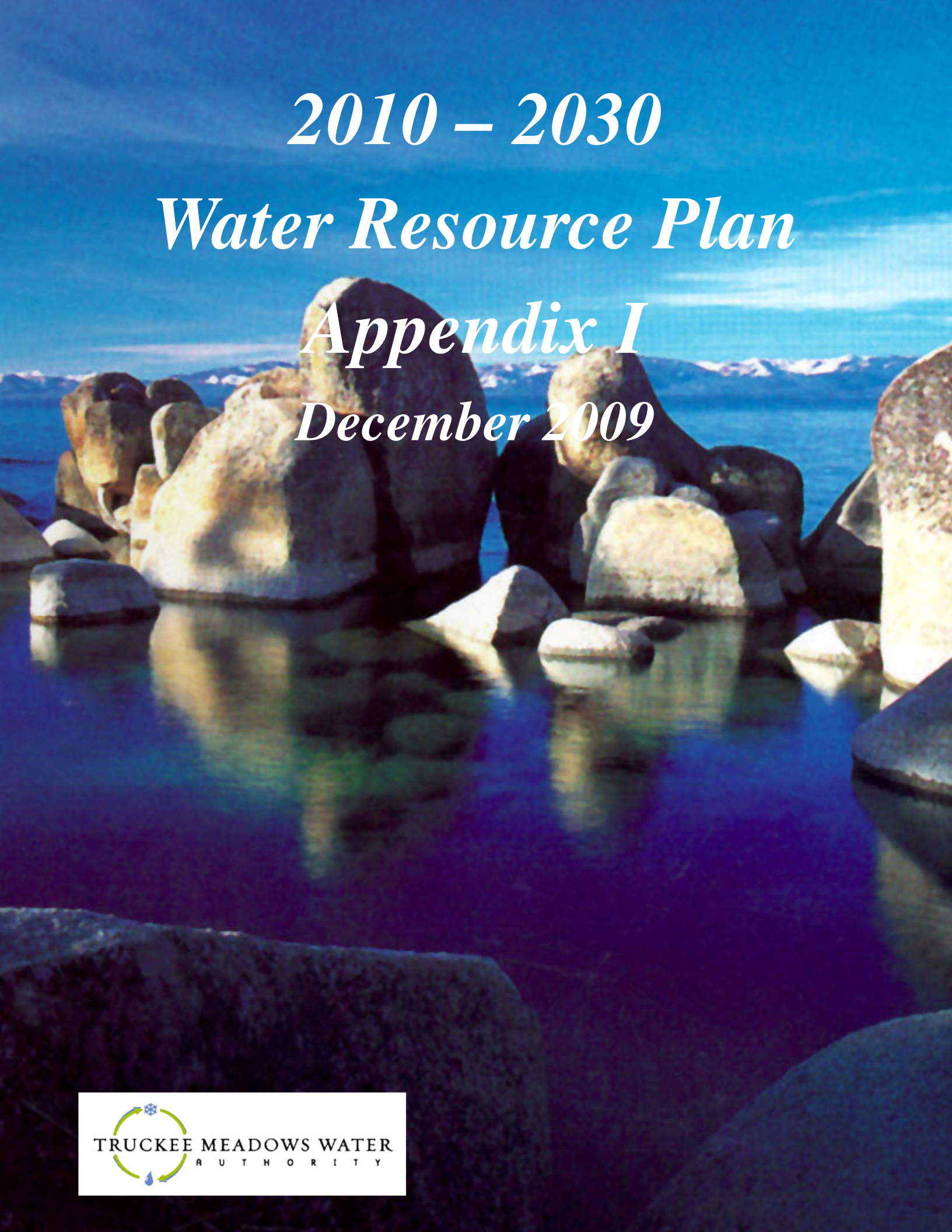

2010 – 2030
Water Resource Plan
Appendix I
December 2009

TRUCKEE MEADOWS WATER AUTHORITY

Appendix I:

Washoe County Building Projections and Water Demand Projections

TRUCKEE MEADOWS WATER AUTHORITY
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Memorandum

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TO: File

FROM: **Shawn Stoddard, Ph.D. Senior Resource Economist**

DATE: December 4, 2009

SUBJ: TPEM Series No. 2: Washoe County Building Projections

Findings

- A Washoe County Projection of new dwellings and commercial building as a function of projected population.
- A Disaggregation of Washoe County to TMWA service area.
- A Disaggregation of Washoe County to selected hydrographic basins.
- A statistical vector auto regression ("VAR") model is developed for projecting future dwelling units as a function of current building inventory and projected population.
- A VAR model is developed for projecting commercial buildings as a function of projected single family dwelling units.

Results

This report will present the results in the following manner. First, graphical presentation of projections. Second, tabular presentation of the County projection, and disaggregation to the TMWA service area and hydrographic basins. Third, discussion of the methodology and statistic used to develop each of these models. Last, appendices of statistical outputs.

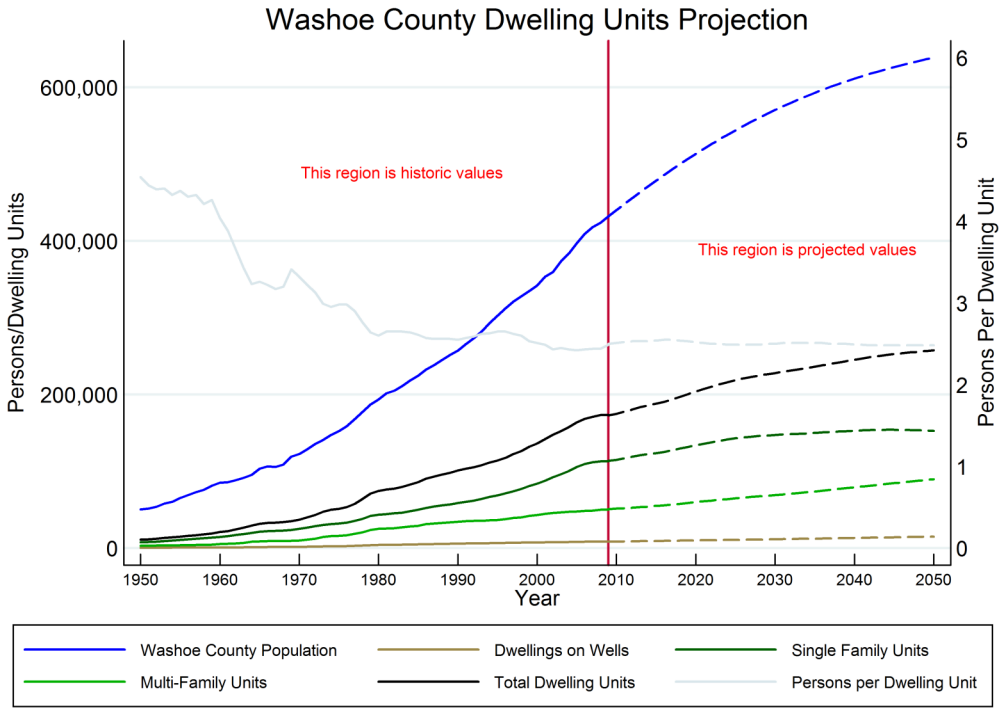

Figure 1: Washoe County Dwelling Unit Projections 2009 to 2050.

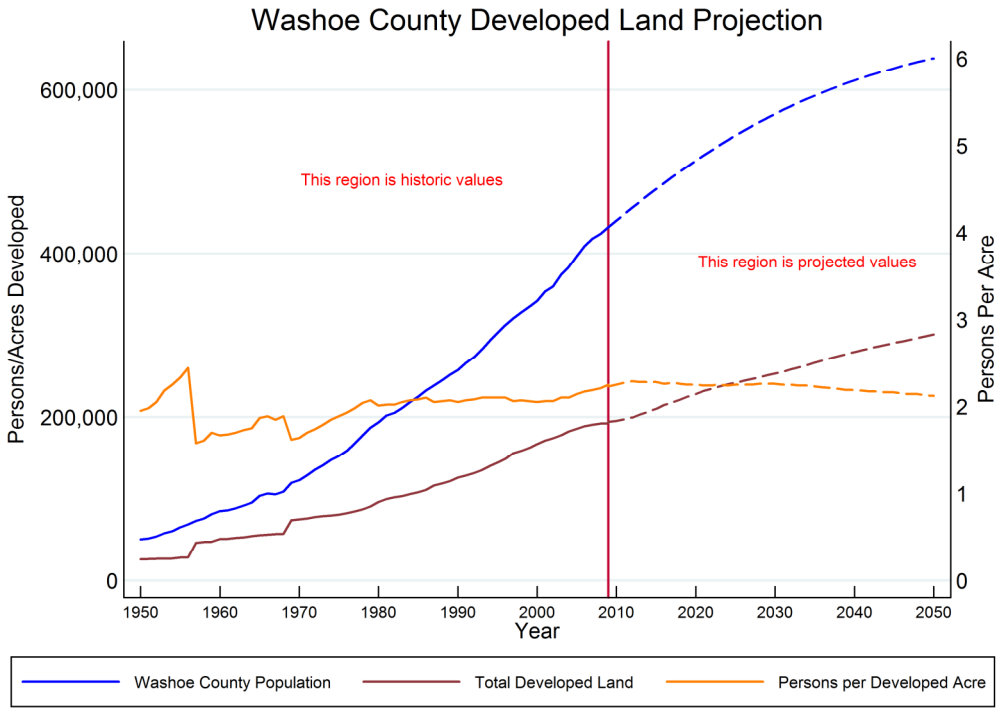

Figure 2: Washoe County Developed Land Projection 2009 to 2050.

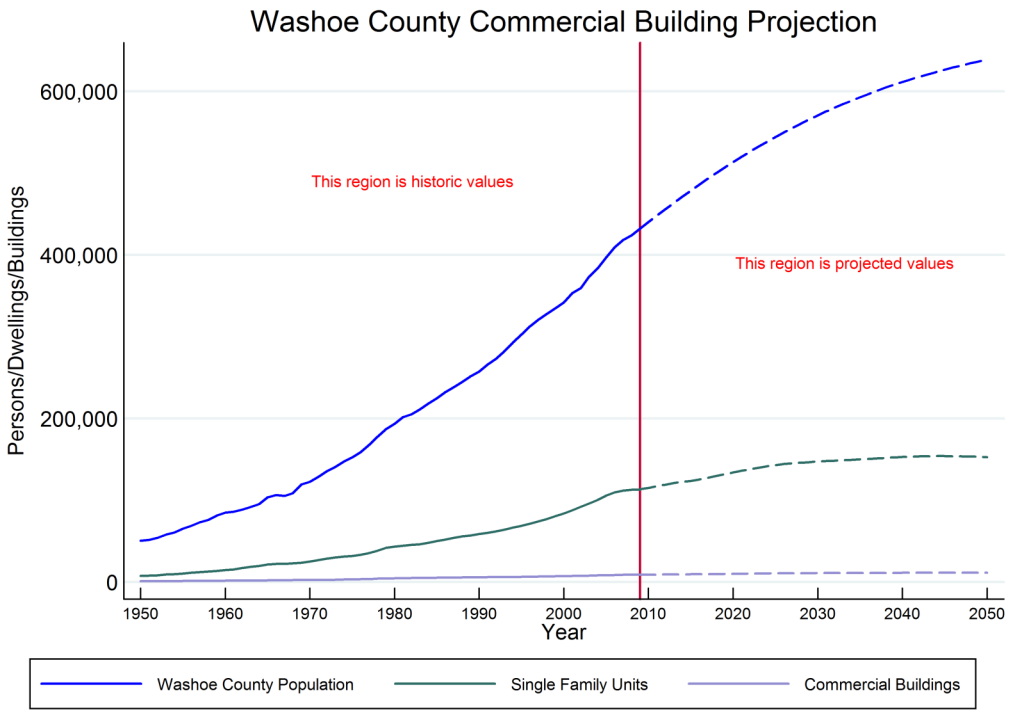

Figure 3: Washoe County Commercial Building Projection 2009 to 2050.

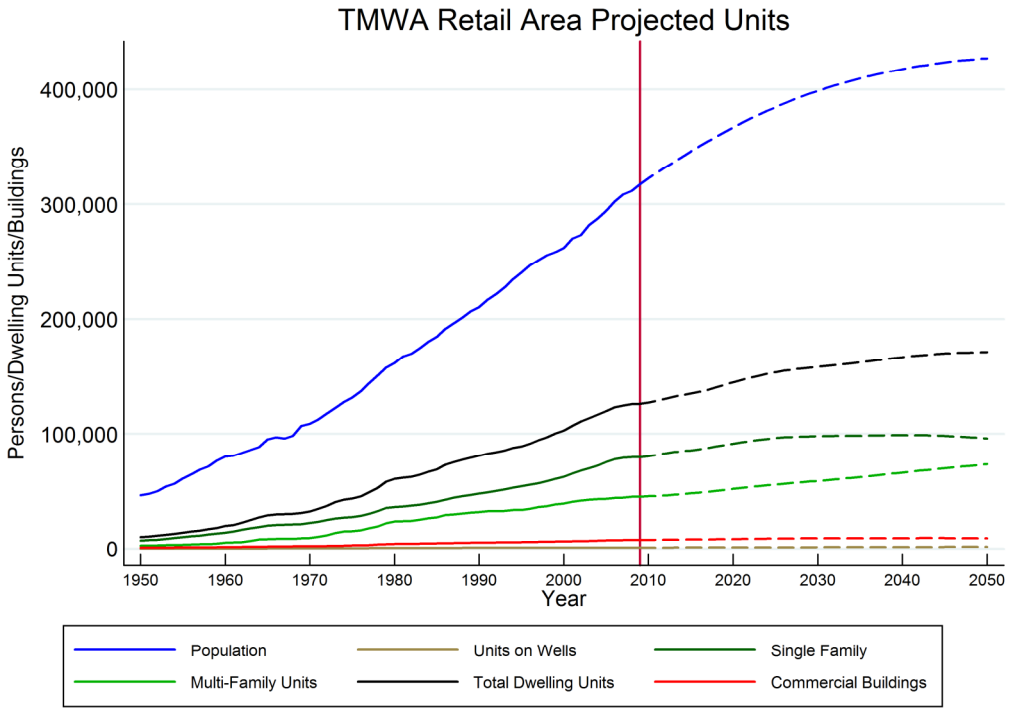

Figure 4: TMWA Retail Service Area Building Projection 2009 to 2050.

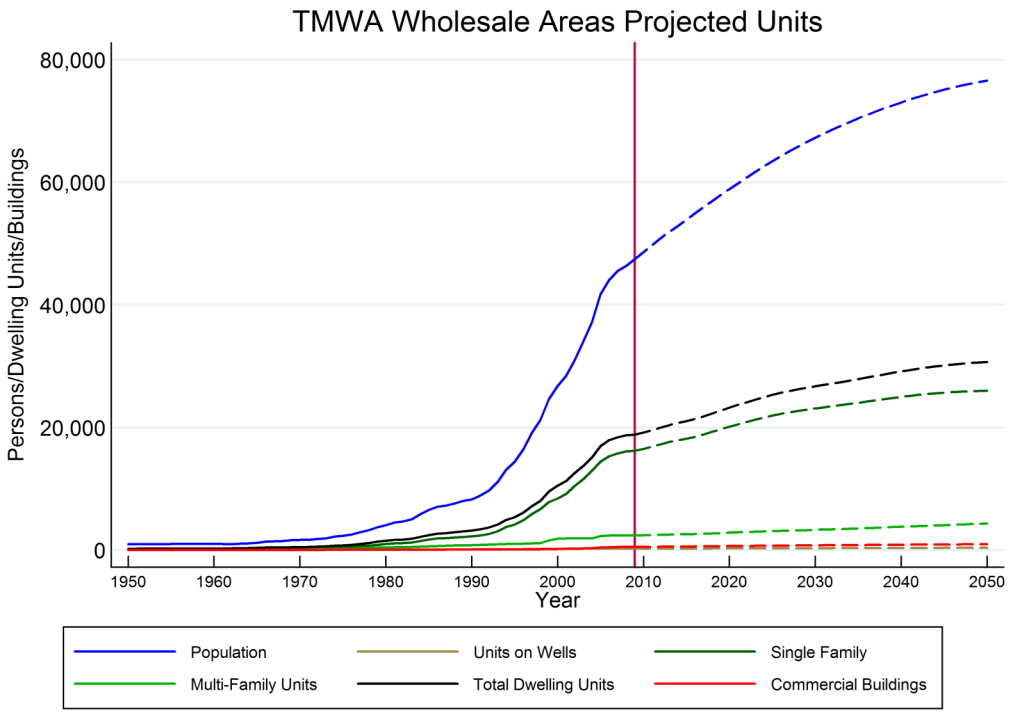

Figure 5: TMWA Total Wholesale Area Building Projection 2009 to 2050.

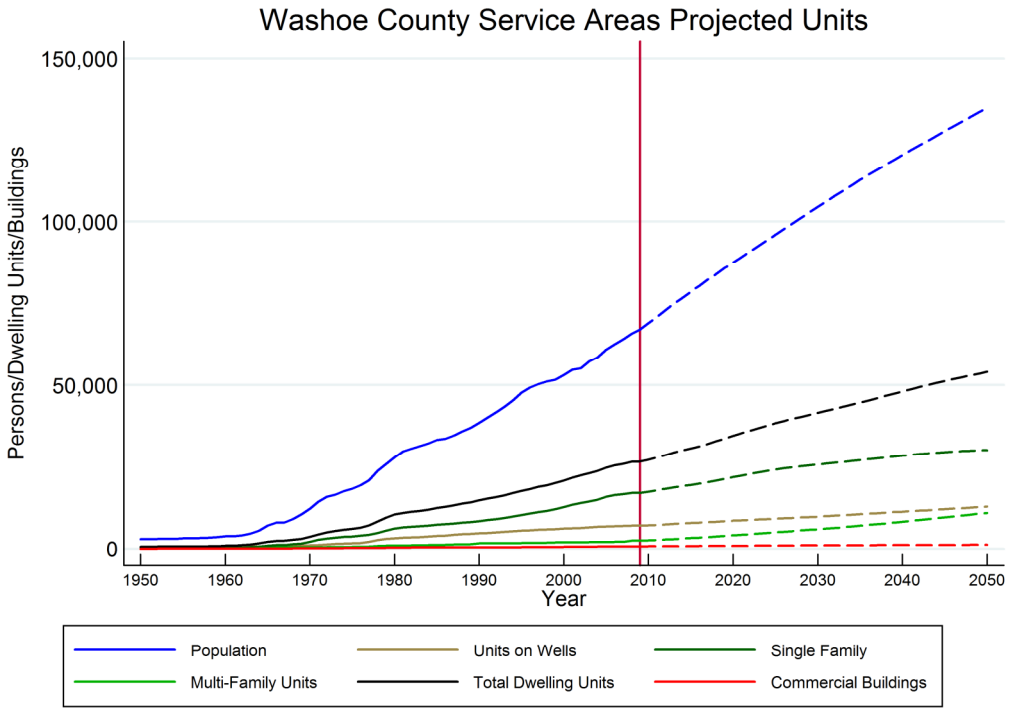

Figure 6: Washoe County/Non-TMWA Served Areas Building Projection 2009 to 2050.

Table 1: Washoe County Population and Building Projections 2009 to 2050.

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings	Developed Land ac.
2009	432,010	8,412	113,592	50,905	172,908	8,945	194,082
2010	440,081	8,492	114,967	51,543	175,002	9,035	195,403
2011	448,038	8,621	117,148	51,925	177,693	9,122	197,462
2012	455,872	8,807	119,150	52,491	180,448	9,229	199,377
2013	463,577	9,030	121,124	53,316	183,470	9,345	203,265
2014	471,146	9,195	122,553	54,139	185,886	9,447	206,554
2015	478,572	9,329	123,800	55,050	188,179	9,544	210,030
2016	485,851	9,474	125,338	55,770	190,582	9,634	214,554
2017	492,977	9,611	127,295	56,587	193,493	9,730	217,640
2018	499,946	9,783	129,655	57,649	197,088	9,841	221,153
2019	506,754	9,964	131,871	58,651	200,486	9,960	224,902
2020	513,398	10,121	133,959	59,881	203,960	10,087	227,973
2021	519,876	10,274	136,043	61,027	207,344	10,212	231,729
2022	526,185	10,400	137,907	61,981	210,288	10,330	234,557
2023	532,324	10,526	139,746	63,025	213,298	10,446	237,043
2024	538,291	10,669	141,508	63,910	216,087	10,555	239,860
2025	544,088	10,800	142,989	64,836	218,625	10,655	241,667
2026	549,713	10,943	144,249	65,818	221,010	10,746	243,946
2027	555,166	11,085	145,218	66,624	222,927	10,822	246,334
2028	560,450	11,220	146,026	67,506	224,752	10,887	248,180
2029	565,564	11,372	146,772	68,326	226,470	10,942	250,675
2030	570,511	11,527	147,367	69,092	227,986	10,987	252,889
2031	575,293	11,690	147,943	70,010	229,643	11,028	255,175
2032	579,911	11,865	148,478	70,878	231,221	11,063	258,009
2033	584,368	12,033	148,940	71,811	232,784	11,095	260,469
2034	588,667	12,210	149,469	72,827	234,506	11,127	263,338
2035	592,810	12,387	150,018	73,785	236,190	11,157	266,282
2036	596,801	12,561	150,602	74,855	238,018	11,190	268,867
2037	600,644	12,742	151,233	75,937	239,912	11,224	271,832
2038	604,340	12,917	151,813	77,004	241,733	11,258	274,493
2039	607,895	13,089	152,380	78,154	243,624	11,293	277,011
2040	611,312	13,263	152,893	79,238	245,395	11,325	279,690
2041	614,593	13,430	153,305	80,327	247,062	11,355	281,919
2042	617,744	13,600	153,662	81,433	248,695	11,381	284,218
2043	620,767	13,770	153,894	82,466	250,129	11,402	286,454
2044	623,667	13,938	154,002	83,532	251,473	11,417	288,400
2045	626,448	14,112	154,017	84,572	252,700	11,426	290,574
2046	629,112	14,285	153,899	85,573	253,758	11,428	292,583
2047	631,665	14,461	153,708	86,615	254,784	11,425	294,572
2048	634,110	14,644	153,450	87,619	255,712	11,416	296,777
2049	636,450	14,826	153,123	88,641	256,591	11,403	298,822
2050	638,689	15,014	152,784	89,701	257,499	11,387	301,045

Table 2: Population and Building Data and Projection – TMWA Retail Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	46,540	163	7,191	2,888	10,242	1,005
1951	47,656	169	7,603	2,954	10,726	1,036
1952	50,027	176	8,040	3,172	11,388	1,085
1953	54,071	181	8,803	3,291	12,275	1,130
1954	56,459	204	9,423	3,424	13,051	1,166
1955	61,003	227	10,175	3,567	13,969	1,215
1956	64,672	232	11,047	3,754	15,033	1,265
1957	68,694	240	11,629	4,025	15,894	1,315
1958	71,633	255	12,598	4,174	17,027	1,366
1959	76,741	274	13,224	4,512	18,010	1,419
1960	80,172	293	14,175	5,357	19,825	1,572
1961	81,106	299	15,006	5,518	20,823	1,630
1962	83,574	331	16,496	5,970	22,797	1,696
1963	86,027	359	17,777	6,901	25,037	1,781
1964	88,671	389	18,895	8,109	27,393	1,884
1965	95,181	423	20,123	8,517	29,063	1,983
1966	96,956	451	20,651	8,694	29,796	2,064
1967	96,026	471	20,864	8,720	30,055	2,134
1968	98,235	487	21,090	8,808	30,385	2,196
1969	107,110	511	21,573	9,098	31,182	2,264
1970	108,754	526	22,602	9,394	32,522	2,354
1971	112,579	543	23,632	10,518	34,693	2,407
1972	117,741	562	25,062	11,695	37,319	2,478
1973	122,584	580	26,372	13,733	40,685	2,618
1974	127,658	596	27,093	15,006	42,695	2,927
1975	131,553	609	27,631	15,364	43,604	3,024
1976	136,817	631	28,736	16,087	45,454	3,123
1977	143,976	663	30,527	17,915	49,105	3,273
1978	150,613	711	32,791	19,512	53,014	3,918
1979	157,654	753	35,424	22,170	58,347	4,089
1980	161,698	772	36,321	23,650	60,743	4,272
1981	167,467	785	36,820	24,100	61,705	4,401
1982	169,863	799	37,470	24,411	62,680	4,481
1983	174,620	815	38,257	25,292	64,364	4,586
1984	180,300	832	39,491	26,529	66,852	4,693
1985	184,707	848	40,941	27,312	69,101	4,779
1986	191,524	861	42,706	29,450	73,017	4,901
1987	196,452	885	44,479	29,876	75,240	5,019
1988	201,363	907	45,782	30,580	77,269	5,162
1989	206,561	921	46,700	31,521	79,142	5,280
1990	210,382	932	48,060	32,049	81,041	5,385
1991	216,736	946	49,073	32,673	82,692	5,476
1992	221,758	955	50,309	32,767	84,031	5,533
1993	227,673	972	51,613	32,878	85,463	5,599
1994	234,663	980	53,190	33,653	87,823	5,690
1995	240,680	991	54,388	33,828	89,207	5,784
1996	246,654	1,002	55,594	34,825	91,421	5,979
1997	251,456	1,010	57,006	36,410	94,426	6,100
1998	255,636	1,015	58,771	37,156	96,942	6,243
1999	258,398	1,024	60,883	38,598	100,505	6,402

