TRUCKEE MEADOWS WATER AUTHORITY

2016-2035

WATER RESOURCE PLAN

APPENDIX 4

APPENDIX 4-1

TPEM Series No. 6: Washoe County Population Projection 2015 to 2060 (Expanded)

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TO: File

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

DATE: September 1, 2015

SUBJECT: TPEM Series No. 6: Washoe County Population Projection 2015 to 2060 (Expanded)

Findings

- Washoe County population projection is updated with 2014 population estimates.
- 2014 population is 436,797, a 4.7% increase compared to 2010's population of 417,379 persons.
- Washoe County population from 1950 to 2014 continues to be well modeled by a logistic curve.
- Projected populations for 2015 to 2060 are presented here:

Year	Population	Year	Population
2014	436,797	2038	554,358
2015	443,729	2039	557,241
2016	450,488	2040	559,995
2017	457,072	2041	562,624
2018	463,476	2042	565,133
2019	469,699	2043	567,