Table 2: Population and Building Data and Projection – TMWA Retail Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	262,109	1,031	62,653	39,225	102,909	6,505
2001	270,140	1,040	65,326	40,790	107,156	6,647
2002	273,245	1,048	67,842	41,960	110,850	6,775
2003	281,998	1,054	69,995	42,614	113,663	6,910
2004	287,717	1,064	72,349	43,308	116,721	7,117
2005	294,315	1,074	75,321	43,489	119,884	7,303
2006	302,526	1,085	77,858	44,135	123,078	7,451
2007	308,461	1,095	79,178	44,408	124,681	7,584
2008	311,719	1,097	79,740	45,110	125,947	7,668
2009	317,563	1,098	79,816	45,153	126,067	7,694
2010	322,647	1,106	80,552	45,619	127,277	7,758
2011	327,446	1,119	81,876	45,870	128,865	7,822
2012	332,233	1,141	83,066	46,285	130,492	7,902
2013	336,897	1,166	84,229	46,929	132,324	7,990
2014	341,489	1,185	85,006	47,569	133,760	8,066
2015	346,213	1,199	85,651	48,284	135,134	8,138
2016	350,614	1,214	86,493	48,825	136,532	8,203
2017	354,873	1,228	87,619	49,451	138,298	8,273
2018	358,972	1,247	89,016	50,290	140,553	8,356
2019	363,029	1,267	90,305	51,072	142,644	8,445
2020	367,009	1,283	91,499	52,052	144,834	8,541
2021	370,861	1,299	92,682	52,953	146,934	8,634
2022	374,578	1,312	93,707	53,682	148,701	8,722
2023	378,104	1,324	94,709	54,486	150,519	8,807
2024	381,407	1,338	95,652	55,147	152,137	8,887
2025	384,589	1,351	96,398	55,841	153,590	8,958
2026	387,802	1,365	96,990	56,580	154,935	9,022
2027	390,743	1,379	97,382	57,162	155,923	9,073
2028	393,567	1,392	97,662	57,808	156,862	9,115
2029	396,300	1,407	97,897	58,396	157,700	9,148
2030	398,816	1,422	98,029	58,935	158,386	9,173
2031	401,154	1,439	98,147	59,602	159,188	9,194
2032	403,460	1,456	98,234	60,223	159,913	9,210
2033	405,621	1,473	98,272	60,897	160,642	9,224
2034	407,737	1,490	98,352	61,638	161,480	9,237
2035	409,752	1,508	98,444	62,326	162,278	9,249
2036	411,558	1,525	98,556	63,106	163,187	9,263
2037	413,282	1,542	98,697	63,892	164,131	9,278
2038	414,870	1,559	98,803	64,662	165,024	9,293
2039	416,421	1,575	98,898	65,498	165,971	9,309
2040	417,889	1,592	98,956	66,274	166,822	9,322
2041	419,343	1,607	98,946	67,050	167,603	9,334
2042	420,563	1,623	98,900	67,837	168,360	9,342
2043	421,575	1,639	98,771	68,558	168,968	9,346
2044	422,783	1,654	98,563	69,303	169,520	9,345
2045	423,775	1,670	98,294	70,022	169,986	9,339
2046	424,638	1,686	97,940	70,706	170,332	9,327
2047	425,458	1,701	97,541	71,419	170,661	9,311
2048	426,091	1,718	97,099	72,098	170,915	9,291
2049	426,813	1,734	96,615	72,787	171,136	9,267
2050	427,422	1,751	96,124	73,505	171,380	9,241

Table 3: Population and Building Data and Projection – South Truckee Meadows Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	0	0	0	0	0	0
1951	0	0	0	0	0	0
1952	0	0	0	0	0	0
1953	0	0	0	0	0	0
1954	0	0	0	0	0	0
1955	0	0	0	0	0	0
1956	0	0	0	0	0	0
1957	0	0	0	0	0	0
1958	0	0	0	0	0	0
1959	0	0	0	0	0	0
1960	0	0	0	0	0	0
1961	0	0	0	0	0	0
1962	0	0	0	0	0	0
1963	0	0	0	0	0	0
1964	0	0	0	0	0	0
1965	0	0	0	0	0	0
1966	0	0	0	0	0	0
1967	0	0	0	0	0	0
1968	0	0	0	0	0	0
1969	0	0	0	0	0	0
1970	0	0	0	0	0	0
1971	0	0	0	0	0	0
1972	0	0	0	0	0	0
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
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1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	1
1994	0	0	0	0	0	1
1995	0	0	0	0	0	3
1996	0	0	0	0	0	7
1997	967	0	363	0	363	28
1998	1,627	0	617	0	617	38
1999	3,985	0	1,163	387	1,550	61

Table 3: Population and Building Projection – South Truckee Meadows Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	5,733	0	1,575	676	2,251	97
2001	6,666	0	1,970	674	2,644	118
2002	7,723	0	2,454	679	3,133	137
2003	9,537	0	3,169	675	3,844	180
2004	11,901	0	4,152	676	4,828	229
2005	15,523	0	5,303	1,020	6,323	272
2006	16,832	0	5,827	1,021	6,848	315
2007	17,783	0	6,165	1,023	7,188	335
2008	18,362	0	6,399	1,020	7,419	345
2009	18,950	0	6,502	1,021	7,523	347
2010	19,573	0	6,682	1,039	7,721	353
2011	20,229	0	6,911	1,050	7,961	358
2012	20,872	0	7,133	1,065	8,198	364
2013	21,491	0	7,357	1,084	8,441	371
2014	22,094	0	7,550	1,104	8,654	377
2015	22,702	0	7,735	1,126	8,861	382
2016	23,328	0	7,940	1,144	9,084	388
2017	23,964	0	8,175	1,164	9,339	394
2018	24,592	0	8,440	1,189	9,629	400
2019	25,231	0	8,700	1,214	9,914	407
2020	25,839	0	8,954	1,243	10,197	415
2021	26,457	0	9,212	1,270	10,482	422
2022	27,084	0	9,459	1,293	10,752	429
2023	27,697	0	9,707	1,319	11,026	436
2024	28,314	0	9,953	1,341	11,294	442
2025	28,911	0	10,182	1,364	11,546	449
2026	29,500	0	10,397	1,389	11,786	455
2027	30,082	0	10,594	1,410	12,004	460
2028	30,640	0	10,780	1,432	12,212	465
2029	31,201	0	10,963	1,453	12,416	470
2030	31,749	0	11,135	1,474	12,609	474
2031	32,269	0	11,308	1,497	12,805	478
2032	32,794	0	11,478	1,520	12,998	482
2033	33,297	0	11,643	1,544	13,187	486
2034	33,795	0	11,814	1,570	13,384	489
2035	34,297	0	11,988	1,595	13,583	493
2036	34,773	0	12,166	1,622	13,788	497
2037	35,249	0	12,349	1,650	13,999	501
2038	35,714	0	12,528	1,678	14,206	504
2039	36,167	0	12,708	1,707	14,415	508
2040	36,621	0	12,884	1,735	14,619	512
2041	37,070	0	13,052	1,764	14,816	516
2042	37,492	0	13,216	1,793	15,009	519
2043	37,899	0	13,370	1,820	15,190	523
2044	38,310	0	13,513	1,848	15,361	526
2045	38,701	0	13,648	1,876	15,524	528
2046	39,078	0	13,772	1,903	15,675	531
2047	39,437	0	13,888	1,931	15,819	533
2048	39,781	0	13,998	1,959	15,957	535
2049	40,123	0	14,101	1,987	16,088	537
2050	40,448	0	14,203	2,015	16,218	538

Table 4: Population and Building Projection – Hidden Valley Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	0	0	0	0	0	0
1951	0	0	0	0	0	0
1952	0	0	0	0	0	0
1953	0	0	0	0	0	0
1954	0	0	0	0	0	0
1955	0	0	0	0	0	0
1956	0	0	0	0	0	0
1957	0	0	0	0	0	0
1958	0	0	0	0	0	2
1959	0	0	0	0	0	2
1960	0	0	0	0	0	2
1961	23	0	6	0	6	2
1962	33	0	9	0	9	2
1963	151	0	44	0	44	2
1964	227	0	70	0	70	2
1965	265	0	81	0	81	2
1966	475	0	146	0	146	2
1967	502	0	157	0	157	2
1968	517	0	160	0	160	2
1969	560	0	163	0	163	3
1970	545	0	163	0	163	3
1971	529	0	163	0	163	3
1972	543	0	172	0	172	3
1973	572	0	190	0	190	4
1974	768	0	257	0	257	4
1975	809	0	268	0	268	4
1976	981	0	326	0	326	4
1977	1,196	0	408	0	408	7
1978	1,372	0	483	0	483	7
1979	1,381	0	511	0	511	7
1980	1,379	0	518	0	518	7
1981	1,411	0	520	0	520	7
1982	1,415	0	522	0	522	7
1983	1,435	0	529	0	529	7
1984	1,802	0	668	0	668	7
1985	1,991	0	745	0	745	7
1986	2,243	0	855	0	855	7
1987	2,274	0	871	0	871	7
1988	2,298	0	882	0	882	8
1989	2,354	0	902	0	902	9
1990	2,394	0	922	0	922	10
1991	2,477	0	945	0	945	11
1992	2,536	0	961	0	961	11
1993	2,595	0	974	0	974	11
1994	2,661	0	996	0	996	11
1995	2,749	0	1,019	0	1,019	11
1996	3,016	0	1,118	0	1,118	11
1997	3,038	0	1,141	0	1,141	11
1998	3,170	0	1,202	0	1,202	11
1999	3,304	0	1,285	0	1,285	11

Table 4: Population and Building Projection – Hidden Valley Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	3,436	0	1,349	0	1,349	11
2001	3,592	0	1,425	0	1,425	12
2002	3,752	0	1,522	0	1,522	14
2003	3,811	0	1,536	0	1,536	14
2004	3,831	0	1,554	0	1,554	17
2005	3,891	0	1,585	0	1,585	18
2006	3,930	0	1,599	0	1,599	19
2007	3,978	0	1,608	0	1,608	22
2008	3,995	0	1,614	0	1,614	22
2009	4,073	0	1,617	0	1,617	22
2010	4,119	0	1,625	0	1,625	24
2011	4,180	0	1,645	0	1,645	25
2012	4,234	0	1,663	0	1,663	26
2013	4,277	0	1,680	0	1,680	27
2014	4,315	0	1,690	0	1,690	28
2015	4,345	0	1,696	0	1,696	30
2016	4,381	0	1,706	0	1,706	31
2017	4,419	0	1,722	0	1,722	32
2018	4,452	0	1,743	0	1,743	33
2019	4,482	0	1,761	0	1,761	35
2020	4,505	0	1,778	0	1,778	36
2021	4,528	0	1,794	0	1,794	37
2022	4,549	0	1,806	0	1,806	39
2023	4,567	0	1,818	0	1,818	40
2024	4,585	0	1,829	0	1,829	42
2025	4,597	0	1,836	0	1,836	43
2026	4,603	0	1,839	0	1,839	44
2027	4,609	0	1,839	0	1,839	46
2028	4,609	0	1,837	0	1,837	47
2029	4,606	0	1,833	0	1,833	48
2030	4,603	0	1,828	0	1,828	49
2031	4,591	0	1,822	0	1,822	51
2032	4,582	0	1,816	0	1,816	52
2033	4,568	0	1,809	0	1,809	53
2034	4,550	0	1,802	0	1,802	54
2035	4,535	0	1,796	0	1,796	55
2036	4,514	0	1,790	0	1,790	56
2037	4,492	0	1,784	0	1,784	58
2038	4,470	0	1,778	0	1,778	59
2039	4,443	0	1,771	0	1,771	60
2040	4,419	0	1,764	0	1,764	61
2041	4,391	0	1,755	0	1,755	63
2042	4,362	0	1,746	0	1,746	64
2043	4,329	0	1,735	0	1,735	65
2044	4,297	0	1,723	0	1,723	66
2045	4,263	0	1,710	0	1,710	67
2046	4,226	0	1,695	0	1,695	68
2047	4,186	0	1,679	0	1,679	69
2048	4,146	0	1,663	0	1,663	70
2049	4,105	0	1,646	0	1,646	71
2050	4,063	0	1,629	0	1,629	72

Table 5: Population and Building Projection – Spanish Springs Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	0	0	0	0	0	0
1951	0	0	0	0	0	0
1952	0	0	0	0	0	0
1953	0	0	0	0	0	0
1954	0	0	0	0	0	0
1955	0	0	0	0	0	0
1956	0	0	0	0	0	0
1957	0	0	0	0	0	0
1958	0	0	0	0	0	0
1959	0	0	0	0	0	0
1960	0	0	0	0	0	0
1961	0	0	0	0	0	0
1962	0	0	0	0	0	0
1963	0	0	0	0	0	0
1964	0	0	0	0	0	0
1965	0	0	0	0	0	0
1966	0	0	0	0	0	0
1967	0	0	0	0	0	0
1968	0	0	0	0	0	0
1969	0	0	0	0	0	0
1970	0	0	0	0	0	0
1971	0	0	0	0	0	0
1972	0	0	0	0	0	0
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	327	0	121	0	121	0
1980	591	0	222	0	222	1
1981	868	0	320	0	320	2
1982	959	0	354	0	354	2
1983	1,169	0	431	0	431	2
1984	1,451	0	538	0	538	2
1985	1,884	0	705	0	705	3
1986	1,996	0	761	0	761	3
1987	2,076	0	795	0	795	3
1988	2,298	0	882	0	882	3
1989	2,576	0	987	0	987	3
1990	2,684	0	1,034	0	1,034	4
1991	3,046	0	1,162	0	1,162	4
1992	3,600	0	1,364	0	1,364	4
1993	4,694	0	1,762	0	1,762	5
1994	5,892	0	2,205	0	2,205	6
1995	6,429	0	2,383	0	2,383	6
1996	7,455	0	2,763	0	2,763	6
1997	8,173	0	3,069	0	3,069	6
1998	8,639	0	3,276	0	3,276	6
1999	8,891	0	3,458	0	3,458	7

Table 5: Population and Building Data and Projection – Spanish Springs Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	9,156	0	3,595	0	3,595	9
2001	9,779	0	3,879	0	3,879	12
2002	11,235	0	4,558	0	4,558	12
2003	12,269	0	4,945	0	4,945	24
2004	13,077	0	5,305	0	5,305	24
2005	13,849	0	5,641	0	5,641	35
2006	14,591	0	5,936	0	5,936	51
2007	14,950	0	6,043	0	6,043	64
2008	15,167	0	6,128	0	6,128	65
2009	15,439	0	6,129	0	6,129	65
2010	15,722	0	6,202	0	6,202	70
2011	16,054	0	6,318	0	6,318	74
2012	16,356	0	6,424	0	6,424	79
2013	16,623	0	6,529	0	6,529	84
2014	16,860	0	6,604	0	6,604	88
2015	17,086	0	6,669	0	6,669	93
2016	17,334	0	6,750	0	6,750	98
2017	17,585	0	6,853	0	6,853	103
2018	17,822	0	6,978	0	6,978	108
2019	18,057	0	7,095	0	7,095	113
2020	18,260	0	7,206	0	7,206	118
2021	18,466	0	7,316	0	7,316	124
2022	18,676	0	7,414	0	7,414	129
2023	18,865	0	7,510	0	7,510	135
2024	19,058	0	7,602	0	7,602	140
2025	19,228	0	7,679	0	7,679	146
2026	19,386	0	7,745	0	7,745	152
2027	19,532	0	7,794	0	7,794	157
2028	19,658	0	7,835	0	7,835	162
2029	19,782	0	7,872	0	7,872	167
2030	19,895	0	7,901	0	7,901	172
2031	19,981	0	7,929	0	7,929	177
2032	20,070	0	7,955	0	7,955	182
2033	20,142	0	7,977	0	7,977	187
2034	20,208	0	8,003	0	8,003	192
2035	20,273	0	8,029	0	8,029	197
2036	20,322	0	8,058	0	8,058	202
2037	20,368	0	8,089	0	8,089	207
2038	20,406	0	8,117	0	8,117	212
2039	20,433	0	8,144	0	8,144	217
2040	20,463	0	8,169	0	8,169	222
2041	20,486	0	8,188	0	8,188	227
2042	20,494	0	8,204	0	8,204	233
2043	20,494	0	8,214	0	8,214	237
2044	20,493	0	8,217	0	8,217	242
2045	20,478	0	8,214	0	8,214	247
2046	20,455	0	8,205	0	8,205	252
2047	20,423	0	8,192	0	8,192	256
2048	20,380	0	8,175	0	8,175	260
2049	20,339	0	8,155	0	8,155	265
2050	20,286	0	8,134	0	8,134	269

Table 6: Population and Building Data and Projection – Sun Valley Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	882	0	159	35	194	1
1951	889	0	165	35	200	1
1952	879	0	165	35	200	3
1953	899	0	169	35	204	4
1954	891	0	171	35	206	5
1955	913	0	174	35	209	5
1956	908	0	176	35	211	5
1957	912	0	176	35	211	5
1958	892	0	177	35	212	5
1959	908	0	178	35	213	5
1960	894	0	186	35	221	6
1961	872	0	189	35	224	6
1962	847	0	196	35	231	8
1963	801	0	198	35	233	8
1964	774	0	203	36	239	8
1965	822	0	208	43	251	11
1966	820	0	208	44	252	12
1967	818	0	211	45	256	12
1968	847	0	215	47	262	14
1969	927	0	217	53	270	16
1970	990	0	224	72	296	17
1971	1,038	0	230	90	320	20
1972	1,148	0	235	129	364	22
1973	1,217	0	242	162	404	25
1974	1,268	0	244	180	424	28
1975	1,343	0	246	199	445	30
1976	1,382	0	246	213	459	32
1977	1,525	0	248	272	520	32
1978	1,685	0	249	344	593	33
1979	1,821	0	255	419	674	36
1980	1,898	0	261	452	713	39
1981	2,003	0	262	476	738	52
1982	2,049	0	263	493	756	55
1983	2,162	0	269	528	797	59
1984	2,309	0	274	582	856	62
1985	2,406	0	280	620	900	62
1986	2,531	0	281	684	965	65
1987	2,601	0	281	715	996	67
1988	2,710	0	285	755	1,040	68
1989	2,774	0	285	778	1,063	68
1990	2,858	0	282	819	1,101	69
1991	3,022	0	283	870	1,153	71
1992	3,191	0	285	924	1,209	71
1993	3,439	0	327	964	1,291	71
1994	4,128	0	555	990	1,545	71
1995	4,784	0	751	1,022	1,773	72
1996	5,509	0	983	1,059	2,042	72
1997	6,436	0	1,319	1,098	2,417	74
1998	7,265	0	1,619	1,136	2,755	77
1999	7,944	0	1,915	1,175	3,090	77

Table 6: Population and Building Data and Projection – Sun Valley Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	7,947	0	1,919	1,201	3,120	78
2001	7,906	0	1,917	1,219	3,136	81
2002	7,760	0	1,919	1,229	3,148	81
2003	7,850	0	1,921	1,243	3,164	81
2004	7,849	0	1,926	1,258	3,184	81
2005	7,908	0	1,923	1,298	3,221	83
2006	8,102	0	1,949	1,347	3,296	84
2007	8,253	0	1,966	1,370	3,336	85
2008	8,291	0	1,975	1,375	3,350	85
2009	8,424	0	1,968	1,376	3,344	85
2010	8,548	0	1,980	1,392	3,372	85
2011	8,657	0	2,006	1,401	3,407	86
2012	8,768	0	2,029	1,415	3,444	86
2013	8,875	0	2,050	1,436	3,486	86
2014	8,984	0	2,062	1,457	3,519	87
2015	9,098	0	2,071	1,480	3,551	87
2016	9,201	0	2,085	1,498	3,583	87
2017	9,297	0	2,105	1,518	3,623	87
2018	9,389	0	2,131	1,545	3,676	87
2019	9,478	0	2,154	1,570	3,724	88
2020	9,571	0	2,175	1,602	3,777	88
2021	9,657	0	2,195	1,631	3,826	89
2022	9,741	0	2,212	1,655	3,867	89
2023	9,819	0	2,228	1,681	3,909	89
2024	9,890	0	2,242	1,703	3,945	89
2025	9,956	0	2,251	1,725	3,976	89
2026	10,027	0	2,256	1,750	4,006	89
2027	10,089	0	2,257	1,769	4,026	89
2028	10,151	0	2,255	1,791	4,046	89
2029	10,208	0	2,252	1,810	4,062	89
2030	10,261	0	2,246	1,829	4,075	88
2031	10,309	0	2,240	1,851	4,091	88
2032	10,359	0	2,234	1,872	4,106	87
2033	10,403	0	2,226	1,894	4,120	87
2034	10,448	0	2,219	1,919	4,138	86
2035	10,489	0	2,212	1,942	4,154	86
2036	10,527	0	2,206	1,968	4,174	85
2037	10,560	0	2,200	1,994	4,194	85
2038	10,591	0	2,193	2,020	4,213	84
2039	10,623	0	2,186	2,048	4,234	84
2040	10,651	0	2,178	2,074	4,252	83
2041	10,681	0	2,169	2,100	4,269	83
2042	10,706	0	2,159	2,127	4,286	82
2043	10,724	0	2,147	2,151	4,298	81
2044	10,749	0	2,133	2,177	4,310	81
2045	10,765	0	2,117	2,201	4,318	80
2046	10,782	0	2,100	2,225	4,325	79
2047	10,800	0	2,083	2,249	4,332	78
2048	10,812	0	2,064	2,273	4,337	78
2049	10,824	0	2,044	2,296	4,340	77
2050	10,836	0	2,024	2,321	4,345	76

Table 7: Population and Building Data and Projection – All Wholesale Service Areas

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	968	19	159	35	213	1
1951	977	20	165	35	220	1
1952	966	20	165	35	220	3
1953	987	20	169	35	224	4
1954	982	21	171	35	227	5
1955	1,004	21	174	35	230	5
1956	998	21	176	35	232	5
1957	1,003	21	176	35	232	5
1958	984	22	177	35	234	7
1959	1,001	22	178	35	235	7
1960	987	23	186	35	244	8
1961	989	23	196	35	254	8
1962	968	24	205	35	264	10
1963	1,045	26	243	35	304	10
1964	1,091	29	272	36	337	10
1965	1,189	31	289	43	363	13
1966	1,402	32	355	44	431	14
1967	1,425	33	368	45	446	14
1968	1,474	34	375	47	456	16
1969	1,604	34	380	53	467	19
1970	1,655	36	387	72	495	20
1971	1,691	37	394	90	521	23
1972	1,820	41	407	129	577	25
1973	1,919	43	432	162	637	29
1974	2,180	48	501	180	729	32
1975	2,323	56	515	199	770	34
1976	2,540	58	573	213	844	36
1977	2,917	67	656	272	995	39
1978	3,253	69	732	344	1,145	40
1979	3,723	72	887	419	1,378	43
1980	4,084	81	1,001	452	1,534	47
1981	4,519	86	1,103	476	1,665	61
1982	4,667	90	1,139	493	1,722	64
1983	5,022	94	1,229	528	1,851	68
1984	5,836	102	1,480	582	2,164	72
1985	6,562	104	1,731	620	2,455	72
1986	7,058	110	1,897	684	2,691	75
1987	7,256	116	1,948	715	2,779	77
1988	7,617	120	2,048	755	2,923	79
1989	8,026	123	2,174	778	3,075	80
1990	8,271	130	2,237	819	3,186	83
1991	8,888	131	2,390	870	3,391	86
1992	9,693	139	2,610	924	3,673	87
1993	11,112	145	3,062	964	4,171	88
1994	13,103	159	3,755	990	4,904	90
1995	14,407	164	4,154	1,022	5,340	92
1996	16,452	175	4,864	1,059	6,098	96
1997	19,110	185	5,893	1,098	7,176	119
1998	21,204	192	6,713	1,136	8,041	133
1999	24,625	196	7,820	1,562	9,578	156

Table 7: Population and Building Data and Projection – All Wholesale Service Areas

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	26,789	202	8,438	1,878	10,518	195
2001	28,460	204	9,192	1,893	11,289	223
2002	30,995	212	10,454	1,908	12,574	244
2003	34,005	217	11,571	1,918	13,706	299
2004	37,202	221	12,937	1,934	15,092	351
2005	41,730	229	14,451	2,318	16,998	409
2006	44,028	233	15,311	2,368	17,912	469
2007	45,539	233	15,782	2,392	18,407	506
2008	46,389	234	16,115	2,394	18,743	518
2009	47,476	234	16,217	2,396	18,847	520
2010	48,563	236	16,489	2,432	19,157	532
2011	49,730	239	16,881	2,451	19,571	543
2012	50,851	244	17,249	2,480	19,973	555
2013	51,903	249	17,617	2,520	20,386	568
2014	52,898	253	17,906	2,561	20,720	580
2015	53,887	256	18,171	2,606	21,033	592
2016	54,912	260	18,481	2,642	21,383	604
2017	55,939	263	18,855	2,682	21,800	616
2018	56,936	267	19,292	2,734	22,293	629
2019	57,942	272	19,711	2,784	22,767	643
2020	58,870	275	20,113	2,844	23,232	657
2021	59,811	279	20,517	2,901	23,697	672
2022	60,761	282	20,891	2,948	24,121	686
2023	61,662	284	21,263	3,000	24,547	700
2024	62,570	288	21,626	3,044	24,958	714
2025	63,424	291	21,948	3,090	25,329	727
2026	64,255	294	22,238	3,139	25,671	740
2027	65,056	297	22,484	3,179	25,960	752
2028	65,809	300	22,706	3,223	26,229	763
2029	66,562	303	22,920	3,264	26,487	774
2030	67,281	307	23,111	3,302	26,720	784
2031	67,934	310	23,300	3,348	26,958	794
2032	68,598	314	23,483	3,392	27,189	803
2033	69,213	318	23,655	3,438	27,411	813
2034	69,814	322	23,838	3,489	27,649	822
2035	70,417	326	24,025	3,537	27,888	831
2036	70,967	330	24,219	3,590	28,139	841
2037	71,511	334	24,421	3,645	28,400	850
2038	72,031	338	24,616	3,698	28,652	860
2039	72,525	342	24,809	3,755	28,906	870
2040	73,021	345	24,995	3,810	29,150	879
2041	73,501	349	25,164	3,864	29,377	888
2042	73,933	353	25,324	3,920	29,597	898
2043	74,334	356	25,465	3,972	29,793	906
2044	74,745	360	25,585	4,025	29,970	915
2045	75,117	363	25,690	4,078	30,131	923
2046	75,456	367	25,772	4,128	30,267	930
2047	75,772	371	25,842	4,181	30,394	937
2048	76,051	375	25,900	4,231	30,506	943
2049	76,334	378	25,946	4,283	30,607	949
2050	76,588	382	25,990	4,337	30,709	955

Table 8: Population and Building Data and Projection – Washoe County Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	2,972	362	185	107	654	48
1951	2,963	370	190	107	667	48
1952	3,005	375	200	109	684	57
1953	3,044	379	203	109	691	58
1954	3,063	389	210	109	708	58
1955	3,192	400	216	115	731	61
1956	3,231	415	221	115	751	63
1957	3,306	421	229	115	765	64
1958	3,378	446	242	115	803	67
1959	3,558	462	258	115	835	68
1960	3,834	514	313	121	948	75
1961	3,864	547	323	122	992	78
1962	4,110	613	369	139	1,121	83
1963	4,635	708	500	141	1,349	85
1964	5,532	766	708	235	1,709	91
1965	7,051	850	1,000	303	2,153	111
1966	7,998	899	1,155	404	2,458	120
1967	8,083	938	1,188	404	2,530	131
1968	9,075	975	1,414	418	2,807	153
1969	10,490	1,000	1,632	422	3,054	168
1970	12,159	1,045	2,136	455	3,636	186
1971	14,349	1,199	2,756	467	4,422	194
1972	15,851	1,356	3,161	507	5,024	199
1973	16,487	1,503	3,428	541	5,472	214
1974	17,557	1,580	3,717	575	5,872	265
1975	18,334	1,667	3,809	601	6,077	273
1976	19,345	1,801	4,000	626	6,427	279
1977	20,914	2,157	4,293	683	7,133	286
1978	23,751	2,678	4,824	858	8,360	312
1979	25,780	3,055	5,537	949	9,541	330
1980	27,876	3,263	6,207	1,002	10,472	358
1981	29,729	3,374	6,545	1,035	10,954	396
1982	30,601	3,478	6,760	1,054	11,292	410
1983	31,376	3,568	6,896	1,101	11,565	416
1984	32,197	3,734	7,077	1,127	11,938	419
1985	33,298	3,907	7,365	1,185	12,457	421
1986	33,645	4,072	7,503	1,252	12,827	428
1987	34,640	4,281	7,678	1,308	13,267	436
1988	35,866	4,448	7,969	1,346	13,763	440
1989	36,971	4,582	8,188	1,395	14,165	445
1990	38,501	4,736	8,427	1,668	14,831	465
1991	40,107	4,868	8,743	1,691	15,302	469
1992	41,672	5,016	9,062	1,713	15,791	474
1993	43,381	5,169	9,386	1,729	16,284	478
1994	45,395	5,366	9,876	1,747	16,989	483
1995	47,676	5,530	10,346	1,795	17,671	504
1996	49,206	5,668	10,753	1,817	18,238	529
1997	50,283	5,823	11,222	1,837	18,882	553
1998	51,079	5,919	11,592	1,859	19,370	563
1999	51,597	6,050	12,078	1,941	20,069	581

Table 8: Population and Building Data and Projection – Washoe County Service Area

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	53,079	6,169	12,712	1,959	20,840	602
2001	54,708	6,296	13,431	1,974	21,701	614
2002	55,142	6,406	13,969	1,995	22,370	628
2003	57,180	6,555	14,462	2,030	23,047	649
2004	58,556	6,704	15,003	2,048	23,755	687
2005	60,837	6,830	15,878	2,073	24,781	714
2006	62,487	6,945	16,362	2,115	25,422	735
2007	64,007	7,029	16,720	2,123	25,872	752
2008	65,704	7,078	16,995	2,474	26,547	762
2009	67,056	7,091	17,053	2,476	26,620	763
2010	68,937	7,162	17,420	2,612	27,194	776
2011	70,851	7,274	17,886	2,723	27,883	788
2012	72,841	7,434	18,329	2,847	28,610	803
2013	74,812	7,625	18,772	2,987	29,384	818
2014	76,672	7,768	19,135	3,129	30,032	832
2015	78,495	7,885	19,472	3,281	30,638	845
2016	80,358	8,011	19,858	3,423	31,292	858
2017	82,161	8,131	20,314	3,574	32,019	872
2018	83,940	8,280	20,841	3,745	32,866	887
2019	85,769	8,437	21,349	3,915	33,701	903
2020	87,474	8,574	21,841	4,105	34,520	920
2021	89,193	8,707	22,338	4,293	35,338	937
2022	90,916	8,818	22,803	4,471	36,092	954
2023	92,582	8,929	23,268	4,659	36,856	970
2024	94,306	9,054	23,724	4,839	37,617	986
2025	95,981	9,169	24,137	5,025	38,331	1,001
2026	97,692	9,295	24,515	5,220	39,030	1,015
2027	99,411	9,420	24,846	5,403	39,669	1,028
2028	101,078	9,539	25,152	5,595	40,286	1,040
2029	102,799	9,672	25,449	5,786	40,907	1,051
2030	104,507	9,809	25,721	5,974	41,504	1,061
2031	106,147	9,952	25,991	6,179	42,122	1,071
2032	107,841	10,105	26,255	6,383	42,743	1,081
2033	109,474	10,253	26,507	6,596	43,356	1,090
2034	111,105	10,409	26,773	6,820	44,002	1,099
2035	112,739	10,564	27,043	7,042	44,649	1,108
2036	114,289	10,717	27,321	7,279	45,317	1,117
2037	115,841	10,877	27,608	7,520	46,005	1,126
2038	117,364	11,031	27,888	7,765	46,684	1,136
2039	118,854	11,183	28,167	8,021	47,371	1,145
2040	120,363	11,337	28,437	8,275	48,049	1,155
2041	121,865	11,485	28,689	8,533	48,707	1,164
2042	123,311	11,635	28,932	8,797	49,364	1,173
2043	124,738	11,786	29,152	9,057	49,995	1,181
2044	126,214	11,935	29,348	9,324	50,607	1,189
2045	127,664	12,090	29,527	9,592	51,209	1,196
2046	129,095	12,243	29,681	9,859	51,783	1,202
2047	130,519	12,400	29,819	10,135	52,354	1,208
2048	131,922	12,562	29,945	10,410	52,917	1,213
2049	133,357	12,724	30,056	10,691	53,471	1,218
2050	134,763	12,891	30,164	10,980	54,035	1,222

Table 9: Population and Building Data and Projection – Basin 85, Spanish Springs Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	55	12	0	0	12	1
1951	58	13	0	0	13	1
1952	57	13	0	0	13	1
1953	62	14	0	0	14	1
1954	61	14	0	0	14	1
1955	66	15	0	0	15	1
1956	69	16	0	0	16	1
1957	69	16	0	0	16	1
1958	67	16	0	0	16	1
1959	68	16	0	0	16	1
1960	69	17	0	0	17	1
1961	66	17	0	0	17	1
1962	62	17	0	0	17	1
1963	62	18	0	0	18	1
1964	58	18	0	0	18	1
1965	59	18	0	0	18	1
1966	59	18	0	0	18	1
1967	58	18	0	0	18	1
1968	58	18	0	0	18	1
1969	65	19	0	0	19	1
1970	64	19	0	0	19	1
1971	65	20	0	0	20	1
1972	63	20	0	0	20	1
1973	60	20	0	0	20	1
1974	60	20	0	0	20	1
1975	60	20	0	0	20	1
1976	60	20	0	0	20	1
1977	62	21	0	0	21	1
1978	71	25	0	0	25	1
1979	416	33	121	0	154	1
1980	695	39	222	0	261	2
1981	988	44	320	0	364	3
1982	1,092	49	354	0	403	3
1983	1,321	56	431	0	487	3
1984	1,634	68	538	0	606	3
1985	2,085	75	705	0	780	4
1986	2,219	85	761	0	846	4
1987	2,337	94	801	0	895	4
1988	2,614	105	898	0	1,003	4
1989	2,905	114	999	0	1,113	4
1990	3,515	121	1,233	0	1,354	5
1991	4,312	128	1,517	0	1,645	5
1992	5,555	134	1,971	0	2,105	5
1993	7,278	150	2,582	0	2,732	6
1994	9,347	184	3,314	0	3,498	7
1995	10,368	213	3,630	0	3,843	9
1996	12,082	241	4,237	0	4,478	16
1997	14,053	252	5,025	0	5,277	20
1998	16,091	260	5,842	0	6,102	23
1999	19,154	277	7,021	152	7,450	30

Table 9: Population and Building Data and Projection – Basin 85, Spanish Springs Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	20,536	287	7,625	151	8,063	37
2001	22,697	293	8,558	152	9,003	52
2002	25,387	303	9,845	151	10,299	52
2003	28,435	321	10,986	154	11,461	71
2004	31,301	342	12,205	151	12,698	74
2005	33,911	371	13,289	153	13,813	92
2006	37,261	378	14,446	335	15,159	139
2007	39,554	383	15,067	538	15,988	199
2008	41,105	387	15,381	840	16,608	214
2009	41,888	387	15,402	840	16,629	225
2010	43,245	391	15,671	997	17,059	244
2011	44,653	398	16,044	1,131	17,573	263
2012	46,014	407	16,394	1,272	18,073	282
2013	47,310	418	16,742	1,422	18,582	302
2014	48,556	426	17,017	1,576	19,019	322
2015	49,805	433	17,269	1,738	19,440	342
2016	51,103	440	17,563	1,897	19,900	362
2017	52,418	447	17,918	2,063	20,428	383
2018	53,716	456	18,333	2,243	21,032	405
2019	55,025	465	18,730	2,426	21,621	427
2020	56,278	473	19,112	2,624	22,209	451
2021	57,547	481	19,495	2,824	22,800	474
2022	58,839	487	19,850	3,021	23,358	498
2023	60,095	494	20,203	3,226	23,923	522
2024	61,364	501	20,548	3,428	24,477	546
2025	62,595	508	20,853	3,637	24,998	570
2026	63,821	516	21,128	3,854	25,498	594
2027	65,031	523	21,362	4,065	25,950	617
2028	66,207	530	21,573	4,285	26,388	640
2029	67,394	538	21,775	4,505	26,818	663
2030	68,558	546	21,956	4,725	27,227	685
2031	69,678	555	22,135	4,960	27,650	707
2032	70,818	564	22,309	5,196	28,069	728
2033	71,927	573	22,472	5,441	28,486	750
2034	73,033	582	22,645	5,697	28,924	772
2035	74,154	591	22,823	5,954	29,368	794
2036	75,236	600	23,007	6,225	29,832	816
2037	76,321	610	23,198	6,502	30,310	838
2038	77,393	619	23,383	6,783	30,785	860
2039	78,459	628	23,566	7,077	31,271	883
2040	79,531	637	23,741	7,371	31,749	906
2041	80,609	646	23,902	7,670	32,218	928
2042	81,650	655	24,054	7,977	32,686	950
2043	82,664	664	24,187	8,281	33,132	972
2044	83,721	673	24,301	8,595	33,569	993
2045	84,745	683	24,400	8,910	33,993	1,014
2046	85,749	692	24,477	9,227	34,396	1,035
2047	86,751	702	24,543	9,553	34,798	1,055
2048	87,726	711	24,598	9,880	35,189	1,074
2049	88,729	721	24,642	10,214	35,577	1,093
2050	89,712	731	24,683	10,557	35,971	1,111

Table 10: Population and Building Data and Projection – Basin 86, Sun Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	882	0	159	35	194	1
1951	889	0	165	35	200	1
1952	879	0	165	35	200	3
1953	899	0	169	35	204	4
1954	895	1	171	35	207	5
1955	917	1	174	35	210	5
1956	912	1	176	35	212	5
1957	916	1	176	35	212	5
1958	896	1	177	35	213	5
1959	912	1	178	35	214	5
1960	898	1	186	35	222	6
1961	876	1	189	35	225	6
1962	851	1	196	35	232	8
1963	804	1	198	35	234	8
1964	777	1	203	36	240	8
1965	825	1	208	43	252	11
1966	833	2	208	46	256	12
1967	831	2	211	47	260	12
1968	860	2	215	49	266	14
1969	955	2	219	57	278	16
1970	1,020	2	224	79	305	17
1971	1,084	3	230	101	334	20
1972	1,218	4	238	144	386	22
1973	1,284	4	242	180	426	25
1974	1,348	4	244	203	451	28
1975	1,457	4	249	230	483	30
1976	1,520	6	250	249	505	32
1977	1,689	7	248	321	576	32
1978	1,889	8	253	404	665	33
1979	2,035	9	264	480	753	37
1980	2,103	9	266	515	790	40
1981	2,223	9	267	543	819	54
1982	2,322	11	272	574	857	57
1983	2,463	12	274	622	908	61
1984	2,743	15	293	709	1,017	64
1985	2,868	16	300	757	1,073	64
1986	3,037	16	307	835	1,158	67
1987	3,185	19	308	893	1,220	69
1988	3,338	20	313	948	1,281	70
1989	3,450	21	314	987	1,322	70
1990	3,640	24	311	1,067	1,402	71
1991	3,884	24	313	1,145	1,482	73
1992	4,109	27	316	1,214	1,557	74
1993	4,414	28	359	1,270	1,657	74
1994	5,090	29	581	1,295	1,905	74
1995	5,795	29	785	1,334	2,148	75
1996	6,799	32	1,018	1,470	2,520	75
1997	7,733	33	1,356	1,515	2,904	78
1998	8,430	36	1,595	1,566	3,197	81
1999	8,433	36	1,640	1,604	3,280	82

Table 10: Population and Building Data and Projection – Basin 86, Sun Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	8,410	36	1,634	1,632	3,302	84
2001	8,382	37	1,636	1,652	3,325	87
2002	8,245	38	1,642	1,665	3,345	87
2003	8,326	38	1,642	1,676	3,356	87
2004	8,337	39	1,645	1,698	3,382	90
2005	8,396	40	1,637	1,743	3,420	92
2006	8,618	41	1,676	1,789	3,506	93
2007	8,768	42	1,687	1,815	3,544	94
2008	8,796	42	1,693	1,819	3,554	94
2009	8,965	42	1,696	1,821	3,559	94
2010	9,123	43	1,717	1,839	3,599	94
2011	9,252	43	1,750	1,848	3,641	95
2012	9,387	44	1,780	1,863	3,687	95
2013	9,527	46	1,809	1,887	3,742	96
2014	9,673	47	1,831	1,911	3,789	96
2015	9,825	47	1,849	1,939	3,835	96
2016	9,961	48	1,872	1,959	3,879	97
2017	10,092	49	1,902	1,982	3,933	97
2018	10,219	50	1,937	2,014	4,001	97
2019	10,343	51	1,970	2,043	4,064	98
2020	10,478	52	2,002	2,081	4,135	98
2021	10,603	53	2,033	2,115	4,201	99
2022	10,723	54	2,061	2,142	4,257	99
2023	10,842	55	2,089	2,172	4,316	100
2024	10,948	55	2,115	2,197	4,367	100
2025	11,055	56	2,137	2,222	4,415	100
2026	11,171	57	2,156	2,250	4,463	100
2027	11,277	58	2,171	2,271	4,500	100
2028	11,381	59	2,183	2,294	4,536	100
2029	11,482	60	2,194	2,315	4,569	100
2030	11,580	61	2,203	2,335	4,599	100
2031	11,673	62	2,211	2,359	4,632	99
2032	11,765	63	2,219	2,381	4,663	99
2033	11,857	64	2,226	2,406	4,696	98
2034	11,948	65	2,234	2,433	4,732	98
2035	12,034	66	2,243	2,457	4,766	97
2036	12,116	67	2,251	2,486	4,804	97
2037	12,195	68	2,261	2,514	4,843	96
2038	12,268	69	2,269	2,542	4,880	96
2039	12,347	71	2,278	2,572	4,921	95
2040	12,420	72	2,286	2,600	4,958	95
2041	12,492	73	2,292	2,628	4,993	94
2042	12,560	74	2,297	2,657	5,028	94
2043	12,620	75	2,301	2,682	5,058	93
2044	12,687	76	2,302	2,709	5,087	93
2045	12,747	77	2,302	2,734	5,113	92
2046	12,807	78	2,301	2,758	5,137	91
2047	12,864	79	2,298	2,783	5,160	90
2048	12,916	81	2,294	2,806	5,181	89
2049	12,971	82	2,289	2,830	5,201	89
2050	13,024	83	2,284	2,855	5,222	88

Table 11: Population and Building Data and Projection – Basin 87, Truckee Meadows

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	45,236	209	6,830	2,916	9,955	1,002
1951	46,389	216	7,243	2,982	10,441	1,033
1952	48,784	223	7,682	3,200	11,105	1,079
1953	52,842	230	8,447	3,319	11,996	1,122
1954	55,265	253	9,070	3,452	12,775	1,158
1955	59,810	278	9,823	3,595	13,696	1,207
1956	63,519	285	10,698	3,782	14,765	1,256
1957	67,557	295	11,283	4,053	15,631	1,304
1958	69,525	325	11,999	4,202	16,526	1,360
1959	74,619	347	12,625	4,540	17,512	1,412
1960	78,243	376	13,587	5,385	19,348	1,543
1961	79,287	383	14,427	5,546	20,356	1,598
1962	81,913	425	15,921	5,998	22,344	1,665
1963	84,701	472	17,250	6,929	24,651	1,751
1964	87,561	511	18,402	8,137	27,050	1,854
1965	93,956	554	19,590	8,545	28,689	1,951
1966	95,778	588	20,126	8,720	29,434	2,032
1967	94,943	615	20,355	8,746	29,716	2,101
1968	97,203	635	20,596	8,835	30,066	2,161
1969	106,049	659	21,090	9,124	30,873	2,232
1970	107,727	678	22,119	9,418	32,215	2,327
1971	111,625	699	23,158	10,542	34,399	2,380
1972	117,013	724	24,635	11,729	37,088	2,449
1973	122,099	746	26,027	13,751	40,524	2,590
1974	127,580	769	26,865	15,035	42,669	2,901
1975	131,626	792	27,442	15,394	43,628	2,993
1976	137,157	815	28,626	16,126	45,567	3,090
1977	144,803	864	30,570	17,953	49,387	3,242
1978	150,474	903	32,511	19,551	52,965	3,889
1979	156,862	955	34,884	22,215	58,054	4,063
1980	160,939	991	35,772	23,695	60,458	4,250
1981	166,726	1,009	36,277	24,146	61,432	4,375
1982	168,917	1,033	36,921	24,377	62,331	4,454
1983	173,385	1,060	37,705	25,144	63,909	4,560
1984	179,059	1,088	38,953	26,351	66,392	4,666
1985	183,568	1,111	40,436	27,128	68,675	4,750
1986	190,566	1,135	42,258	29,259	72,652	4,871
1987	195,329	1,169	43,976	29,665	74,810	4,991
1988	200,102	1,201	45,291	30,293	76,785	5,135
1989	205,357	1,224	46,226	31,231	78,681	5,250
1990	209,201	1,247	47,390	31,949	80,586	5,356
1991	215,077	1,271	48,344	32,444	82,059	5,443
1992	219,446	1,294	49,335	32,526	83,155	5,496
1993	224,852	1,331	50,447	32,626	84,404	5,563
1994	231,176	1,356	51,800	33,362	86,518	5,650
1995	237,084	1,387	52,949	33,538	87,874	5,750
1996	242,699	1,414	54,191	34,350	89,955	5,952
1997	247,558	1,436	55,635	35,891	92,962	6,102
1998	250,984	1,445	57,099	36,634	95,178	6,246
1999	253,526	1,463	59,016	38,131	98,610	6,430

Table 11: Population and Building Data and Projection – Basin 87, Truckee Meadows

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	257,904	1,483	60,726	39,049	101,258	6,566
2001	264,564	1,501	63,109	40,334	104,944	6,719
2002	266,669	1,519	65,212	41,451	108,182	6,870
2003	274,458	1,537	67,018	42,069	110,624	7,038
2004	278,794	1,563	68,859	42,679	113,101	7,297
2005	284,996	1,585	71,296	43,207	116,088	7,534
2006	290,371	1,606	72,864	43,663	118,133	7,703
2007	295,007	1,626	73,884	43,733	119,243	7,810
2008	298,369	1,630	74,458	44,465	120,553	7,893
2009	304,240	1,634	74,637	44,507	120,778	7,910
2010	308,951	1,648	75,295	44,931	121,874	7,963
2011	313,432	1,672	76,526	45,152	123,350	8,018
2012	317,922	1,706	77,632	45,533	124,871	8,089
2013	322,326	1,748	78,713	46,140	126,601	8,168
2014	326,661	1,779	79,433	46,740	127,952	8,235
2015	331,128	1,803	80,029	47,414	129,246	8,296
2016	335,270	1,830	80,810	47,917	130,557	8,351
2017	339,256	1,855	81,855	48,502	132,212	8,411
2018	343,094	1,887	83,154	49,295	134,336	8,483
2019	346,889	1,920	84,351	50,031	136,302	8,561
2020	350,625	1,949	85,459	50,960	138,368	8,646
2021	354,228	1,977	86,557	51,810	140,344	8,728
2022	357,688	1,999	87,507	52,490	141,996	8,804
2023	360,977	2,022	88,436	53,243	143,701	8,878
2024	364,046	2,048	89,309	53,855	145,212	8,945
2025	367,006	2,071	89,998	54,499	146,568	9,004
2026	370,006	2,097	90,543	55,185	147,825	9,055
2027	372,747	2,123	90,901	55,718	148,742	9,093
2028	375,377	2,147	91,154	56,311	149,612	9,121
2029	377,925	2,174	91,366	56,848	150,388	9,141
2030	380,266	2,202	91,482	57,335	151,019	9,152
2031	382,440	2,232	91,583	57,947	151,762	9,160
2032	384,586	2,263	91,657	58,512	152,432	9,162
2033	386,590	2,293	91,684	59,128	153,105	9,162
2034	388,557	2,325	91,751	59,808	153,884	9,162
2035	390,416	2,357	91,828	60,435	154,620	9,160
2036	392,080	2,388	91,925	61,151	155,464	9,160
2037	393,667	2,421	92,048	61,872	156,341	9,161
2038	395,115	2,452	92,139	62,575	157,166	9,162
2039	396,530	2,483	92,219	63,341	158,043	9,163
2040	397,859	2,514	92,264	64,048	158,826	9,162
2041	399,182	2,544	92,247	64,754	159,545	9,159
2042	400,275	2,574	92,195	65,469	160,238	9,153
2043	401,174	2,604	92,067	66,120	160,791	9,142
2044	402,257	2,634	91,864	66,792	161,290	9,127
2045	403,138	2,664	91,605	67,439	161,708	9,107
2046	403,893	2,695	91,267	68,049	162,011	9,081
2047	404,614	2,726	90,886	68,688	162,300	9,051
2048	405,150	2,758	90,466	69,291	162,515	9,017
2049	405,776	2,790	90,006	69,905	162,701	8,979
2050	406,293	2,824	89,541	70,543	162,908	8,940

Table 12: Population and Building Data and Projection – Basin 91, Truckee Canyon Segment

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	450	79	8	12	99	0
1951	449	81	8	12	101	0
1952	452	81	8	14	103	0
1953	454	81	8	14	103	0
1954	450	82	8	14	104	0
1955	467	83	10	14	107	0
1956	460	84	9	14	107	0
1957	471	85	10	14	109	0
1958	459	85	10	14	109	0
1959	464	85	10	14	109	0
1960	457	89	10	14	113	0
1961	440	90	9	14	113	0
1962	422	91	10	14	115	0
1963	392	91	9	14	114	0
1964	372	91	10	14	115	0
1965	380	91	11	14	116	0
1966	390	95	11	14	120	0
1967	377	95	9	14	118	1
1968	391	98	9	14	121	3
1969	416	98	9	14	121	3
1970	435	106	10	14	130	3
1971	428	107	11	14	132	3
1972	426	112	9	14	135	3
1973	434	121	9	14	144	4
1974	431	121	9	14	144	4
1975	450	124	10	15	149	6
1976	455	127	10	14	151	6
1977	472	137	11	13	161	7
1978	517	156	12	14	182	7
1979	567	179	17	14	210	7
1980	642	191	35	15	241	8
1981	654	192	36	13	241	8
1982	691	196	41	18	255	9
1983	738	200	42	30	272	9
1984	1,028	211	139	31	381	9
1985	1,176	223	185	32	440	9
1986	1,432	254	261	31	546	11
1987	1,645	284	314	32	630	11
1988	1,796	304	352	33	689	11
1989	1,931	318	388	34	740	12
1990	2,035	338	411	35	784	12
1991	2,105	353	415	35	803	12
1992	2,169	365	422	35	822	12
1993	2,222	375	423	36	834	12
1994	2,269	382	434	33	849	12
1995	2,323	387	441	33	861	15
1996	2,363	393	449	34	876	16
1997	2,354	397	452	35	884	18
1998	2,365	403	462	32	897	20
1999	2,342	408	469	34	911	21

Table 12: Population and Building Data and Projection – Basin 91, Truckee Canyon Segment

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	2,399	414	494	34	942	22
2001	2,617	430	572	36	1,038	23
2002	2,867	439	692	32	1,163	24
2003	3,451	446	912	33	1,391	26
2004	4,121	456	1,183	33	1,672	34
2005	6,241	459	2,049	34	2,542	35
2006	7,283	465	2,464	34	2,963	38
2007	7,736	468	2,625	34	3,127	39
2008	8,009	470	2,731	35	3,236	40
2009	8,141	472	2,725	35	3,232	40
2010	8,335	476	2,777	35	3,288	42
2011	8,553	483	2,847	36	3,366	44
2012	8,763	493	2,913	36	3,442	45
2013	8,964	505	2,979	37	3,521	47
2014	9,147	514	3,032	37	3,583	49
2015	9,328	522	3,081	38	3,641	50
2016	9,517	530	3,138	38	3,706	52
2017	9,702	537	3,205	39	3,781	54
2018	9,884	546	3,284	40	3,870	55
2019	10,065	556	3,359	40	3,955	57
2020	10,232	565	3,432	41	4,038	59
2021	10,399	573	3,505	42	4,120	61
2022	10,572	580	3,574	43	4,197	63
2023	10,731	587	3,642	43	4,272	65
2024	10,895	594	3,708	44	4,346	67
2025	11,050	601	3,768	44	4,413	68
2026	11,203	609	3,822	45	4,476	70
2027	11,357	617	3,869	46	4,532	72
2028	11,496	624	3,912	46	4,582	74
2029	11,640	632	3,953	47	4,632	75
2030	11,779	641	3,990	47	4,678	77
2031	11,904	649	4,027	48	4,724	78
2032	12,037	659	4,064	48	4,771	80
2033	12,158	668	4,098	49	4,815	81
2034	12,277	678	4,134	50	4,862	83
2035	12,393	687	4,171	50	4,908	85
2036	12,499	696	4,209	51	4,956	86
2037	12,608	706	4,249	52	5,007	88
2038	12,711	716	4,287	53	5,056	89
2039	12,803	725	4,325	53	5,103	91
2040	12,901	734	4,362	54	5,150	92
2041	12,995	743	4,396	55	5,194	94
2042	13,080	752	4,428	56	5,236	95
2043	13,159	761	4,457	56	5,274	97
2044	13,243	770	4,483	57	5,310	98
2045	13,323	780	4,506	58	5,344	100
2046	13,390	789	4,524	58	5,371	101
2047	13,457	798	4,541	59	5,398	102
2048	13,522	808	4,556	60	5,424	104
2049	13,582	818	4,568	60	5,446	105
2050	13,640	828	4,580	61	5,469	106

Table 13: Population and Building Data and Projection – Basin 92, Lemmon Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	2,336	37	433	44	514	18
1951	2,288	38	433	44	515	18
1952	2,267	39	433	44	516	22
1953	2,273	39	433	44	516	25
1954	2,250	42	434	44	520	25
1955	2,280	43	435	44	522	25
1956	2,250	44	435	44	523	26
1957	2,265	46	434	44	524	29
1958	3,294	46	693	44	783	29
1959	3,345	49	692	44	785	31
1960	3,247	56	703	44	803	57
1961	3,151	61	703	45	809	61
1962	3,127	71	720	62	853	61
1963	3,024	86	730	64	880	62
1964	2,887	92	735	65	892	62
1965	3,350	107	831	85	1,023	67
1966	3,596	115	904	86	1,105	67
1967	3,562	121	908	86	1,115	69
1968	3,657	138	906	87	1,131	73
1969	3,947	151	908	90	1,149	74
1970	4,568	168	1,105	93	1,366	77
1971	4,955	249	1,181	97	1,527	77
1972	5,398	310	1,300	101	1,711	80
1973	5,692	381	1,372	136	1,889	85
1974	5,753	409	1,378	137	1,924	86
1975	5,992	432	1,413	141	1,986	94
1976	6,339	490	1,469	147	2,106	97
1977	6,796	662	1,480	176	2,318	99
1978	8,830	932	1,990	186	3,108	100
1979	10,227	1,095	2,490	200	3,785	100
1980	10,329	1,170	2,499	211	3,880	106
1981	10,677	1,211	2,503	220	3,934	111
1982	10,927	1,228	2,513	291	4,032	116
1983	11,414	1,261	2,542	404	4,207	116
1984	11,659	1,319	2,595	409	4,323	117
1985	12,004	1,378	2,702	411	4,491	119
1986	12,103	1,431	2,762	421	4,614	121
1987	12,392	1,497	2,825	424	4,746	125
1988	12,683	1,543	2,840	484	4,867	128
1989	12,841	1,578	2,847	495	4,920	134
1990	13,014	1,605	2,907	501	5,013	139
1991	13,627	1,632	2,950	617	5,199	145
1992	14,111	1,658	3,062	627	5,347	151
1993	14,711	1,686	3,203	633	5,522	152
1994	15,439	1,730	3,368	680	5,778	158
1995	16,118	1,751	3,527	696	5,974	164
1996	16,649	1,772	3,596	803	6,171	171
1997	17,168	1,805	3,788	854	6,447	175
1998	17,652	1,827	4,008	859	6,694	185
1999	18,784	1,838	4,411	1,057	7,306	187

Table 13: Population and Building Data and Projection – Basin 92, Lemmon Valley

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	19,650	1,854	4,793	1,068	7,715	190
2001	21,267	1,867	5,216	1,353	8,436	197
2002	22,141	1,882	5,683	1,417	8,982	202
2003	23,130	1,908	5,944	1,471	9,323	218
2004	24,591	1,922	6,489	1,565	9,976	239
2005	25,760	1,935	6,983	1,575	10,493	247
2006	26,996	1,946	7,447	1,590	10,983	254
2007	27,575	1,956	7,595	1,595	11,146	267
2008	27,787	1,962	7,651	1,614	11,227	269
2009	28,314	1,962	7,667	1,611	11,240	270
2010	29,000	1,973	7,829	1,638	11,440	276
2011	29,653	1,997	8,023	1,650	11,670	281
2012	30,315	2,033	8,205	1,669	11,907	287
2013	30,964	2,078	8,388	1,696	12,162	292
2014	31,570	2,109	8,534	1,723	12,366	298
2015	32,163	2,133	8,668	1,753	12,554	303
2016	32,765	2,159	8,824	1,776	12,759	309
2017	33,348	2,183	9,010	1,803	12,996	314
2018	33,917	2,215	9,227	1,838	13,280	320
2019	34,495	2,248	9,436	1,870	13,554	326
2020	35,025	2,276	9,636	1,910	13,822	333
2021	35,563	2,303	9,839	1,948	14,090	339
2022	36,092	2,323	10,026	1,979	14,328	346
2023	36,600	2,344	10,213	2,013	14,570	352
2024	37,119	2,368	10,396	2,042	14,806	358
2025	37,615	2,389	10,560	2,073	15,022	364
2026	38,108	2,412	10,708	2,105	15,225	370
2027	38,595	2,435	10,835	2,131	15,401	375
2028	39,058	2,456	10,951	2,160	15,567	380
2029	39,532	2,481	11,063	2,187	15,731	385
2030	39,993	2,506	11,164	2,213	15,883	389
2031	40,421	2,533	11,264	2,243	16,040	393
2032	40,857	2,562	11,361	2,271	16,194	397
2033	41,271	2,590	11,453	2,302	16,345	401
2034	41,675	2,619	11,551	2,335	16,505	405
2035	42,079	2,647	11,651	2,367	16,665	409
2036	42,445	2,675	11,753	2,402	16,830	413
2037	42,811	2,704	11,860	2,438	17,002	417
2038	43,160	2,732	11,963	2,473	17,168	421
2039	43,491	2,758	12,066	2,510	17,334	425
2040	43,827	2,785	12,165	2,546	17,496	429
2041	44,155	2,810	12,256	2,582	17,648	433
2042	44,454	2,835	12,343	2,618	17,796	436
2043	44,743	2,861	12,420	2,652	17,933	440
2044	45,042	2,885	12,487	2,688	18,060	443
2045	45,323	2,911	12,547	2,722	18,180	446
2046	45,589	2,936	12,596	2,755	18,287	449
2047	45,844	2,961	12,639	2,789	18,389	452
2048	46,083	2,988	12,675	2,822	18,485	454
2049	46,331	3,014	12,707	2,856	18,577	457
2050	46,558	3,041	12,736	2,891	18,668	459

Table 14: Population and Building Data and Projection – Basin 00, All Other Basin in Washoe County

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1950	1,522	207	105	23	335	32
1951	1,524	211	109	23	343	32
1952	1,560	215	117	23	355	40
1953	1,573	216	118	23	357	40
1954	1,583	222	121	23	366	40
1955	1,659	228	123	29	380	43
1956	1,691	238	126	29	393	45
1957	1,724	239	131	29	399	45
1958	1,759	250	139	29	418	45
1959	1,883	260	153	29	442	45
1960	2,079	291	188	35	514	48
1961	2,127	317	194	35	546	50
1962	2,266	363	220	35	618	54
1963	2,721	425	332	35	792	54
1964	3,645	471	527	128	1,126	60
1965	4,860	533	775	176	1,484	77
1966	5,698	564	911	276	1,751	86
1967	5,764	591	937	276	1,804	95
1968	6,608	605	1,151	288	2,044	113
1969	7,770	616	1,358	288	2,262	125
1970	8,751	634	1,666	317	2,617	135
1971	10,459	701	2,201	321	3,223	143
1972	11,304	789	2,451	343	3,583	147
1973	11,413	854	2,579	355	3,788	156
1974	12,223	901	2,812	375	4,088	204
1975	12,641	960	2,847	383	4,190	207
1976	13,172	1,032	2,955	389	4,376	212
1977	13,997	1,196	3,168	410	4,774	217
1978	15,833	1,434	3,582	557	5,573	240
1979	17,082	1,609	4,085	628	6,322	254
1980	18,959	1,716	4,736	670	7,122	271
1981	20,445	1,780	5,064	689	7,533	307
1982	21,192	1,850	5,272	698	7,820	316
1983	21,707	1,888	5,389	724	8,001	321
1984	22,207	1,967	5,530	737	8,234	324
1985	22,851	2,056	5,704	789	8,549	326
1986	22,883	2,122	5,758	844	8,724	330
1987	23,481	2,219	5,887	887	8,993	332
1988	24,317	2,302	6,111	918	9,331	333
1989	25,079	2,371	6,288	950	9,609	335
1990	25,747	2,463	6,471	984	9,918	350
1991	26,747	2,537	6,671	997	10,205	353
1992	27,749	2,632	6,881	1,002	10,515	355
1993	28,718	2,716	7,054	1,010	10,780	358
1994	29,844	2,824	7,330	1,015	11,169	361
1995	31,067	2,918	7,556	1,041	11,515	367
1996	31,718	2,993	7,719	1,044	11,756	374
1997	32,007	3,096	7,872	1,051	12,019	379
1998	32,364	3,155	8,062	1,056	12,273	383
1999	32,405	3,248	8,232	1,124	12,604	389

Table 14: Population and Building Data and Projection – Basin 00, All Other Basin in Washoe County

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2000	33,032	3,328	8,513	1,128	12,969	403
2001	33,814	3,413	8,866	1,134	13,413	406
2002	34,056	3,485	9,189	1,142	13,816	412
2003	35,372	3,576	9,526	1,155	14,257	418
2004	36,359	3,668	9,919	1,163	14,750	421
2005	37,561	3,743	10,384	1,173	15,300	425
2006	38,485	3,827	10,624	1,206	15,657	428
2007	39,398	3,883	10,834	1,208	15,925	433
2008	39,729	3,918	10,924	1,210	16,052	437
2009	40,503	3,926	10,947	1,206	16,079	437
2010	41,488	3,972	11,172	1,222	16,366	446
2011	42,488	4,040	11,453	1,228	16,721	453
2012	43,516	4,134	11,720	1,238	17,092	461
2013	44,522	4,246	11,986	1,255	17,487	470
2014	45,449	4,331	12,200	1,271	17,802	479
2015	46,341	4,402	12,397	1,289	18,088	487
2016	47,267	4,478	12,625	1,303	18,406	495
2017	48,159	4,551	12,898	1,319	18,768	503
2018	49,021	4,640	13,214	1,340	19,194	512
2019	49,915	4,734	13,519	1,360	19,613	521
2020	50,715	4,817	13,812	1,385	20,014	531
2021	51,527	4,899	14,108	1,408	20,415	541
2022	52,335	4,967	14,383	1,426	20,776	551
2023	53,104	5,036	14,657	1,447	21,140	561
2024	53,906	5,113	14,926	1,463	21,502	570
2025	54,670	5,185	15,167	1,481	21,833	579
2026	55,436	5,263	15,386	1,499	22,148	588
2027	56,207	5,340	15,575	1,514	22,429	595
2028	56,937	5,415	15,748	1,530	22,693	603
2029	57,688	5,497	15,915	1,544	22,956	609
2030	58,430	5,582	16,066	1,557	23,205	616
2031	59,119	5,670	16,216	1,574	23,460	622
2032	59,835	5,765	16,362	1,589	23,716	627
2033	60,507	5,857	16,500	1,606	23,963	633
2034	61,166	5,953	16,647	1,624	24,224	638
2035	61,830	6,049	16,797	1,641	24,487	644
2036	62,435	6,145	16,951	1,660	24,756	649
2037	63,036	6,244	17,111	1,679	25,034	655
2038	63,614	6,340	17,266	1,698	25,304	661
2039	64,165	6,435	17,420	1,719	25,574	667
2040	64,727	6,532	17,569	1,738	25,839	672
2041	65,275	6,625	17,707	1,757	26,089	678
2042	65,782	6,720	17,838	1,776	26,334	683
2043	66,282	6,816	17,956	1,794	26,566	689
2044	66,792	6,910	18,059	1,812	26,781	693
2045	67,281	7,008	18,151	1,829	26,988	698
2046	67,760	7,106	18,228	1,846	27,180	702
2047	68,218	7,206	18,295	1,863	27,364	705
2048	68,665	7,309	18,355	1,879	27,543	709
2049	69,116	7,412	18,405	1,896	27,713	712
2050	69,545	7,518	18,454	1,913	27,885	714

Discussion

The memorandum "TPEM Series No. 1: Washoe County Population Projection 2009 to 2050", developed a population projection model based on the fitting of a logistic curve model to past population and project that population to the year 2050. That was the first of three steps to developing a water demand projection. The second step, described in this memorandum is the development of a Washoe County Inventory of buildings that consume water and then use that inventory to project future building inventories as a function of population. The third step is the estimation of water demand as a function of building inventories and historic water use coefficients. The water demand projection is describe in TPEM Series No. 3.

Data Development and Graphical Analysis

The development of a time series projection requires a time series data source from which trends and relationships can be modeled and used to project future trends. As a general rule, the time series needs to be at least as long as the projection horizon and longer if possible. The planning horizon for the 2030 Water Resource plan is 22 years, 2009 to 2030. A review of available data showed that time series statistic on annual building construction by building type for Washoe County is not available. Assessor's parcel and building data was used to construction the required annualized data using building card records and the construction year for each building.

For land area analysis a geographic information system ("GIS") was used to compute annualized land development by computing the parcel land area for each parcel and year the building was constructed. The GIS was also used to assign spatial attributes to each parcel to facilitate the disaggregation of the County Projects to smaller sub areas. Each parcel was assigned the following attributes: X and Y location, name of utility service area, and hydrographic water basin name and number. The spatial attributes provide the means to allocate the County projections to sub areas and maintain the condition that all county sub area projection must sum back to the county total projection.

The analysis and model estimation process followed the following steps:

- Convert Assessor's database in to a time series for analysis.
- Estimate statistical models and refine to obtain best statistical performance.
- Perform share / ratio analysis on each sub area.
- Project sub area shares through planning horizon.
- Disaggregate projections using sub county shares.
- Develop graphs and tables for water resource plan.

Each of these steps is described in detail below.

Convert Assessor's database to a time series.

The Assessor's generic parcel data files were downloaded, imported into a statistical database. The complete download contains a number of different data tables and various support tables. The full data dictionary and a the most recent version of the data can be downloaded from, http://www.washoecounty.us/assessor/dl.htm. From this download the Property File and Building File tables are used for analysis. The GIS parcel data is provided to TMWA as part of a data license, however the parcel data can also be purchased by visiting,

http://www.co.washoe.nv.us/gis/datawarehouse.htm. The list of service areas and basins names used in this analysis are provide in Appendix A.

The time series data needs to be able to provide a count of new buildings by year by building type. In the data there are several dates stored; in the property table there is the year of original construction and average year of construction. The building table has the year when a building was constructed and each parcel can have more than on building. Using the various combination of dates, four possible measures for when a parcel of land is considered developed. 1) Acres by the year of the first building constructed. 2) acres by the year of the last building constructed. 3) the average year of all buildings on a parcel and 4) the midpoint between the first and last year.

A review of Figure 7 shows that all measures converge and provide a reasonable trend in land development. One event that stands out is what looks to be the development of very large tracts of land. This can be seen as sharp shift or steps in the land development curve. This would happen when a large parcel of land has its first building constructed and develop continues for several years. The blue line, " Cumulative Acres by First Year", provide a clear trend line from about 1970 to 2008. This line is consistent with the other measures of year developed and provides the longest time series for analysis.

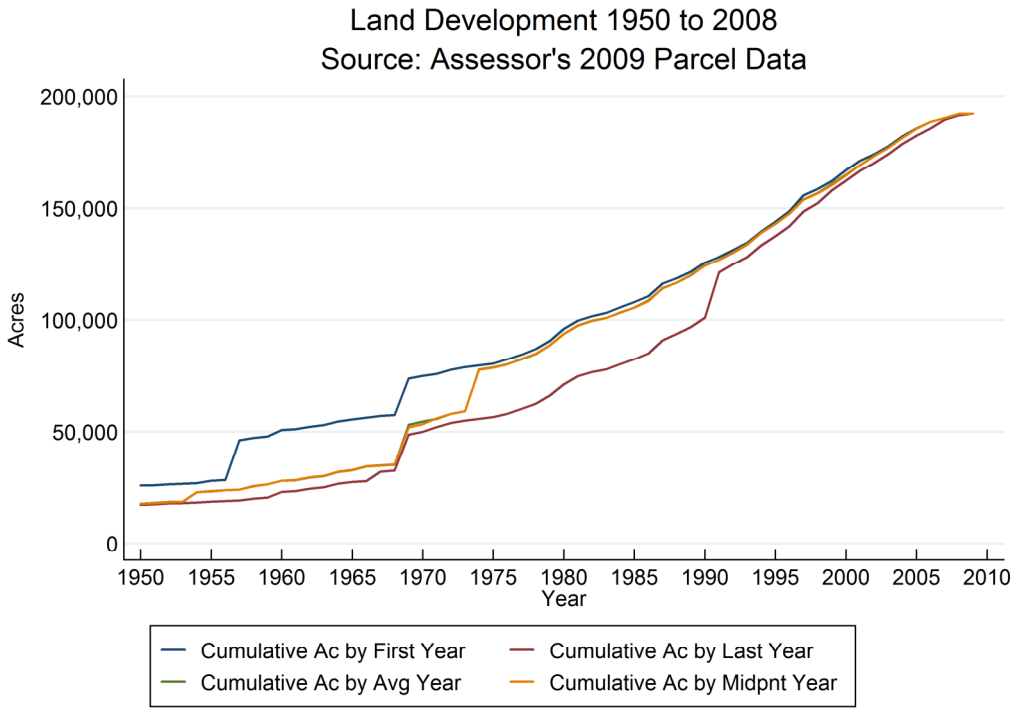

Figure 7: Land development trends by year of buildings.

Figure 8 is a view of all population and dwelling data. The historic and projection population is shown to determine how its trend might relate to the developed and total dwelling units. The Total developed land shows a strong relationship over time. The persons per dwelling unit, and persons per developed acre of land is computed. The graph shows that since about 1980 the trend has been relatively constant for these two measures. The measures prior to 1980 suggest that the housing data when compared to population might not present a complete picture. It is

both possible and expected that over time older properties might be redeveloped. This results in a count of dwelling units for these year as being too low relative to population, hence, the large person per dwelling units.

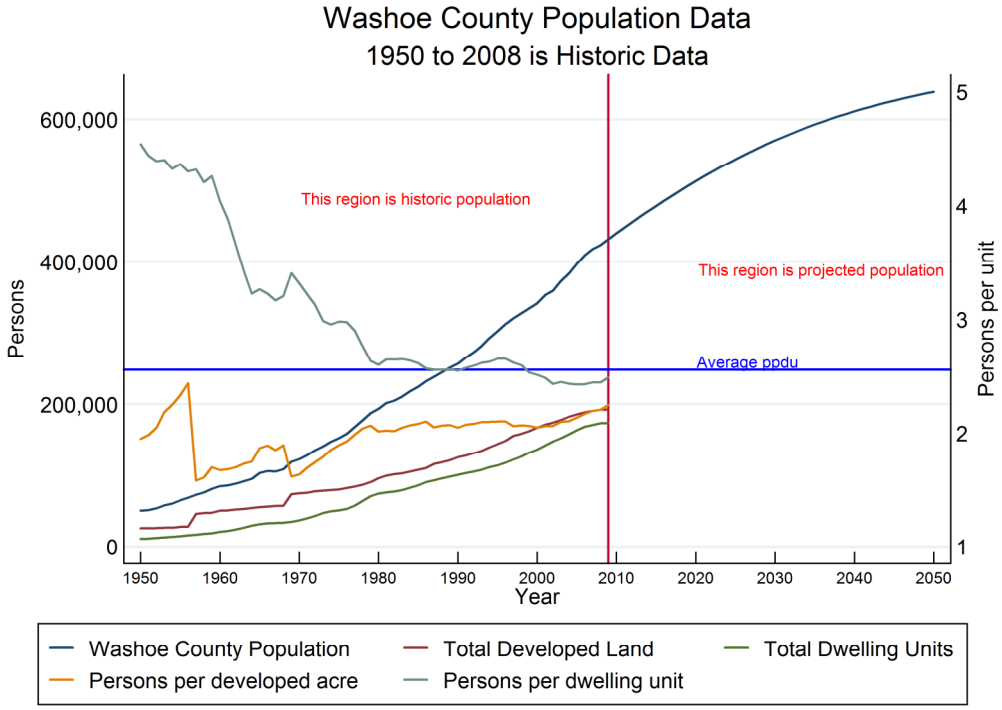

Figure 8: Washoe County population and developed land.

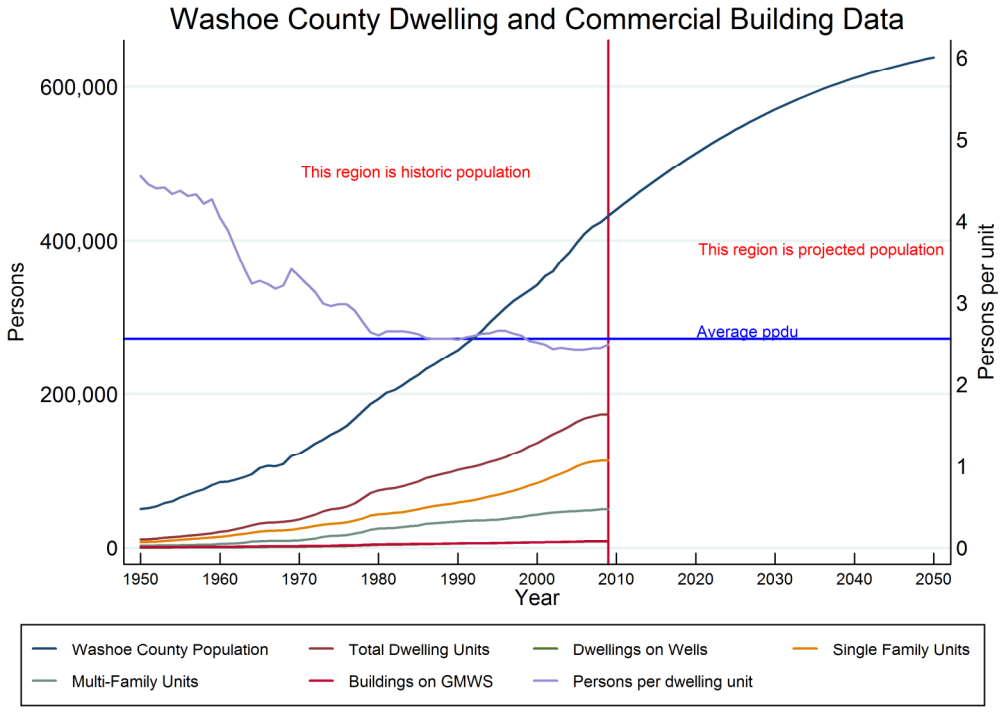

Figure 9: Washoe County population, dwelling units, and commercial buildings data.

The parcel and building data was reclassified into four major classes of building: dwellings on well, single family units, multi-family units, and commercial buildings (Figure 9). These classification correspond to classes of water customer classes. Dwellings on wells are generally single family homes on a domestic wells. Single family units correspond to TMWA's residential metered water service ("RMWS"), and the multi-family units correspond to the multi-unit metered rates ("MMWS"). The commercial buildings are members of the general metered water service ("GMWS"). Irrigation service are not directly estimated from the parcel data.

Of note in the data is the lines for dwelling on wells and GMWS builds are very close but are not the same.

The chart clearly shows that there should be a statistical relation ship between population and the defined classes of dwelling units and commercial buildings.

The review of the data graphs clearly show strong relationships between the variables and with time. Therefore, a time series analysis is the best approach to developing a projection model.

Model Estimations

The data created for this analysis is a multivariate time series where multiple variables have interdependencies. The interdependent variables are: population, dwelling units as described above, developed land, and commercial buildings. Population is treated as an exogenous variable while the all other variables are considered endogenous to the model.

The graphs above show a clear trend in the data over time, this is evidence of autocorrelation in each of the variables. Autocorrelation is generally defined as the statistical correlation between values of a variable at different points in time, hence the time trend. The presence of a time trend and autocorrelation requires that the data be processed to correct for the autocorrelation and thus making it possible to model the relationship between the variables. The required transformation is to take the first difference between two time periods or compute the annual change in each variable.

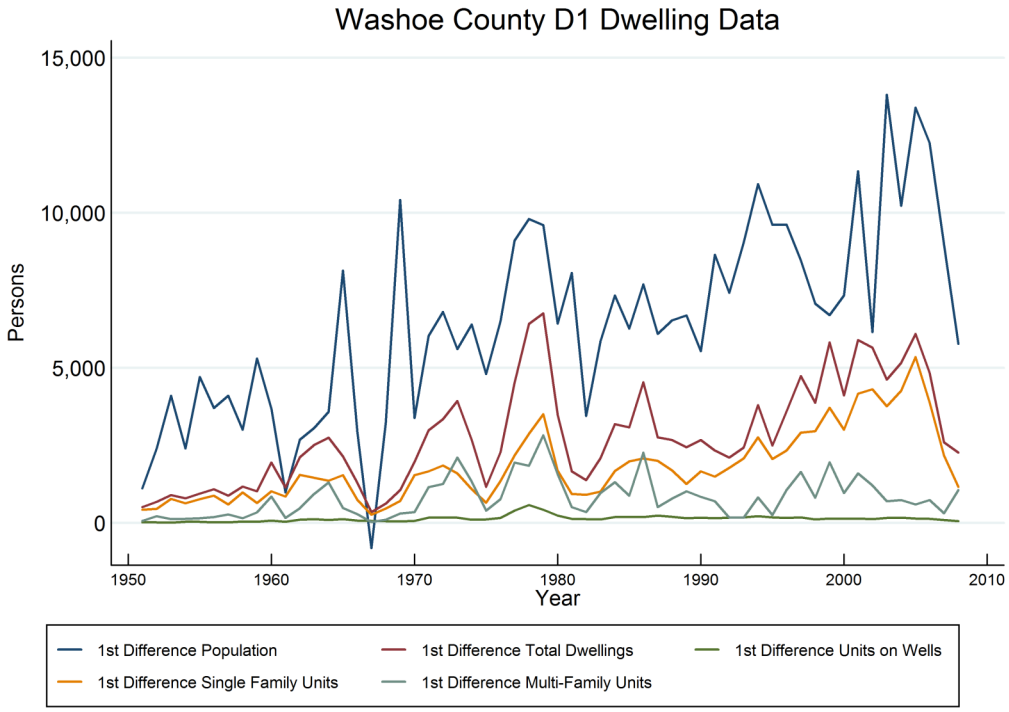

Figure 10: First difference or annual change in Washoe County dwelling units.

Figure 10 show the results of first differencing the dwelling data presented in Figure 9. The first differenced process is referred to as "D(1)". This data is free of autocorrelation and is considered stationary, this is a requirement for estimating any time series model.

Data that conforms to multiple time series that are interdependent are generally modeled using vector autoregression ("VAR") models. In a VAR, all the variables are treated symmetrically by including each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model including the exogenous variables. Based on this feature, the VAR model can be used as a theory-free method to estimate economic relationships.

There are a large number of good descriptions of VARs on the Internet, one such reference is the VAR page on Wikipedia. The VAR models in this study were estimated using STATA version 11. To simplify the discussion of the modeling process, this memo will skip the mathematic notation and describe the commands used and an explanation of the model results.

All data processing and statistical estimations were perform using a statistical software program call STATA, from www.stata.com. STATA is a robust software system with modules designed for the analysis of time series data. All commands used here where tested with versions 10 and 11 on Windows Vista 64-bit.

STATA's "var" command was used to estimate all vector autoregressive models. The var fits a multivariate time series regression of each dependent variable on lags of itself and on lags of all the other dependent variables. The var also has the ability to fit models that include exogenous variables.

Five models were estimated in the process of finding the model that provided a balance of good fit to the data, stable statistical properties, and ability to create a useful projection.

1. VAR of dwellings on wells, single family, multi-family units, lag years 1 to 4, and population as an exogenous variable. This first model used non-difference data and served to provide a baseline measure of stability and autocorrelation.
2. VAR of first differenced dwelling unit variables, lag years 1 to 4, population is exogenous. Developed using output from Model 1.
3. Expanded Model 2 to include a variable for developed land.
4. Expanded Model 3 to include commercial buildings variables.
5. Using results from Model 4, this model was developed to project commercial buildings as a function single family dwelling units.

Model 1 Estimation

Model 1 used data that did have a time trend and was not stationary, the regression would not provide a model that could be used for a projection, but measures of the extent of autocorrelation, and other statistical properties to help with the fitting of a VAR model.

```
Var cdwell0 cdwell1 cdwell2, lag(1/4) exog(population)
```

This model provided a good fit to the data, with R^2 equal .9998 for each equation, the model did not pass other required statistical tests.

```
varlmar, mlag(5)
```

Test for autocorrelation showed no autocorrelation when there should be autocorrelation.

```
varstable
```

Test for stability condition of the VAR model, this model does not satisfy stability condition.

These statistical test show that Model 1 must not be used as a projection model. Statistical results are shown in Appendix 1.

Model 2 Estimation

Mode1 2 was estimated using first differenced data for dwelling units and population. The first difference is the same as the number of new units built in a given year. Figure 10 shows the data used in Model 2 for the years 1955 to 2009. Full statistical output is shown in Appendix 2

```
var d1cdwell0 d1cdwell1 d1cdwell2 , lags(1/4) exog(d1pop)
```

Estimation of Model 2 resulted in a stable model, free of autocorrelation. A Wald test of the hypothesis that the endogenous variables at a given lag are jointly zero for each equation and for all equation jointly showed that the model should be estimated without the year two lag.

Final form of Model 2 is:

```
. var d1cdwell0 d1cdwell1 d1cdwell2 , lags(1 3 4) exog(d1pop);
```

```
Vector autoregression

Sample:  1955 - 2009                            No. of obs      =        55
Log likelihood = -1111.099                      AIC             =  41.60362
FPE            =  2.39e+14                      HQIC            =  42.06937
Det(Sigma_ml)  =  7.07e+13                      SBIC            =  42.80802

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1cdwell0             11     48.9717   0.7981   217.3791   0.0000
d1cdwell1             11     529.165   0.8321    272.575   0.0000
d1cdwell2             11     487.367   0.5189   59.31402   0.0000
------------------------------------------------------------------
```

This model fits the data well. There is no autocorrelation at any of the lags and the VAR satisfies stability conditions.

Granger Causality Test is used to test for statistical causality between the variables showed the following conclusions:

1. Number of dwelling units on wells is statistically caused by single family and multi-family units
2. Single family units are not statistically caused by multi-family units.
3. Multi-family units are not statistically caused by single family units.

Figure 11 shows that Model 2 fits the data well and provides what appears to be a reasonable projection of future dwelling units. However a model is required that has the ability to project dwelling units, land used, and commercial buildings. Working with Model 2 as a base, this model is extended in Model 3 to include developed land.

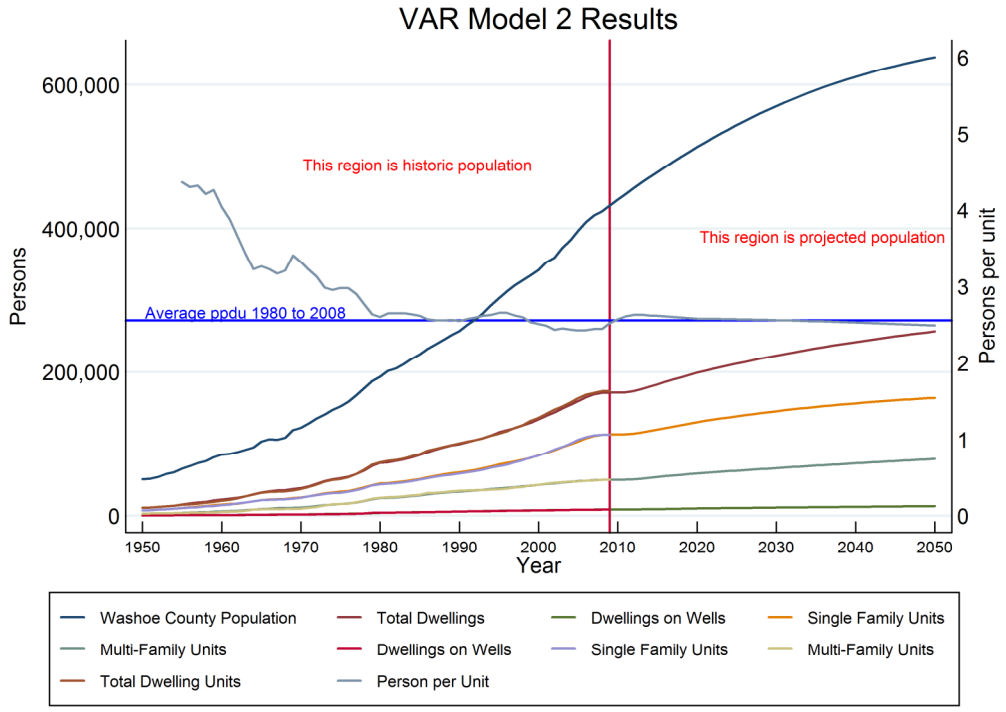

Figure 11: Results of Model 2.

Model 3 Estimation

Model 3 starts with adding developed land to Model 2 and re-estimating the VAR model. The initial results showed that the land development variable was not significant. An earlier review of the data showed that there might be problems with the developed land data prior to 1980, and changes in the number of persons per acre of developed land. A series of models were estimated using restrictions on the range of years. The different models are listed below. The first model stared with 1970 to 2008 data, each model dropped older years until a significant model is found. The model significant model used data from 1979 to 2008.

Models estimated were:

```
var d1cdwell0 d1cdwell1 d1cdwell2 d1land, lags(1 3 4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land, lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1970,2008), lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1976,2008), lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1977,2008), lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1978,2008), lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1979,2008), lags(1/4) exog(d1pop);
 var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1980,2008), lags(1/4) exog(d1pop);
```

The 1979 to 2008 period provided the best results for developed land while at the same time improved the model's dwelling unit estimations. Since this model is also a function of population the model was also expanded to include a lag variable of population. The additional population parameter resulted in an improvement in the model R^2 values as shown below.

The finale form of Model 3 is:

```
. var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1979,2008),
>     lags(1/4) exog(d1pop L.d1pop);

Vector autoregression

Sample:  1979 - 2008                              No. of obs      =        30
Log likelihood = -774.3133                        AIC             =  56.68755
FPE            =  1.21e+20                        HQIC            =  57.82313
Det(Sigma_ml)  =  3.08e+17                        SBIC            =  60.23725

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1cdwell0             19     21.9384   0.9543   627.1573   0.0000
d1cdwell1             19     531.197   0.9223   356.1751   0.0000
d1cdwell2             19     586.326   0.6577   57.64332   0.0000
d1land                19     904.986   0.8207   137.3353   0.0000
------------------------------------------------------------------
```

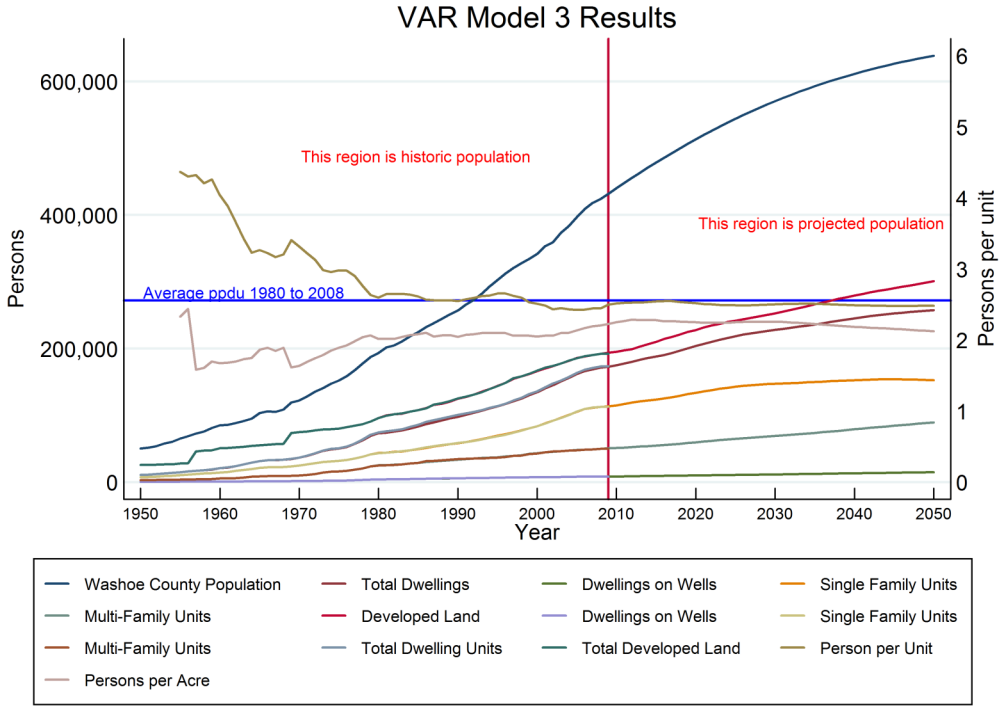

Figure 12: Results of Model 3.

Figure 12 shows the graphical projections using model 3. The does a very good job of fitting the historic data and provides a projection that is dependent on the population projection. The full statistical output for model 3 is included in Appendix 3.

Model 4 Estimation

The models developed so far focused on the residential dwelling units and developed land. The last group to be projected is the commercial buildings. Using the same logic as above, model 3 was expanded to include commercial building counts. This approach did not result in a stable and stationary model that could project residential units, developed land and commercial building. Model 4 failed to provide any useful results.

Model 5 Estimation

Model 5 is the final step in developing the full projection model for buildings in Washoe County. Model 3 provide a full residential projection. Model 5 uses the resulting residential projections as input to project commercial buildings.

In model 3 dwelling units are dependent on land and population. The commercial building are dependent on the single family dwelling units. Since the dwelling units are projected using the population, using these values as an exogenous variable results in commercial building projection being indirectly related to population.

In 1978 the MGM / Bailys / Hilton / Grand Sierra Resort was completed. This marked the end of very large commercial building projects and a change in the data properties. If data before 1979

is used then the resulting model is unstable and poorly fits the data. When the data is limited 1979 to 2008 the resulting model is fits well and is stable.

The final model as shown below, provides the best fit to the commercial building data.

```
var d1build4 if tin(1979,2008), lags(1 2) exog(d1cdwell1 l2.d1cdwell1) noconstant;

Vector autoregression

Sample:  1979 - 2008                              No. of obs      =        30
Log likelihood = -146.1764                        AIC             =  10.01176
FPE            =  1306.991                        HQIC            =  10.07153
Det(Sigma_ml)  =   999.464                        SBIC            =  10.19859

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1build4               4     33.9592   0.9637    796.494   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
    d1build4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1build4     |
    d1build4 |
         L1. |   .0803256   .0592312     1.36   0.175    -.0357653    .1964165
         L2. |   .1341093   .0575757     2.33   0.020      .021263    .2469556
             |
   d1cdwell1 |
         --. |   .0250521   .0057714     4.34   0.000     .0137402    .0363639
         L2. |   .0211022   .0065057     3.24   0.001     .0083512    .0338532
------------------------------------------------------------------------------

. varsoc, maxlag(5);

   Selection-order criteria
   Sample:  1979 - 2008                        Number of obs      =        30
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -150.302                      1503.82   10.1534   10.1833   10.2469  |
  |  1 |  -148.67  3.2634    1  0.071  1442.49   10.1113   10.1562   10.2515  |
  |  2 | -146.176   4.987*   1  0.026  1306.99*  10.0118*  10.0715*  10.1986* |
  |  3 | -145.718  .91702    1  0.338  1357.13   10.0479   10.1226   10.2814  |
  |  4 | -145.342  .75159    1  0.386  1418.09   10.0895   10.1791   10.3697  |
  |  5 | -145.108  .46887    1  0.494  1497.26   10.1405   10.2451   10.4675  |
  +---------------------------------------------------------------------------+
   Endogenous:  d1build4
    Exogenous:  d1cdwell1 L2.d1cdwell1

. varlmar, mlag(5);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |    4.4730     1     0.03443   |
  |   2  |    0.0990     1     0.75304   |
  |   3  |    1.1045     1     0.29328   |
  |   4  |    3.7406     1     0.05310   |
  |   5  |    0.0431     1     0.83554   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varstable;
```

```
 Eigenvalue stability condition
+------------------------------------+
|        Eigenvalue        |   Modulus   |
|--------------------------+-------------|
|    .4085679              |   .408568   |
|  -.3282423               |   .328242   |
+------------------------------------+
 All the eigenvalues lie inside the unit circle.
 VAR satisfies stability condition.
```

Figure 13 shows the combined results of Models 3 and 5. The chart shows that the models fit the historic data well. The projected values are following a trend that is reasonable. The projected trend for persons per dwelling unit and persons per developed show that the projection will meet the needs of the projected population.

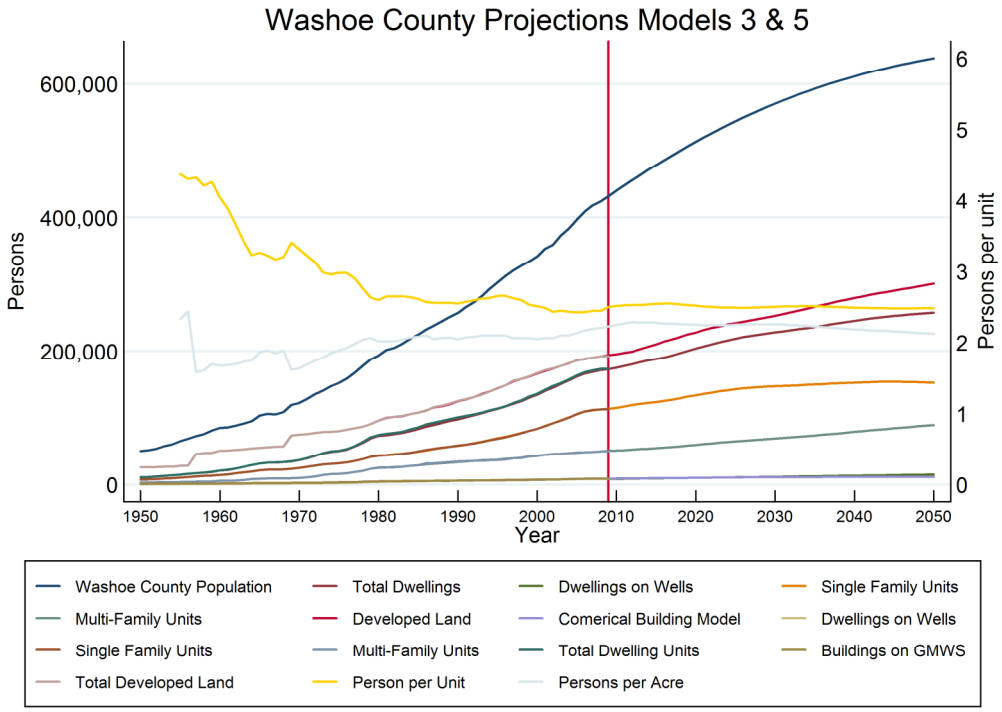

Figure 13: Combined results of models 3 and 5.

Building Projection

Figure 14, Figure 15, and Figure 16 present the final projections for Washoe County. Appendix 5 provides the data used and model projections for 2009 to 2050.

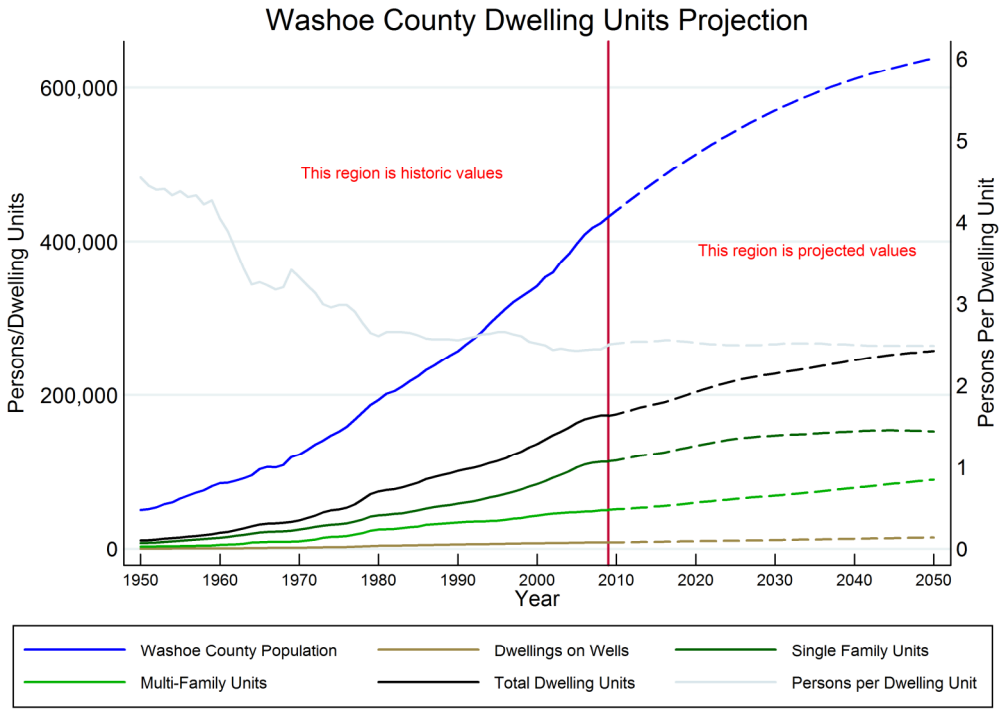

Figure 14: Washoe County Building Projections

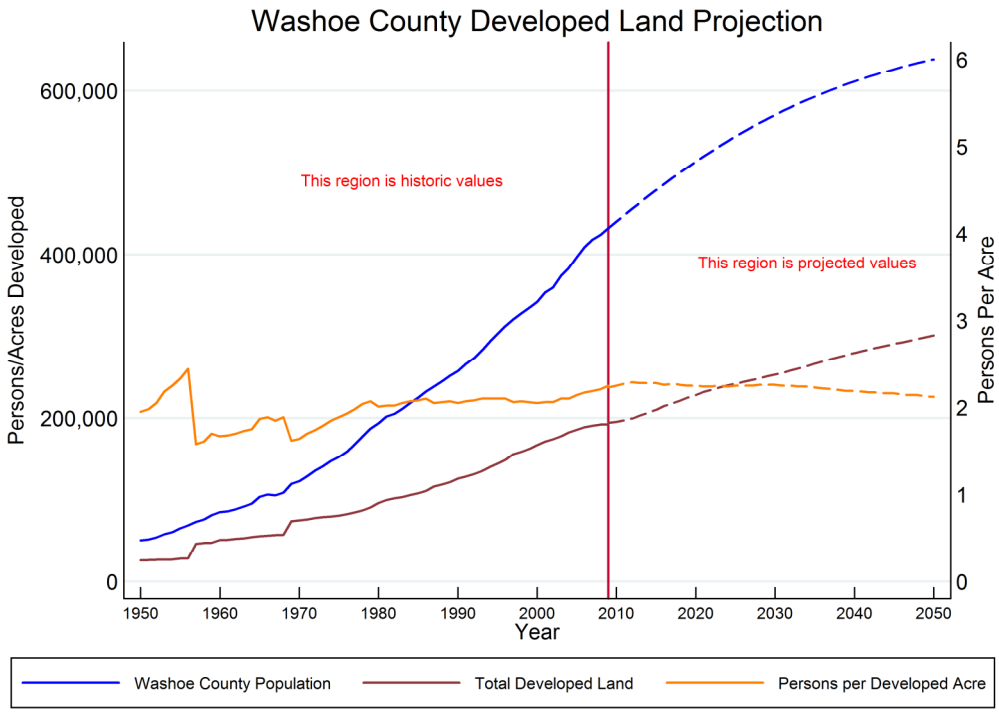

Figure 15: Washoe County Developed Land Projections

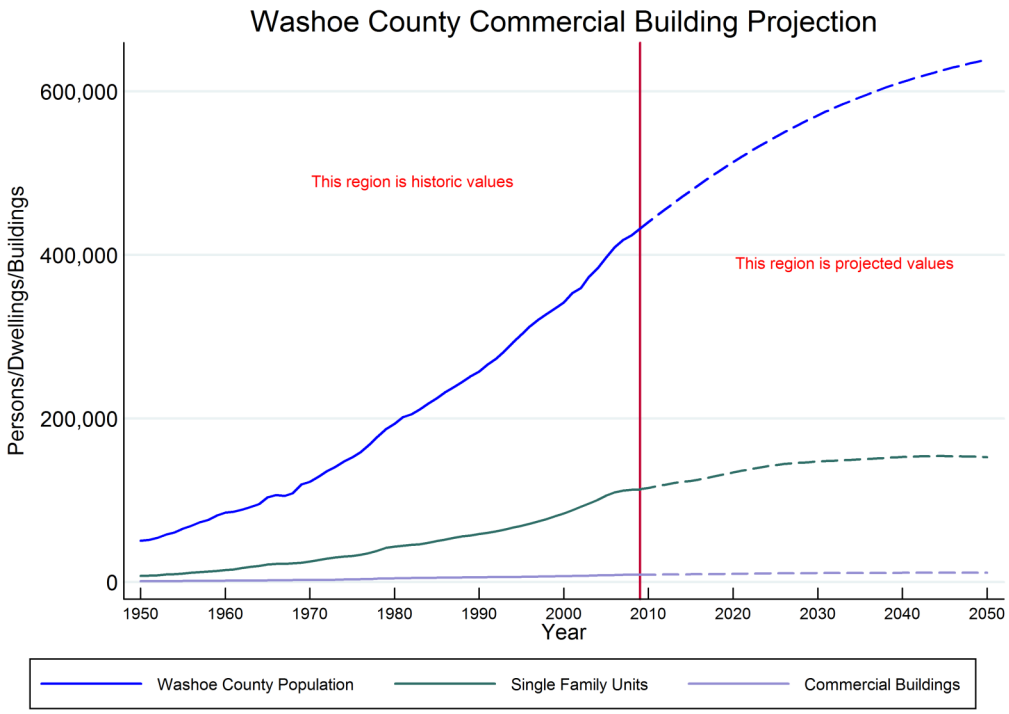

Figure 16: Washoe County Commercial Building Projections

Share Analysis of County Building Inventory

The disaggregation of the projection require the use of shares of buildings and population by each sub-area of interest. Each parcel and building used in the projection model has both a location and year constructed. By using GIS and construction years the data set can be tabulated by any GIS polygon if the parcel has been attributed with the name of the polygon that contains the parcel. In the initial data construction, each parcel/building was attributed with the water utility service area and the hydrographic basin. Appendix 6 provides a listing of all areas attributed to each parcel.

Project Sub-Area Ratios

For each area the buildings were tabulated by type and year. These area totals were divided by the county total buildings for the year. The resulting area shares time series is then extrapolated through the year 2050 using a double-exponential smoothing function. This process accounts for changes in the shares over time and requires that all the shares in a given year sums to 1.

Figure 17 shows the extrapolated shares of single family units in the three service area. The data showed that there is a downward trend in the share of units in TMWA's retail service area. The method requires that the shares sum to 1, thus, there is an increasing trend in the County and Wholesale Areas. Figure 18 show the resulting projection of new single family. The projection is the product of County projection and the sub-area shares. Figure 17 and Figure 18 is just one sample of many graphs used to create all the sub-area projections.

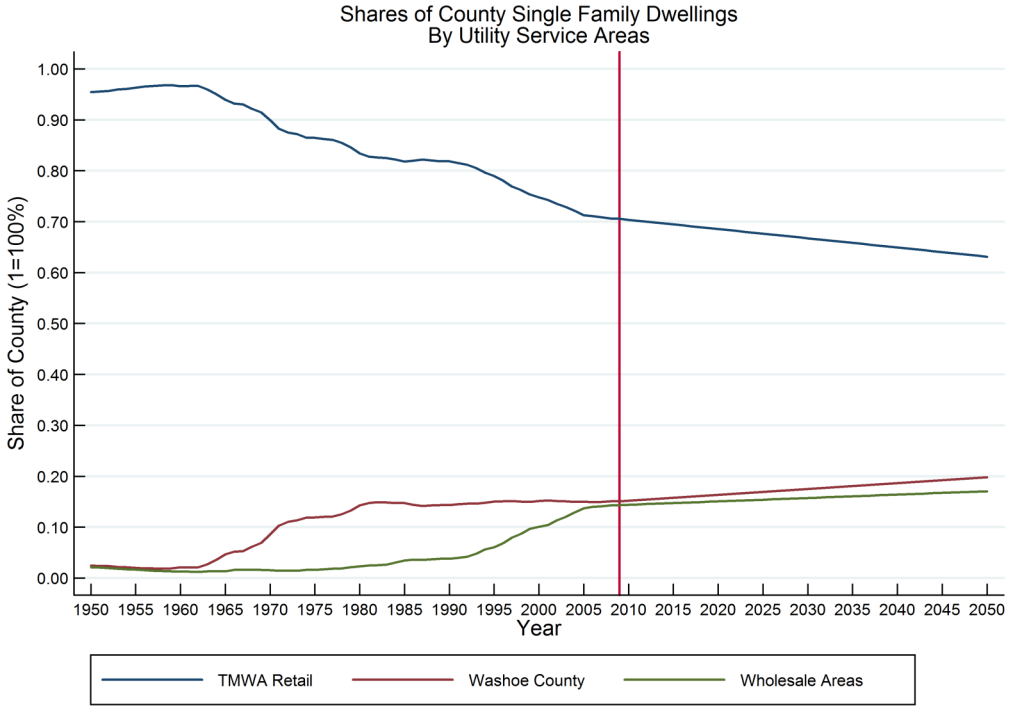

Figure 17: Shares of Single Family Dwelling Units.

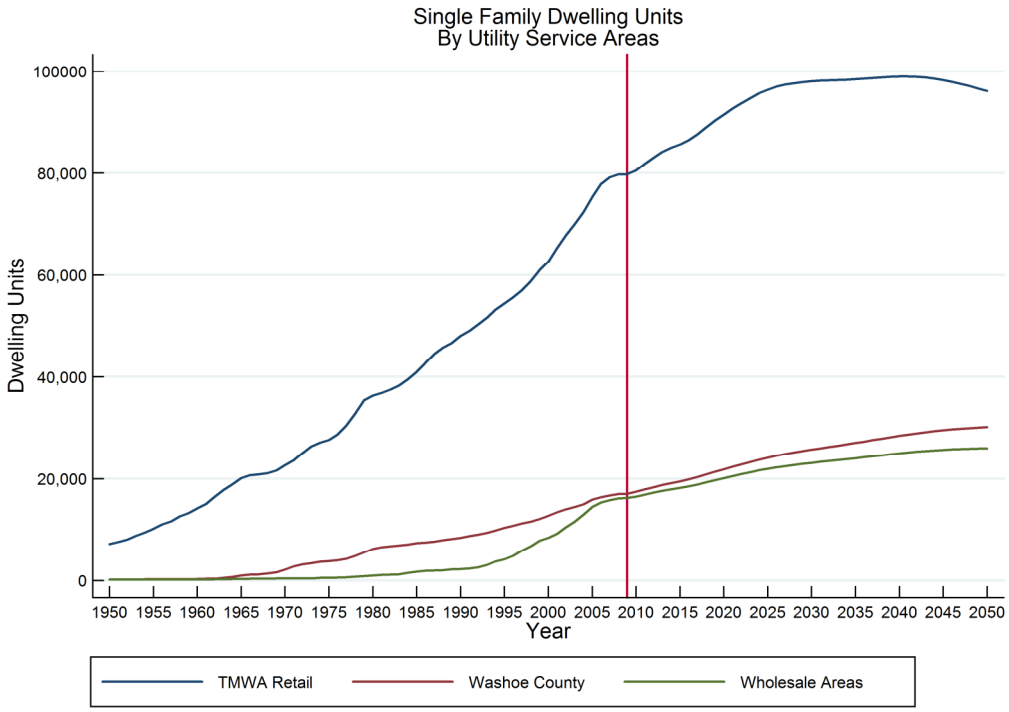

Figure 18: Number of Single Family Dwelling Units by Service Area.

Appendix 1: Statistical Output for Model 1.

Variables:

Cdwell0 – cumulative dwelling units on wells.
Cdwell1 – cumulative single family dwelling units.
Cdwell2 – cumulative multi-family dwelling units.
Population – annual estimated population.

```
. var  cdwell0 cdwell1 cdwell2, lags(1/4) exog(population)

Vector autoregression

Sample:  1954 - 2009                              No. of obs      =        56
Log likelihood = -1106.089                        AIC             =  41.00318
FPE            =  1.33e+14                        HQIC            =   41.5921
Det(Sigma_ml)  =  2.87e+13                        SBIC            =  42.52219

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
cdwell0              14     41.4743   0.9998   316887.3   0.0000
cdwell1              14     498.784   0.9998   283144.7   0.0000
cdwell2              14     461.999   0.9993   83687.08   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
cdwell0      |
     cdwell0 |
         L1. |   1.547769   .1405541    11.01   0.000     1.272288     1.82325
         L2. |  -1.113004   .2478692    -4.49   0.000    -1.598819   -.6271896
         L3. |   .3048972   .2472716     1.23   0.218    -.1797463    .7895407
         L4. |  -.0559794   .1233487    -0.45   0.650    -.2977384    .1857795
             |
     cdwell1 |
         L1. |  -.0107271   .0113305    -0.95   0.344    -.0329344    .0114802
         L2. |   .0072315   .0227666     0.32   0.751    -.0373903    .0518532
         L3. |  -.0199523   .0245618    -0.81   0.417    -.0680925     .028188
         L4. |   .0022602    .017242     0.13   0.896    -.0315336    .0360539
             |
     cdwell2 |
         L1. |   .0179503   .0121944     1.47   0.141    -.0059503    .0418509
         L2. |  -.0132338   .0176875    -0.75   0.454    -.0479007    .0214332
         L3. |   .0317291   .0182436     1.74   0.082    -.0040277    .0674859
         L4. |   .0065666   .0148178     0.44   0.658    -.0224758    .0356089
             |
  population |   .0072362   .0013037     5.55   0.000     .0046811    .0097913
       _cons |  -240.2169   50.77607    -4.73   0.000    -339.7362   -140.6977
-------------+----------------------------------------------------------------
cdwell1      |
     cdwell0 |
         L1. |  -.2107261    1.69035    -0.12   0.901    -3.523752      3.1023
         L2. |  -1.802227   2.980957    -0.60   0.545    -7.644796    4.040342
         L3. |  -2.944513   2.973771    -0.99   0.322    -8.772997    2.883972
         L4. |   3.952675   1.483432     2.66   0.008     1.045201    6.860149
             |
     cdwell1 |
         L1. |   1.661824   .1362641    12.20   0.000     1.394752    1.928897
         L2. |   -.861812   .2737989    -3.15   0.002    -1.398448   -.3251762
         L3. |   .3395191   .2953884     1.15   0.250    -.2394316    .9184698
         L4. |    -.36804   .2073582    -1.77   0.076    -.7744546    .0383746
             |
     cdwell2 |
         L1. |  -.1285914    .146654    -0.88   0.381     -.416028    .1588452
```

```
         L2. |   .3381629   .2127163     1.59   0.112    -.0787534    .7550791
         L3. |  -.0655523   .2194035    -0.30   0.765    -.4955753    .3644708
         L4. |  -.0227233    .178204    -0.13   0.899    -.3719966    .3265501
             |
  population |   .0666153   .0156782     4.25   0.000     .0358865     .097344
       _cons |  -2047.045     610.65    -3.35   0.001    -3243.897   -850.1933
-------------+----------------------------------------------------------------
cdwell2      |
     cdwell0 |
         L1. |   2.406284    1.56569     1.54   0.124     -.662412    5.474979
         L2. |  -.0231151   2.761117    -0.01   0.993    -5.434805    5.388574
         L3. |  -6.686921   2.754461    -2.43   0.015    -12.08557   -1.288278
         L4. |   4.384658   1.374032     3.19   0.001     1.691605    7.077711
             |
     cdwell1 |
         L1. |  -.0978931   .1262149    -0.78   0.438    -.3452697    .1494835
         L2. |  -.0683415   .2536067    -0.27   0.788    -.5654015    .4287184
         L3. |    .129438    .273604     0.47   0.636    -.4068161     .665692
         L4. |  -.0495625   .1920659    -0.26   0.796    -.4260048    .3268797
             |
     cdwell2 |
         L1. |   1.016091   .1358385     7.48   0.000      .749852    1.282329
         L2. |   .0875905   .1970288     0.44   0.657    -.2985789    .4737599
         L3. |   .0191941   .2032229     0.09   0.925    -.3791155    .4175036
         L4. |  -.2579352   .1650617    -1.56   0.118    -.5814503    .0655798
             |
  population |   .0401639    .014522     2.77   0.006     .0117014    .0686265
       _cons |   -1209.12   565.6156    -2.14   0.033    -2317.707   -100.5342
------------------------------------------------------------------------------

. varlmar, mlag(5)

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |    6.8107     9     0.65683   |
  |   2  |   10.4651     9     0.31416   |
  |   3  |   16.2480     9     0.06188   |
  |   4  |    6.7597     9     0.66212   |
  |   5  |    4.5922     9     0.86831   |
  +--------------------------------------+
   H0: no autocorrelation at lag order
. varstable

   Eigenvalue stability condition
  +----------------------------------------+
  |        Eigenvalue         |   Modulus  |
  |---------------------------+------------|
  |   1.011295 +   .188941i   |   1.02879  |
  |   1.011295 -   .188941i   |   1.02879  |
  |   .8795119 +   .395438i   |    .96432  |
  |   .8795119 -   .395438i   |    .96432  |
  |   .5148084 +   .640223i   |   .821531  |
  |   .5148084 -   .640223i   |   .821531  |
  |  -.4134796 +  .5409449i   |   .680872  |
  |  -.4134796 -  .5409449i   |   .680872  |
  |   .6334685                |   .633469  |
  |  -.1469654 +  .5468726i   |   .566276  |
  |  -.1469654 -  .5468726i   |   .566276  |
  | -.09812614                |   .098126  |
  +----------------------------------------+
   At least one eigenvalue is at least 1.0.
   VAR does not satisfy stability condition.
```

Appendix 2: Statistical Output for Model 2

```
./*************************************************************************/;
. /* Estimate Model 2: using D(1) data                                     */;
. /*************************************************************************/;
. var d1cdwell0 d1cdwell1 d1cdwell2 , lags(1 3 4) exog(d1pop);

Vector autoregression

Sample:  1955 - 2009                              No. of obs      =        55
Log likelihood = -1111.099                        AIC             =  41.60362
FPE            =  2.39e+14                        HQIC            =  42.06937
Det(Sigma_ml)  =  7.07e+13                        SBIC            =  42.80802

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1cdwell0             11     48.9717   0.7981   217.3791   0.0000
d1cdwell1             11     529.165   0.8321    272.575   0.0000
d1cdwell2             11     487.367   0.5189   59.31402   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1cdwell0    |
   d1cdwell0 |
         L1. |   .7156373   .0999725     7.16   0.000     .5196947    .9115798
         L3. |  -.5012112   .1422463    -3.52   0.000    -.7800089   -.2224136
         L4. |   .2231496   .1441166     1.55   0.122    -.0593137    .5056129
             |
   d1cdwell1 |
         L1. |  -.0060018   .0101338    -0.59   0.554    -.0258638    .0138601
         L3. |    .004637   .0148915     0.31   0.756    -.0245497    .0338238
         L4. |  -.0322887   .0148299    -2.18   0.029    -.0613547   -.0032227
             |
   d1cdwell2 |
         L1. |   .0185112    .014588     1.27   0.204    -.0100808    .0471032
         L3. |   .0150774   .0143309     1.05   0.293    -.0130107    .0431654
         L4. |   .0435593   .0140233     3.11   0.002     .0160742    .0710444
             |
       d1pop |   .0099142   .0030533     3.25   0.001     .0039299    .0158985
       _cons |   9.236345   16.81634     0.55   0.583    -23.72307    42.19576
-------------+----------------------------------------------------------------
d1cdwell1    |
   d1cdwell0 |
         L1. |   .0167686   1.080257     0.02   0.988    -2.100497    2.134034
         L3. |   -6.07093   1.537048    -3.95   0.000    -9.083489   -3.058371
         L4. |   4.069388   1.557258     2.61   0.009     1.017219    7.121556
             |
   d1cdwell1 |
         L1. |   .8152572   .1095017     7.45   0.000     .6006378    1.029877
         L3. |   .2189436   .1609104     1.36   0.174     -.096435    .5343222
         L4. |  -.4655193   .1602447    -2.91   0.004    -.7795931   -.1514455
             |
   d1cdwell2 |
         L1. |   .0461715   .1576315     0.29   0.770    -.2627806    .3551236
         L3. |   .0993537   .1548531     0.64   0.521    -.2041529    .4028602
         L4. |   .2274254   .1515291     1.50   0.133    -.0695661    .5244169
             |
       d1pop |   .1101675   .0329924     3.34   0.001     .0455036    .1748314
       _cons |    2.69402   181.7096     0.01   0.988    -353.4503    358.8383
-------------+----------------------------------------------------------------
d1cdwell2    |
   d1cdwell0 |
         L1. |   3.509741   .9949285     3.53   0.000     1.559717    5.459765
         L3. |  -5.001437   1.415638    -3.53   0.000    -7.776036   -2.226837
         L4. |   3.482875   1.434251     2.43   0.015     .6717954    6.293956
```

```
             |
   d1cdwell1 |
         L1. |   .0299776   .1008523     0.30   0.766    -.1676892    .2276444
         L3. |   .1282132   .1482002     0.87   0.387    -.1622539    .4186803
         L4. |  -.2107967   .1475871    -1.43   0.153     -.500062    .0784686
             |
   d1cdwell2 |
         L1. |    .298364   .1451803     2.06   0.040     .0138159    .5829122
         L3. |   .0770643   .1426214     0.54   0.589    -.2024685    .3565971
         L4. |   -.046312   .1395599    -0.33   0.740    -.3198443    .2272204
             |
       d1pop |   .0246779   .0303863     0.81   0.417    -.0348783     .084234
       _cons |   202.5833   167.3565     1.21   0.226    -125.4294     530.596
------------------------------------------------------------------------------

. varsoc, maxlag(5);

   Selection-order criteria
   Sample:  1956 - 2009                         Number of obs      =        54
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -1165.04                       1.4e+15    43.372   43.4572    43.593  |
  |  1 | -1113.68  102.73    9  0.000  2.9e+14   41.8029    42.016*  42.3554* |
  |  2 | -1103.19   20.97    9  0.013  2.7e+14   41.7479   42.0888   42.6319  |
  |  3 | -1093.96  18.473    9  0.030  2.7e+14   41.7391   42.2079   42.9546  |
  |  4 | -1082.93  22.059*   9  0.009  2.6e+14*   41.664*  42.2606    43.211  |
  |  5 | -1075.67  14.515    9  0.105  2.8e+14   41.7285    42.453    43.607  |
  +---------------------------------------------------------------------------+
   Endogenous:  d1cdwell0 d1cdwell1 d1cdwell2
    Exogenous:  d1pop  _cons

. varlmar, mlag(5);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   16.3838     9     0.05929   |
  |   2  |   13.5965     9     0.13742   |
  |   3  |    8.8637     9     0.44995   |
  |   4  |    6.8892     9     0.64865   |
  |   5  |    4.5826     9     0.86908   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varstable;

   Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue         |   Modulus   |
  |---------------------------+-------------|
  |   .3972045 +   .665344i   |    .77489   |
  |   .3972045 -   .665344i   |    .77489   |
  |   .7742836                |   .774284   |
  |   .6487712 +   .367722i   |   .745737   |
  |   .6487712 -   .367722i   |   .745737   |
  |  -.4909283 +  .5464866i   |   .734614   |
  |  -.4909283 -  .5464866i   |   .734614   |
  |   .6497087 +  .2723129i   |   .704468   |
  |   .6497087 -  .2723129i   |   .704468   |
  |  -.7036447                |   .703645   |
  |  -.3254462 +  .4951566i   |   .592533   |
  |  -.3254462 -  .4951566i   |   .592533   |
  +---------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```

```
. varnorm, jbera;

   Jarque-Bera test
  +-------------------------------------------------------+
  |           Equation |            chi2   df  Prob > chi2 |
  |--------------------+----------------------------------|
  |          d1cdwell0 |           24.836   2    0.00000   |
  |          d1cdwell1 |            1.347   2    0.50985   |
  |          d1cdwell2 |            1.374   2    0.50305   |
  |                ALL |           27.558   6    0.00011   |
  +-------------------------------------------------------+

. varwle;

   Equation: d1cdwell0
  +-----------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+-----------------------------|
  |   1 |  82.37677     3     0.000    |
  |   3 |  13.94919     3     0.003    |
  |   4 |  15.86063     3     0.001    |
  +-----------------------------------+
   Equation: d1cdwell1
  +-----------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+-----------------------------|
  |   1 |  70.88463     3     0.000    |
  |   3 |  15.70212     3     0.001    |
  |   4 |  13.42865     3     0.004    |
  +-----------------------------------+
   Equation: d1cdwell2
  +-----------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+-----------------------------|
  |   1 |   35.2992     3     0.000    |
  |   3 |   12.8122     3     0.005    |
  |   4 |  6.262631     3     0.100    |
  +-----------------------------------+
   Equation: All
  +-----------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+-----------------------------|
  |   1 |  164.2091     9     0.000    |
  |   3 |  29.50122     9     0.001    |
  |   4 |  28.56281     9     0.001    |
  +-----------------------------------+

. vargranger;
   Granger causality Wald tests
  +-------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+----------------------------|
  |         d1cdwell0          d1cdwell1 |  17.258     3    0.001    |
  |         d1cdwell0          d1cdwell2 |  15.565     3    0.001    |
  |         d1cdwell0                ALL |   25.96     6    0.000    |
  |--------------------------------------+----------------------------|
  |         d1cdwell1          d1cdwell0 |  16.092     3    0.001    |
  |         d1cdwell1          d1cdwell2 |  3.4898     3    0.322    |
  |         d1cdwell1                ALL |  21.876     6    0.001    |
  |--------------------------------------+----------------------------|
  |         d1cdwell2          d1cdwell0 |  22.612     3    0.000    |
  |         d1cdwell2          d1cdwell1 |  2.2582     3    0.521    |
  |         d1cdwell2                ALL |  30.774     6    0.000    |
  +-------------------------------------------------------------------+
```

Appendix 3: Statistical Output for Model 3

```
. /*************************************************************************/;
. /*  Final form of Model 3 using data from 1979 to 2008                   */;
. /*************************************************************************/;
. var d1cdwell0 d1cdwell1 d1cdwell2 d1land if tin(1979,2008),
>     lags(1/4) exog(d1pop L.d1pop);

Vector autoregression

Sample:  1979 - 2008                            No. of obs      =        30
Log likelihood = -774.3133                      AIC             =  56.68755
FPE            =  1.21e+20                      HQIC            =  57.82313
Det(Sigma_ml)  =  3.08e+17                      SBIC            =  60.23725

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1cdwell0             19     21.9384   0.9543   627.1573   0.0000
d1cdwell1             19     531.197   0.9223   356.1751   0.0000
d1cdwell2             19     586.326   0.6577   57.64332   0.0000
d1land                19     904.986   0.8207   137.3353   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1cdwell0    |
   d1cdwell0 |
         L1. |   .4549723   .1014174     4.49   0.000     .2561979    .6537468
         L2. |  -.1284158   .1243227    -1.03   0.302    -.3720838    .1152522
         L3. |  -.1396786    .129456    -1.08   0.281    -.3934076    .1140504
         L4. |   .0817906   .0999321     0.82   0.413    -.1140728     .277654
             |
   d1cdwell1 |
         L1. |  -.0048105   .0088949    -0.54   0.589    -.0222442    .0126231
         L2. |  -.0211653   .0076204    -2.78   0.005    -.0361009   -.0062297
         L3. |   .0222956   .0093615     2.38   0.017     .0039474    .0406437
         L4. |  -.0444865   .0119841    -3.71   0.000     -.067975    -.020998
             |
   d1cdwell2 |
         L1. |   .0243447   .0081225     3.00   0.003     .0084248    .0402646
         L2. |   .0164548   .0089157     1.85   0.065    -.0010196    .0339292
         L3. |  -.0128279   .0083288    -1.54   0.124     -.029152    .0034961
         L4. |   .0272776   .0096206     2.84   0.005     .0084216    .0461336
             |
      d1land |
         L1. |  -.0138702   .0033281    -4.17   0.000    -.0203932   -.0073471
         L2. |   .0094022   .0043656     2.15   0.031     .0008459    .0179586
         L3. |   .0024622   .0036088     0.68   0.495    -.0046109    .0095353
         L4. |  -.0027809   .0034813    -0.80   0.424    -.0096042    .0040424
             |
       d1pop |
         --. |   .0107341   .0023019     4.66   0.000     .0062225    .0152457
         L1. |   .0072245    .002438     2.96   0.003     .0024462    .0120029
             |
       _cons |   42.83474   28.43599     1.51   0.132    -12.89878    98.56826
-------------+----------------------------------------------------------------
d1cdwell1    |
   d1cdwell0 |
         L1. |  -.4365654   2.455633    -0.18   0.859    -5.249518    4.376387
         L2. |  -.5044786   3.010242    -0.17   0.867    -6.404444    5.395487
         L3. |  -5.275461   3.134535    -1.68   0.092    -11.41904    .8681143
         L4. |  -1.686025    2.41967    -0.70   0.486    -6.428492    3.056442
             |
   d1cdwell1 |
         L1. |   .2745347   .2153731     1.27   0.202    -.1475889    .6966582
         L2. |  -.8123533   .1845126    -4.40   0.000    -1.173991   -.4507152
```

```
         L3. |    .647326   .2266704     2.86   0.004     .2030602    1.091592
         L4. |   -.415264   .2901736    -1.43   0.152    -.9839939    .1534658
             |
  d1cdwell2  |
         L1. |   .5144058   .1966723     2.62   0.009     .1289352    .8998763
         L2. |   .7845129    .215876     3.63   0.000     .3614037    1.207622
         L3. |    .017208   .2016652     0.09   0.932    -.3780486    .4124645
         L4. |    .527891   .2329445     2.27   0.023     .0713282    .9844537
             |
     d1land  |
         L1. |  -.0332213   .0805846    -0.41   0.680    -.1911642    .1247216
         L2. |   .3313024   .1057041     3.13   0.002     .1241261    .5384786
         L3. |    .122285   .0873804     1.40   0.162    -.0489774    .2935474
         L4. |   .1461496   .0842942     1.73   0.083     -.019064    .3113632
             |
      d1pop  |
         --. |   .2622356   .0557359     4.70   0.000     .1529952    .3714761
         L1. |   .2196558    .059031     3.72   0.000     .1039572    .3353544
             |
       _cons |  -3152.896   688.5245    -4.58   0.000    -4502.379   -1803.413
-------------+----------------------------------------------------------------
d1cdwell2    |
  d1cdwell0  |
         L1. |  -.3591651   2.710486    -0.13   0.895     -5.67162     4.95329
         L2. |   6.624631   3.322654     1.99   0.046      .112349    13.13691
         L3. |  -7.334047   3.459846    -2.12   0.034    -14.11522    -.552873
         L4. |   2.641716   2.670791     0.99   0.323    -2.592939     7.87637
             |
  d1cdwell1  |
         L1. |   .1220074   .2377252     0.51   0.608    -.3439255    .5879402
         L2. |  -.3300954   .2036619    -1.62   0.105    -.7292654    .0690745
         L3. |   .3323739   .2501949     1.33   0.184    -.1579991    .8227469
         L4. |  -.1421141   .3202887    -0.44   0.657    -.7698684    .4856403
             |
  d1cdwell2  |
         L1. |   .1181662   .2170835     0.54   0.586    -.3073096    .5436421
         L2. |   .4261575   .2382803     1.79   0.074    -.0408633    .8931783
         L3. |  -.1911607   .2225946    -0.86   0.390    -.6274382    .2451168
         L4. |  -.2283018   .2571201    -0.89   0.375    -.7322481    .2756444
             |
     d1land  |
         L1. |  -.1093341   .0889479    -1.23   0.219    -.2836688    .0650006
         L2. |   .0471625   .1166744     0.40   0.686    -.1815151    .2758401
         L3. |   .1334734    .096449     1.38   0.166    -.0555631      .32251
         L4. |   .0448829   .0930425     0.48   0.630     -.137477    .2272429
             |
      d1pop  |
         --. |   .0075005   .0615204     0.12   0.903    -.1130773    .1280782
         L1. |  -.0420569   .0651574    -0.65   0.519     -.169763    .0856493
             |
       _cons |    475.202   759.9816     0.63   0.532    -1014.335    1964.739
-------------+----------------------------------------------------------------
d1land       |
  d1cdwell0  |
         L1. |  -10.41138   4.183599    -2.49   0.013    -18.61108   -2.211674
         L2. |   11.96176   5.128471     2.33   0.020     1.910139    22.01338
         L3. |  -4.976857   5.340226    -0.93   0.351    -15.44351    5.489793
         L4. |  -2.883659    4.12233    -0.70   0.484    -10.96328    5.195959
             |
  d1cdwell1  |
         L1. |  -.7202104   .3669256    -1.96   0.050    -1.439371   -.0010494
         L2. |   -.614542   .3143494    -1.95   0.051    -1.230655    .0015714
         L3. |   1.036792   .3861725     2.68   0.007     .2799076    1.793676
         L4. |  -1.164875   .4943613    -2.36   0.018    -2.133806    -.195945
             |
  d1cdwell2  |
         L1. |   1.176792   .3350655     3.51   0.000     .5200762    1.833509
```

```
         L2. |  -.1224991   .3677824    -0.33   0.739    -.8433394    .5983412
         L3. |   .1470373   .3435718     0.43   0.669    -.5263511    .8204256
         L4. |   .0550999   .3968615     0.14   0.890    -.7227343    .8329341
             |
      d1land |
         L1. |   .2444112   .1372899     1.78   0.075    -.0246721    .5134944
         L2. |   .0914378   .1800854     0.51   0.612     -.261523    .4443987
         L3. |   .5422549   .1488677     3.64   0.000     .2504795    .8340303
         L4. |  -.0637432   .1436099    -0.44   0.657    -.3452133     .217727
             |
       d1pop |
         --. |   .5109943   .0949559     5.38   0.000     .3248842    .6971044
         L1. |   .1523691   .1005696     1.52   0.130    -.0447436    .3494818
             |
       _cons |  -1460.141   1173.021    -1.24   0.213    -3759.221    838.9383
------------------------------------------------------------------------------

. varsoc, maxlag(5);

   Selection-order criteria
   Sample:  1979 - 2008                        Number of obs      =        30
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -889.952                      1.5e+21   60.1302   60.3095   60.6906  |
  |  1 | -841.675  96.555   16  0.000  1.8e+20   57.9783   58.3967   59.2861  |
  |  2 | -817.167  49.016   16  0.000  1.2e+20   57.4111   58.0686   59.4662  |
  |  3 | -797.533  39.268   16  0.001  1.2e+20   57.1688   58.0654   59.9712  |
  |  4 | -774.313  46.439   16  0.000  1.2e+20   56.6876   57.8231   60.2373  |
  |  5 | -727.831  92.965*  16  0.000  4.6e+19*  54.6554*    56.03*  58.9524* |
  +---------------------------------------------------------------------------+
   Endogenous:  d1cdwell0 d1cdwell1 d1cdwell2 d1land
    Exogenous:  d1pop L.d1pop  _cons

. varlmar, mlag(5);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+------------------------------|
  |   1  |   21.6296    16     0.15556   |
  |   2  |   10.0463    16     0.86420   |
  |   3  |   14.0508    16     0.59493   |
  |   4  |   11.0075    16     0.80902   |
  |   5  |   10.2996    16     0.85052   |
  +--------------------------------------+
   H0: no autocorrelation at lag order
```

```
. varstable;

   Eigenvalue stability condition
  +--------------------------------------+
  |        Eigenvalue         |   Modulus   |
  |---------------------------+-------------|
  |    .905194 +  .3171331i   |    .95914   |
  |    .905194 -  .3171331i   |    .95914   |
  |  -.6671765 +  .6708638i   |   .946141   |
  |  -.6671765 -  .6708638i   |   .946141   |
  |   .4596008 +  .7303522i   |   .862929   |
  |   .4596008 -  .7303522i   |   .862929   |
  |  -.1533229 +  .8368485i   |   .850778   |
  |  -.1533229 -  .8368485i   |   .850778   |
  |    .561003 +   .535652i   |   .775659   |
  |    .561003 -   .535652i   |   .775659   |
  |  -.5498936 +  .5264367i   |   .761261   |
  |  -.5498936 -  .5264367i   |   .761261   |
  |   .7154347                |   .715435   |
  |  -.6874031                |   .687403   |
  | -.02337838 +  .6403213i   |   .640748   |
  | -.02337838 -  .6403213i   |   .640748   |
  +--------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.

. varnorm, jbera;

   Jarque-Bera test
  +-------------------------------------------------------+
  |           Equation |            chi2   df  Prob > chi2 |
  |--------------------+----------------------------------|
  |          d1cdwell0 |            1.247   2    0.53619   |
  |          d1cdwell1 |            0.604   2    0.73928   |
  |          d1cdwell2 |            0.120   2    0.94200   |
  |             d1land |            0.983   2    0.61172   |
  |                ALL |            2.953   8    0.93726   |
  +-------------------------------------------------------+
```

```
. varwle;
```

Equation: d1cdwell0

lag	chi2	df	Prob > chi2
1	42.9305	4	0.000
2	13.36902	4	0.010
3	7.394668	4	0.116
4	21.57724	4	0.000

Equation: d1cdwell1

lag	chi2	df	Prob > chi2
1	16.84752	4	0.002
2	37.44689	4	0.000
3	15.90076	4	0.003
4	5.981038	4	0.201

Equation: d1cdwell2

lag	chi2	df	Prob > chi2
1	2.347908	4	0.672
2	11.93144	4	0.018
3	6.611761	4	0.158
4	4.682397	4	0.321

Equation: d1land

lag	chi2	df	Prob > chi2
1	16.79595	4	0.002
2	13.84194	4	0.008
3	32.75914	4	0.000
4	29.11772	4	0.000

Equation: All

lag	chi2	df	Prob > chi2
1	110.8087	16	0.000
2	68.99355	16	0.000
3	65.30738	16	0.000
4	63.15339	16	0.000

```
. vargranger;
```

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
d1cdwell0	d1cdwell1	88.649	4	0.000
d1cdwell0	d1cdwell2	28.875	4	0.000
d1cdwell0	d1land	31.668	4	0.000
d1cdwell0	ALL	121.39	12	0.000
d1cdwell1	d1cdwell0	29.769	4	0.000
d1cdwell1	d1cdwell2	39.774	4	0.000
d1cdwell1	d1land	26.331	4	0.000
d1cdwell1	ALL	77.044	12	0.000
d1cdwell2	d1cdwell0	15.735	4	0.003
d1cdwell2	d1cdwell1	3.2867	4	0.511
d1cdwell2	d1land	5.6267	4	0.229
d1cdwell2	ALL	32.597	12	0.001
d1land	d1cdwell0	13.442	4	0.009
d1land	d1cdwell1	43.31	4	0.000
d1land	d1cdwell2	15.313	4	0.004
d1land	ALL	104.14	12	0.000

```
. summarize ppdu if tin(1980, 2008), detail;
```

Persons per dwelling unit

Percentiles		Smallest		
1%	2.424941	2.424941		
5%	2.427948	2.427948		
10%	2.432215	2.432215	Obs	29
25%	2.485566	2.433664	Sum of Wgt.	29
50%	2.568762		Mean	2.55509
		Largest	Std. Dev.	.0802069
75%	2.620394	2.64797		
90%	2.64963	2.64963	Variance	.0064331
95%	2.653031	2.653031	Skewness	-.4325158
99%	2.653849	2.653849	Kurtosis	1.770893

```
.
```

Appendix 4: Statistical Output for Model 5

```
. /*************************************************************************/;
. /* Estimate Model 5: Develop a model for commerical buildings            */;
. /*************************************************************************/;
. /* bunch of interated models were tested and not included in the script  */;
. /*************************************************************************/;
. var d1build4 if tin(1979,2008), lags(1 2) exog(d1cdwell1 l2.d1cdwell1) noconstant
> ;

Vector autoregression

Sample:  1979 - 2008                            No. of obs      =        30
Log likelihood = -146.1764                      AIC             =  10.01176
FPE            =  1306.991                      HQIC            =  10.07153
Det(Sigma_ml)  =   999.464                      SBIC            =  10.19859

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d1build4              4     33.9592   0.9637    796.494   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
    d1build4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1build4     |
    d1build4 |
         L1. |   .0803256   .0592312     1.36   0.175    -.0357653    .1964165
         L2. |   .1341093   .0575757     2.33   0.020      .021263    .2469556
             |
   d1cdwell1 |
         --. |   .0250521   .0057714     4.34   0.000     .0137402    .0363639
         L2. |   .0211022   .0065057     3.24   0.001     .0083512    .0338532
------------------------------------------------------------------------------

. varsoc, maxlag(5);

   Selection-order criteria
   Sample:  1979 - 2008                         Number of obs      =        30
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -150.302                      1503.82   10.1534   10.1833   10.2469  |
  |  1 |  -148.67  3.2634    1  0.071  1442.49   10.1113   10.1562   10.2515  |
  |  2 | -146.176   4.987*   1  0.026  1306.99*  10.0118*  10.0715*  10.1986* |
  |  3 | -145.718  .91702    1  0.338  1357.13   10.0479   10.1226   10.2814  |
  |  4 | -145.342  .75159    1  0.386  1418.09   10.0895   10.1791   10.3697  |
  |  5 | -145.108  .46887    1  0.494  1497.26   10.1405   10.2451   10.4675  |
  +---------------------------------------------------------------------------+
   Endogenous:  d1build4
    Exogenous:  d1cdwell1 L2.d1cdwell1

. varlmar, mlag(5);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |    4.4730     1     0.03443   |
  |   2  |    0.0990     1     0.75304   |
  |   3  |    1.1045     1     0.29328   |
  |   4  |    3.7406     1     0.05310   |
  |   5  |    0.0431     1     0.83554   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varstable;
```

Eigenvalue stability condition

Eigenvalue	Modulus
.4085679	.408568
-.3282423	.328242

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Appendix 5: Historic and Projected Building Data.

	Historic Values				Model Predicted Values					
Year	Population	Units on Wells	Single Family	Multi-Family Units	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings	Developed Land
1950	50484	544	7535	3030	544	7535	3030	11109	1054	25901
1951	51600	559	7958	3096	559	7958	3096	11613	1085	26026
1952	54000	571	8405	3316	571	8405	3316	12292	1145	26388
1953	58100	580	9175	3435	580	9175	3435	13190	1192	26595
1954	60500	614	9804	3568	614	9804	3568	13986	1229	26898
1955	65200	648	10564	3717	648	10564	3717	14929	1281	27991
1956	68900	668	11444	3904	668	11444	3904	16016	1333	28276
1957	73000	682	12035	4175	682	12035	4175	16892	1384	46177
1958	76000	723	13017	4324	723	13017	4324	18064	1440	47264
1959	81300	758	13658	4662	758	13658	4662	19078	1494	47854
1960	84988	830	14674	5513	830	14674	5513	21017	1655	50782
1961	85969	869	15525	5675	869	15525	5675	22069	1716	51117
1962	88648	968	17070	6144	968	17070	6144	24182	1789	52201
1963	91705	1093	18520	7077	1093	18520	7077	26690	1876	53025
1964	95289	1184	19875	8380	1184	19875	8380	29439	1985	54544
1965	103420	1304	21412	8863	1304	21412	8863	31579	2107	55443
1966	106356	1382	22160	9142	1382	22160	9142	32684	2198	56267
1967	105541	1442	22420	9169	1442	22420	9169	33031	2279	57116
1968	108776	1496	22879	9273	1496	22879	9273	33648	2365	57508
1969	119192	1545	23585	9573	1545	23585	9573	34703	2451	73716
1970	122574	1607	25124	9921	1607	25124	9921	36652	2560	74957
1971	128600	1779	26781	11075	1779	26781	11075	39635	2624	75868
1972	135400	1959	28632	12331	1959	28632	12331	42922	2702	77725
1973	141000	2126	30229	14435	2126	30229	14435	46790	2861	78813
1974	147400	2224	31311	15763	2224	31311	15763	49298	3224	79625
1975	152200	2332	31958	16162	2332	31958	16162	50452	3331	80463
1976	158700	2490	33309	16927	2490	33309	16927	52726	3438	82415
1977	167800	2887	35480	18872	2887	35480	18872	57239	3598	84562
1978	177600	3458	38348	20713	3458	38348	20713	62519	4270	87055
1979	187200	3880	41852	23538	3880	41852	23538	69270	4462	90635
1980	193623	4116	43529	25103	4117	43725	25477	73319	4670	95886
1981	201680	4245	44463	25611	4255	44370	25599	74225	4810	99963
1982	205130	4367	45369	25961	4375	45502	26222	76099	4911	101919
1983	210990	4477	46378	26921	4488	46132	26822	77442	4988	102572
1984	218320	4668	48048	28237	4668	47892	27930	80490	5071	105880
1985	224580	4859	50032	29117	4877	49684	28888	83449	5166	108160
1986	232270	5043	52106	31387	5070	51296	30293	86658	5276	111000
1987	238360	5282	54111	31898	5284	53287	30985	89556	5391	115678
1988	244890	5475	55804	32678	5450	55189	31963	92602	5505	117396
1989	251580	5626	57062	33698	5609	56869	32976	95455	5608	120695
1990	257120	5798	58724	34536	5777	58406	33640	97823	5715	124979
1991	265762	5945	60212	35235	5920	60325	34688	100933	5806	127780

	Historic Values				Model Predicted Values					
Year	Population	Units on Wells	Single Family	Multi-Family Units	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings	Developed Land
1992	273178	6110	61987	35401	6098	62344	35637	104079	5911	131225
1993	282214	6286	64068	35571	6292	64563	36403	107258	6013	135667
1994	293141	6505	66822	36390	6481	66948	36988	110416	6134	139617
1995	302748	6685	68881	36642	6689	69607	37479	113774	6247	144234
1996	312366	6845	71210	37702	6855	71882	38586	117323	6386	148801
1997	320828	7019	74121	39345	7008	74563	39488	121060	6536	154939
1998	327899	7126	77077	40151	7119	77457	40465	125042	6703	158429
1999	334601	7270	80789	42101	7255	80739	42370	130364	6893	161762
2000	341935	7402	83794	43062	7396	83814	43448	134658	7069	166497
2001	353271	7541	87957	44657	7542	88087	44745	140373	7292	170205
2002	359423	7666	92264	45863	7672	92198	45571	145442	7500	173651
2003	373233	7826	96028	46562	7834	96548	46705	151087	7720	177555
2004	383453	7990	100290	47295	8000	100885	47375	156260	7956	181802
2005	396844	8133	105639	47885	8144	105442	48138	161725	8222	185840
2006	409085	8263	109521	48617	8267	109612	48620	166499	8471	188251
2007	418061	8358	111692	48924	8352	111529	48993	168874	8693	190405
2008	423833	8409	112850	49983	8411	112986	50195	171592	8850	192015
2009	432010	8423	113086	50025	8412	113592	50905	172908	8945	194082
2010	440081				8492	114967	51543	175002	9035	195403
2011	448038				8621	117148	51925	177693	9122	197462
2012	455872				8807	119150	52491	180448	9229	199377
2013	463577				9030	121124	53316	183470	9345	203265
2014	471146				9195	122553	54139	185886	9447	206554
2015	478572				9329	123800	55050	188179	9544	210030
2016	485851				9474	125338	55770	190582	9634	214554
2017	492977				9611	127295	56587	193493	9730	217640
2018	499946				9783	129655	57649	197088	9841	221153
2019	506754				9964	131871	58651	200486	9960	224902
2020	513398				10121	133959	59881	203960	10087	227973
2021	519876				10274	136043	61027	207344	10212	231729
2022	526185				10400	137907	61981	210288	10330	234557
2023	532324				10526	139746	63025	213298	10446	237043
2024	538291				10669	141508	63910	216087	10555	239860
2025	544088				10800	142989	64836	218625	10655	241667
2026	549713				10943	144249	65818	221010	10746	243946
2026	549713				10943	144249	65818	221010	10746	243946
2027	555166				11085	145218	66624	222927	10822	246334
2028	560450				11220	146026	67506	224752	10887	248180
2029	565564				11372	146772	68326	226470	10942	250675
2026	549713				10943	144249	65818	221010	10746	243946
2027	555166				11085	145218	66624	222927	10822	246334

	Historic Values				Model Predicted Values					
Year	Population	Units on Wells	Single Family	Multi-Family Units	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings	Developed Land
2026	549713				10943	144249	65818	221010	10746	243946
2027	555166				11085	145218	66624	222927	10822	246334
2028	560450				11220	146026	67506	224752	10887	248180
2029	565564				11372	146772	68326	226470	10942	250675
2030	570511				11527	147367	69092	227986	10987	252889
2031	575293				11690	147943	70010	229643	11028	255175
2032	579911				11865	148478	70878	231221	11063	258009
2033	584368				12033	148940	71811	232784	11095	260469
2034	588667				12210	149469	72827	234506	11127	263338
2035	592810				12387	150018	73785	236190	11157	266282
2036	596801				12561	150602	74855	238018	11190	268867
2037	600644				12742	151233	75937	239912	11224	271832
2038	604340				12917	151813	77004	241733	11258	274493
2039	607895				13089	152380	78154	243624	11293	277011
2040	611312				13263	152893	79238	245395	11325	279690
2041	614593				13430	153305	80327	247062	11355	281919
2042	617744				13600	153662	81433	248695	11381	284218
2043	620767				13770	153894	82466	250129	11402	286454
2044	623667				13938	154002	83532	251473	11417	288400
2045	626448				14112	154017	84572	252700	11426	290574
2046	629112				14285	153899	85573	253758	11428	292583
2047	631665				14461	153708	86615	254784	11425	294572
2048	634110				14644	153450	87619	255712	11416	296777
2049	636450				14826	153123	88641	256591	11403	298822
2050	638689				15014	152784	89701	257499	11387	301045

Appendix 6: Utility service areas and hydrographic basins name list.

Utility service areas are defined by TMWA's service area boundary as of June 2009. Hydrographic basins in Washoe County is listed below and a simplified list of basins used in this analysis is listed below.

1. Service area names used in analysis.

Code	Name
DD	Double Diamond
HV	Hidden Valley
SS	Spanish Springs
SV	Sun Valley
TR	TMWA Retail Area
WC	Washoe County

2. Simplified hydrographic basins list used.

Basin Num.	**Name**	**Alt.Num.**	**Alt. Name**
089	Washoe Valley	000	Other
090	Lake Tahoe Basin	000	Other
088	Pleasant Valley	000	Other
100	Cold Spring Valley	000	Other
084	Warm Springs Valley	000	Other
099	Red Rock Valley	000	Other
093	Antelope Valley	000	Other
094	Bedell Flat	000	Other
083	Tracy Segment	000	Other
028	Black Rock Desert	000	Other
009	Long Valley	000	Other
014	Surprise Valley	000	Other
081	Pyramid Lake Valley	000	Other
104	Eagle Valley	000	Other
022	San Emidio Desert	000	Other
024	Hualapai Flat	000	Other
021	Smoke Creek Desert	000	Other
100A	Long Valley	000	Other
082	Dodge Flat	000	Other
097	Honey Lake Valley	000	Other
095	Dry Valley	000	Other
080	Winnemucca Lake Valley	000	Other
103	Dayton Valley	000	Other
015	Boulder Valley	000	Other
085	Spanish Springs Valley	085	Spanish Springs Valley
086	Sun Valley	086	Sun Valley
087	Truckee Meadows	087	Truckee Meadows
091	Truckee Canyon Segment	091	Truckee Canyon Segment
092B	Lemmon Valley	092	Lemmon Valley
092A	Lemmon Valley	092	Lemmon Valley

Final basin list.

000	Other
085	Spanish Springs Valley
086	Sun Valley
087	Truckee Meadows
091	Truckee Canyon Segment
092	Lemmon Valley

TRUCKEE MEADOWS WATER AUTHORITY
www.tmh2o.com

Memorandum

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TO: File

FROM: **Shawn Stoddard, Ph.D. Senior Resource Economist**

DATE: December 11, 2009

SUBJ: TPEM Series No. 3: TMWA Water Demand Projections

Findings

- A water demand projection for TMWA's Retail Service area and each wholesale service area.
- Estimated a relationship between Washoe County Buildings and active TMWA billings.
- Estimated a model for metered irrigation water services.
- Estimated annual water use coefficients for each customer class.

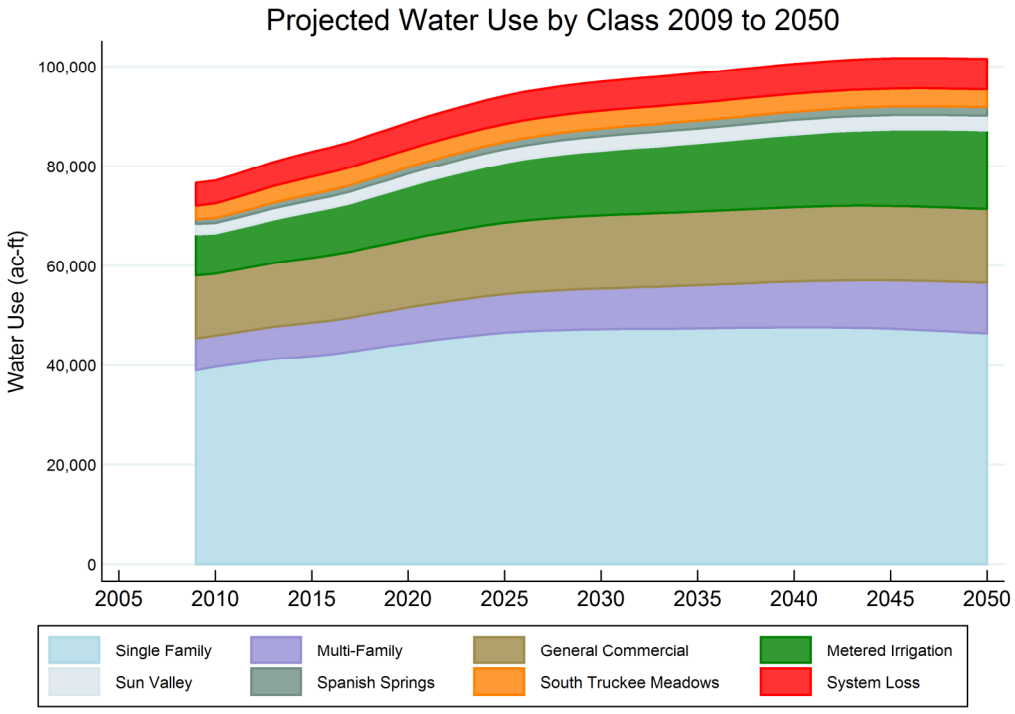

Figure 1: TMWA Projected Water Use 2009 to 2050.

Table 1: Water Demand Projections 2009 to 2050

Year	RMWS	MMWS	GMWS	MIS	Total Retail	Sun Valley	Spanish Springs	South Truckee Meadows	Total Wholesale	Total Deliveries	System Loss	Total Production
2009	39,010	6,380	12,708	8,280	66,378	2,049	901	2,750	5,700	72,078	4,601	76,679
2010	39,679	6,301	12,443	8,121	66,544	2,090	964	2,932	5,986	72,530	4,630	77,160
2011	40,255	6,336	12,545	8,277	67,413	2,130	1,018	3,088	6,236	73,649	4,701	78,350
2012	40,773	6,393	12,673	8,491	68,330	2,171	1,066	3,227	6,464	74,794	4,774	79,568
2013	41,278	6,483	12,814	8,759	69,332	2,212	1,109	3,351	6,672	76,004	4,851	80,855
2014	41,617	6,571	12,936	9,011	70,135	2,252	1,148	3,463	6,863	76,998	4,915	81,913
2015	41,897	6,668	13,053	9,269	70,889	2,293	1,183	3,565	7,041	77,930	4,974	82,904
2016	42,263	6,744	13,157	9,480	71,644	2,333	1,216	3,600	7,149	78,793	5,029	83,822
2017	42,753	6,830	13,268	9,713	72,564	2,374	1,246	3,600	7,220	79,784	5,093	84,877
2018	43,361	6,946	13,402	10,012	73,721	2,415	1,274	3,600	7,289	81,010	5,171	86,181
2019	43,922	7,054	13,543	10,307	74,826	2,455	1,301	3,600	7,356	82,182	5,246	87,428
2020	44,441	7,189	13,697	10,652	75,979	2,496	1,325	3,600	7,421	83,400	5,323	88,723
2021	44,956	7,314	13,847	10,982	77,099	2,536	1,349	3,600	7,485	84,584	5,399	89,983
2022	45,401	7,415	13,988	11,268	78,072	2,577	1,371	3,600	7,548	85,620	5,465	91,085
2023	45,837	7,527	14,125	11,560	79,047	2,618	1,392	3,600	7,610	86,657	5,531	92,188
2024	46,247	7,616	14,253	11,821	79,938	2,658	1,411	3,600	7,669	87,607	5,592	93,199
2025	46,572	7,712	14,366	12,073	80,725	2,699	1,430	3,600	7,729	88,454	5,646	94,100
2026	46,829	7,815	14,470	12,319	81,433	2,740	1,449	3,600	7,789	89,222	5,695	94,917
2027	47,000	7,895	14,550	12,512	81,957	2,780	1,466	3,600	7,846	89,803	5,732	95,535
2028	47,122	7,985	14,618	12,704	82,429	2,821	1,483	3,600	7,904	90,333	5,766	96,099
2029	47,224	8,066	14,672	12,869	82,831	2,861	1,498	3,600	7,959	90,790	5,795	96,585
2030	47,281	8,141	14,711	13,012	83,145	2,902	1,514	3,600	8,016	91,161	5,819	96,980
2031	47,333	8,233	14,746	13,171	83,483	2,902	1,529	3,600	8,031	91,514	5,841	97,355
2032	47,371	8,318	14,772	13,314	83,775	2,902	1,543	3,600	8,045	91,820	5,861	97,681
2033	47,387	8,410	14,793	13,460	84,052	2,902	1,557	3,600	8,059	92,111	5,879	97,990
2034	47,422	8,513	14,815	13,619	84,369	2,902	1,570	3,600	8,072	92,441	5,900	98,341
2035	47,462	8,608	14,832	13,765	84,667	2,902	1,583	3,600	8,085	92,752	5,920	98,672
2036	47,510	8,716	14,856	13,933	85,015	2,902	1,596	3,600	8,098	93,113	5,943	99,056
2037	47,572	8,824	14,880	14,104	85,380	2,902	1,608	3,600	8,110	93,490	5,967	99,457
2038	47,618	8,931	14,904	14,268	85,721	2,902	1,620	3,600	8,122	93,843	5,990	99,833
2039	47,659	9,047	14,930	14,452	86,088	2,902	1,631	3,600	8,133	94,221	6,014	100,235
2040	47,684	9,154	14,950	14,617	86,405	2,902	1,642	3,600	8,144	94,549	6,035	100,584
2041	47,680	9,262	14,969	14,778	86,688	2,902	1,653	3,600	8,155	94,843	6,054	100,897
2042	47,660	9,369	14,982	14,937	86,949	2,902	1,664	3,600	8,166	95,115	6,071	101,186
2043	47,604	9,469	14,989	15,077	87,139	2,902	1,674	3,600	8,176	95,315	6,084	101,399
2044	47,513	9,572	14,987	15,210	87,282	2,902	1,684	3,600	8,186	95,468	6,094	101,562
2045	47,397	9,672	14,978	15,335	87,382	2,902	1,694	3,600	8,196	95,578	6,101	101,679
2046	47,242	9,765	14,958	15,437	87,402	2,902	1,703	3,600	8,205	95,607	6,103	101,710
2047	47,069	9,864	14,932	15,540	87,405	2,902	1,713	3,600	8,215	95,620	6,103	101,723
2048	46,877	9,958	14,902	15,633	87,371	2,902	1,722	3,600	8,224	95,595	6,102	101,697
2049	46,666	10,054	14,863	15,717	87,300	2,902	1,731	3,600	8,233	95,533	6,098	101,631
2050	46,453	10,153	14,822	15,804	87,232	2,902	1,740	3,600	8,242	95,474	6,094	101,568

Table 2: Estimated Annual Water User Per Service.

Year	RMWS	RMWS Base	RFWS	SUFR	MMWS	GMWS	MIS
2003	156.76	167.82	205.62	97.23	432.32	696.72	1,050.09
2004	156.02	179.29	271.51	74.93	445.07	762.79	1,054.98
2005	143.01	162.88	270.00	82.95	409.78	824.57	1,043.45
2006	137.74	159.20	313.35	86.36	455.66	696.91	956.35
2007	150.37	168.59	331.82	73.50	440.38	682.93	1,047.21
2008	143.59	162.87	347.07	81.99	428.78	587.20	947.96
Average	**146.94**	**166.61**	**271.54**	**84.28**	**435.00**	**707.22**	**1,013.15**

Table 3: Retail Water Service Projections 2009 to 2050

Year	Single Family Base	Single Family New	Total Single Family	Multi-Family Units	Multi-Family Services	General Metered Service	Metered Irrigation Service	Total Services
2009	76,292	0	76,890	47,877	4,779	5,855	2,663	90,187
2010	76,890	806	77,696	48,143	4,720	5,733	2,612	90,761
2011	76,890	2,083	78,973	48,408	4,746	5,780	2,662	92,161
2012	76,890	3,231	80,121	48,846	4,789	5,839	2,731	93,480
2013	76,890	4,352	81,242	49,526	4,855	5,904	2,817	94,818
2014	76,890	5,102	81,992	50,201	4,922	5,960	2,898	95,772
2015	76,890	5,724	82,614	50,955	4,996	6,014	2,981	96,605
2016	76,890	6,536	83,426	51,526	5,052	6,062	3,049	97,589
2017	76,890	7,622	84,512	52,187	5,116	6,113	3,124	98,865
2018	76,890	8,970	85,860	53,072	5,203	6,175	3,220	100,458
2019	76,890	10,213	87,103	53,898	5,284	6,240	3,315	101,942
2020	76,890	11,365	88,255	54,932	5,385	6,311	3,426	103,377
2021	76,890	12,506	89,396	55,883	5,479	6,380	3,532	104,787
2022	76,890	13,494	90,384	56,652	5,554	6,445	3,624	106,007
2023	76,890	14,461	91,351	57,501	5,637	6,508	3,718	107,214
2024	76,890	15,370	92,260	58,198	5,706	6,567	3,802	108,335
2025	76,890	16,090	92,980	58,931	5,778	6,619	3,883	109,260
2026	76,890	16,661	93,551	59,710	5,854	6,667	3,962	110,034
2027	76,890	17,039	93,929	60,325	5,914	6,704	4,024	110,571
2028	76,890	17,309	94,199	61,006	5,981	6,735	4,086	111,001
2029	76,890	17,536	94,426	61,627	6,042	6,760	4,139	111,367
2030	76,890	17,663	94,553	62,196	6,098	6,778	4,185	111,614
2031	76,890	17,777	94,667	62,900	6,167	6,794	4,236	111,864
2032	76,890	17,861	94,751	63,555	6,231	6,806	4,282	112,070
2033	76,890	17,898	94,788	64,266	6,301	6,816	4,329	112,234
2034	76,890	17,975	94,865	65,048	6,377	6,826	4,380	112,448
2035	76,890	18,063	94,953	65,774	6,448	6,834	4,427	112,662
2036	76,890	18,171	95,061	66,598	6,529	6,845	4,481	112,916
2037	76,890	18,307	95,197	67,427	6,610	6,856	4,536	113,199
2038	76,890	18,410	95,300	68,240	6,690	6,867	4,589	113,446
2039	76,890	18,501	95,391	69,122	6,777	6,879	4,648	113,695
2040	76,890	18,557	95,447	69,941	6,857	6,888	4,701	113,893
2041	76,890	18,548	95,438	70,760	6,937	6,897	4,753	114,025
2042	76,890	18,503	95,393	71,590	7,019	6,903	4,804	114,119
2043	76,890	18,379	95,269	72,351	7,093	6,906	4,849	114,117
2044	76,890	18,178	95,068	73,137	7,170	6,905	4,892	114,035
2045	76,890	17,919	94,809	73,896	7,245	6,901	4,932	113,887
2046	76,890	17,577	94,467	74,618	7,315	6,892	4,965	113,639
2047	76,890	17,192	94,082	75,371	7,389	6,880	4,998	113,349
2048	76,890	16,766	93,656	76,087	7,460	6,866	5,028	113,010
2049	76,890	16,299	93,189	76,814	7,531	6,848	5,055	112,623
2050	76,890	15,826	92,716	77,572	7,605	6,829	5,083	112,233

Discussion

TPEM memo number 1 provided a population projection for Washoe County. This projection was used in memo number 2 with the Washoe County Assessors data to model building construction and create a projection of new residential dwelling units and commercial buildings. The county level building and population projections were then disaggregated using sub-area shares of the past building inventories.

This memo documents the process of using the projections produced in memos 1 and 2, combined with the recent active billing histories to project new retail water services, estimate annual water use per water service, and project water demand through the year 2050.

Billing data for projecting water services

The billing history data is used to compute water use coefficients and to create a relationship between the Assessor's data and active billing water services. The number of active billing water services is generally less than total number of buildings. This difference is generally the result of vacant/inactive water services, a time lag between Assessor's data and billing, or different functional uses of the property data.

Since population is estimated at July 1 of each calendar year and the building data reflects the calendar year, the June end of month active service counts is used as the projection point for each year, Table 4 shows the service counts used in this study.

Using projected building counts for the years 2003 to 2009, the ratio of active billing services to buildings was computed for residential metered services, multi-family dwelling units, and general metered water services (see Table 5). By multiplying building projections and ratios, the building projection is translated into an active billing service projections shown above in Table 3.

Table 4: Active Billing Service Counts.

Year	Residential Flat Rate Services	Small Unit Flat Rate Services	Residential Metered Services	Residential Total Services
2003	23,851	6,977	36,954	67,782
2004	17,896	5,479	46,327	69,702
2005	13,274	4,208	54,616	72,098
2006	10,319	3,657	61,704	75,680
2007	9,075	3,192	64,623	76,890
2008	8,149	2,859	65,857	76,865
2009	7,349	2,340	66,603	76,292

Year	Multi-Family Flat Rate With Irrigation Units	Multi-Family Flat Rate Units	Metered Multi-Family Units	Total Multi-Family Units
2003	25,465	3,807	15,009	44,281
2004	25,111	3,735	16,978	45,824
2005	25,039	2,562	18,789	46,390
2006	25,006	2,547	18,610	46,163
2007	25,034	2,539	19,832	47,405
2008	24,529	2,535	20,286	47,350
2009	23,383	2,525	21,969	47,877

Year	Multi-Family Flat Rate With Irrigation Services	Multi-Family Flat Rate Services	Metered Multi-Family Services	Total Multi-Family Services
2003	2,136	340	1,658	4,134
2004	2,127	353	1,887	4,367
2005	2,213	252	2,153	4,618
2006	2,239	251	2,040	4,530
2007	2,254	249	2,198	4,701
2008	2,177	244	2,269	4,690
2009	2,048	241	2,490	4,779

Year	General Metered Water Services	Metered Irrigation Water Services
2003	4,949	1,611
2004	5,276	2,142
2005	5,424	2,280
2006	5,427	2,360
2007	5,597	2,506
2008	5,713	2,599
2009	5,855	2,663

Table 5: Ratios of Active Billing to Buildings

Year	Aveage Multi-Family Dwelling Units per Service	Ratio of Active RMWS	Ratio of Active Multi-Family Units	Ratio of Active GMWS Services
2003	10.71	0.9684	1.0391	0.7162
2004	10.49	0.9634	1.0581	0.7413
2005	10.05	0.9572	1.0667	0.7427
2006	10.19	0.972	1.0459	0.7284
2007	10.08	0.9711	1.0675	0.738
2008	10.1	0.9639	1.0497	0.745
2009	10.02	0.9558	1.0603	0.761
Average	10.23	0.9645	1.0553	0.7389

For metered irrigation water services ("MIS") there is no clear correlation to any one land use or building type in the Assessors data. Many if not most MIS services are associated with multi-family properties or commercial properties, therefore, it stands to reason that multi-family and/or commercial water services should be able to statistically explain the MIS services and thus, project future MIS services using projected MMWS and GMWS data.

Three regression models were estimated: MIS as a function of multi-family services, MIS as a function of commercial services, and MIS as a function of both MF services and GMWS services. All three models are statistically significant (see regression results below). However, projection of MIS just using MF or GMWS as the independent variable results in similar short term projections but very different long term projections. The third model using both MF and GMWS results in a projection that reflects an average and is used for the service projection (see Figure 2). The projected MIS services are included in Table 3 above.

```
. regress mis mfservices;

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  1,     5) =   75.66
       Model |  719229.559     1  719229.559           Prob > F      =  0.0003
    Residual |  47529.8698     5  9505.97397           R-squared     =  0.9380
-------------+------------------------------           Adj R-squared =  0.9256
       Total |  766759.429     6  127793.238           Root MSE      =  97.499

------------------------------------------------------------------------------
         mis |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  mfservices |   1.532424   .1761747     8.70   0.000     1.079552    1.985295
       _cons |  -4657.028   801.6619    -5.81   0.002    -6717.765    -2596.29
------------------------------------------------------------------------------
```

```
. regress mis gmws;

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  1,     5) =  109.31
       Model |  733221.196     1  733221.196           Prob > F      =  0.0001
    Residual |  33538.2329     5  6707.64658           R-squared     =  0.9563
-------------+------------------------------           Adj R-squared =  0.9475
       Total |  766759.429     6  127793.238           Root MSE      =    81.9

------------------------------------------------------------------------------
         mis |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gmws |   1.169483   .1118565    10.46   0.000     .8819463    1.457019
       _cons |   -4080.17   611.8558    -6.67   0.001    -5652.995   -2507.344
------------------------------------------------------------------------------

. regress mis gmws mfservices;

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  2,     4) =   55.37
       Model |  740029.967     2  370014.984           Prob > F      =  0.0012
    Residual |  26729.4611     4  6682.36527           R-squared     =  0.9651
-------------+------------------------------           Adj R-squared =  0.9477
       Total |  766759.429     6  127793.238           Root MSE      =  81.746

------------------------------------------------------------------------------
         mis |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gmws |   .7534183   .4270368     1.76   0.152     -.432226    1.939063
  mfservices |   .5703001   .5649815     1.01   0.370    -.9983399     2.13894
       _cons |   -4399.55   687.7984    -6.40   0.003    -6309.184   -2489.915
------------------------------------------------------------------------------
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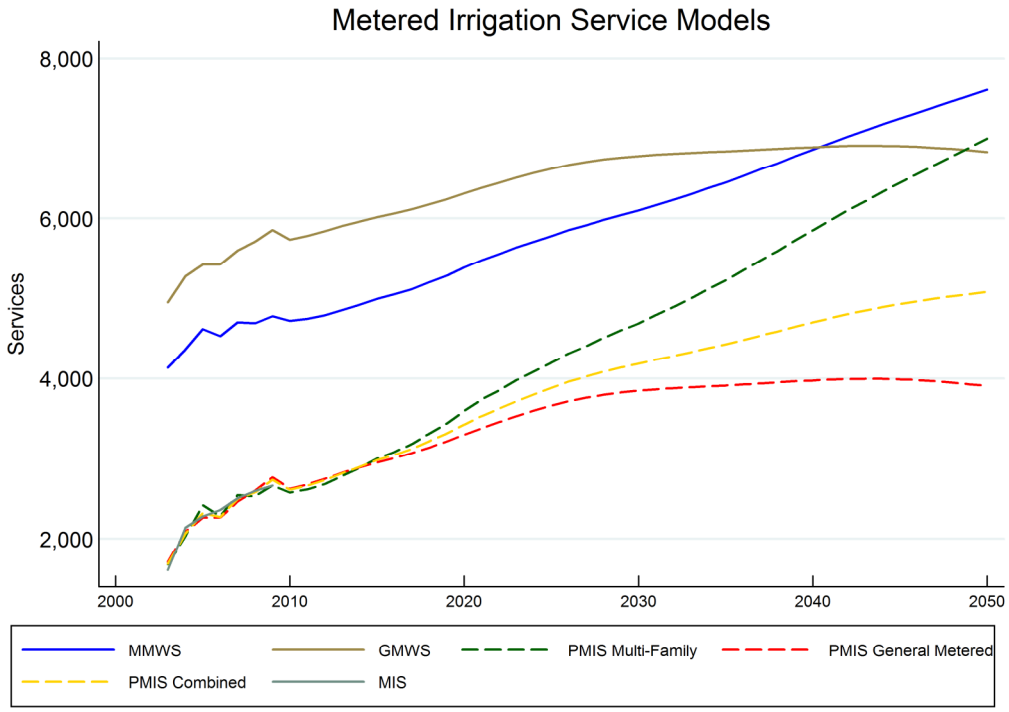

Figure 2: Projected Metered Irrigation Services.

Water use per service

The cost of service study completed in January 2009 contains a complete statistical analysis to date on customer water use that include estimates of annual water use per service. Since there is only six years of completed annual billing, a weighted average water use per service was computed using the annual number of services as weights for each customer class. Table 2 shows the resulting annual water use per service and the average of all years used for the water demand projections.

Single Family Water Services

This is a mixed class of services used in the final projection, prior to 1988 all single family water services were flat rate water services. Since 1988 all new homes are required to have a water meter installed and billed on a metered rate. Following this there was a change in the local plumbing codes to require all new homes to have low flow fixtures installed, this has resulted in a reduction in the amount of water used by newer homes. Over the last few years all of the flat rate homes now have water meters installed and most are now billed on the metered rate. The remaining flat rate customers are expected to be switched to the RMWS rate after June 2010.

There are also a group of flat rate services called "Small Unit Flat Rate" (SUFR) these are like townhouses or condo. Because of this mix of different types of housing and historic rate classes, the RMWS services need to treated in two parts. A base population with an average use per service that reflects the water use of the existing mix of older homes and a second class that reflects the water use of newer RMWS services.

RMWSBase is defined as all single family water services that are currently RMWS or will be changed to RMWS.

RMWS Projection Steps:

1. rmwsbase = rmwstot if year <= 2009. (rmwstot is projected counts)
2. rmwsbase = max(of rmwstot) for year > 2009.
3. rmwsnew = rmwstot – rmwsbase.
4. Estimate use of RMWS, RFWS, SUFR as service count * average use.
5. gen totrmwsuse = rmwsuse + rfwsuse + sufruse
6. average base computed as: gen aaurmwsbase = totrmwsuse/ rmwstot
7. Compute weighted averages for the rmwsbase.
8. compute weighted average of RMWS for new RMWS.
9. Apply the averages to the RMWS classes to create use projections for base, new and the total.

Multi-Family Service Water use

The historic multi-family water services that are still billed on the flat rate are currently being retrofitted. While there is limited meter data, it is reasonable to treat these as MMWS and to treat all multi-family units the same at this time.

Steps to Project Multi-Family:

1. load total water for MMWS.
2. load total MMWS water services and units counts.
3. average use per service equals total use / total services.
4. compute weighted average use per service.
5. MFuse = MFservices * average.

GMWS Service Water use

This is the general class of commercial water service.

1. compute annual weighted average for all services.
2. apply to projected service counts
3. convert to acre-feet.

MIS Service Water Use

Metered irrigation water service, these service are generally attached with commercial sites or multi-family sites

1. services are modeled using regression on MMWS and GMWS.
2. compute average use per water service
3. apply average to projected services.

Resulting Water demand projections

Table 1 above contains the resulting water demand projections for all retail classes of customers. Figure 1 presents the projection results in graphical formation.

Wholesale Water Use Analysis

Sun Valley GID

The best information for projecting Sun Valley's future wholesale demands is contained it's 2007 Water System Master Plan Update .

Using building estimates and charts of customer growth assume build out in 2030. It is estimated that Sun Valley GID could see an average growth of 121 customer per year with build out occurring in the year 2030 with 8,645 customers.

Using the overall average TMWA deliveries per customer for 2006, 2007, 2008 of 109.47 (x1,000 gal) wholesale demand is project to the year 2030.

Table 6: Sun Valley GIS Projections

Year	Customers	TMWA Water Supplied	Projected Demand (ac-ft)	Average Use Per Customer
2002	5,795			
2003	5,735	678,695	2,083	118.3
2004	5,743	714,426	2,192	124.4
2005	5,728	672,094	2,063	117.3
2006	5,741	650,897	1,998	113.4
2007	5,862	667,416	2,048	113.9
2008	5,983	605,388	1,858	101.2
2009	6,104	667,692	2,049	
2010	6,225	680,928	2,090	
2011	6,346	694,164	2,130	
2012	6,467	707,400	2,171	
2013	6,588	720,635	2,212	
2014	6,709	733,871	2,252	
2015	6,830	747,107	2,293	
2016	6,951	760,342	2,333	
2017	7,072	773,578	2,374	
2018	7,193	786,814	2,415	
2019	7,314	800,050	2,455	
2020	7,435	813,285	2,496	
2021	7,556	826,521	2,536	
2022	7,677	839,757	2,577	
2023	7,798	852,992	2,618	
2024	7,919	866,228	2,658	
2025	8,040	879,464	2,699	
2026	8,161	892,700	2,740	
2027	8,282	905,935	2,780	
2028	8,403	919,171	2,821	
2029	8,524	932,407	2,861	
2030	8,645	945,642	2,902	
…				
2050	8,645	945,642	2,902	

Spanish Springs and South Truckee Meadows

This projection is an updated version of the projection done in 2006.

Water use is extrapolated using a natural logarithm function

Table 7: Spanish Springs and South Truckee Meadows Projection

	Spanish Springs		South Truckee Meadows	
Year	Water Use (x1,000 gal)	Water Use (ac-ft)	Water Use	Water Use (ac-ft)
2002				
2003				
2004	58,856	171	146,332	645
2005	144,354	453	514,077	1,460
2006	206,222	619	705,879	1,936
2007	220,632	736	871,967	2,274
2008	284,203	827	645,834	2,536
2009		901		2,750
2010		964		2,932
2011		1,018		3,088
2012		1,066		3,227
2013		1,109		3,351
2014		1,148		3,463
2015		1,183		3,565
2016		1,216		3,600
2017		1,246		3,600
2018		1,274		3,600
2019		1,301		3,600
2020		1,325		3,600
2021		1,349		3,600
2022		1,371		3,600
2023		1,392		3,600
2024		1,411		3,600
2025		1,430		3,600
2026		1,449		3,600
2027		1,466		3,600
2028		1,483		3,600
2029		1,498		3,600
2030		1,514		3,600
…				
2050		1,740		3,600

Total Production System losses

The system losses are assumed to be 6%.

Total Production = Total sales + losses
Losses = Total Projection * Loss rate

Total Production = (Total Sales)/(1-loss rate)
Total loss = Total Production * loss rate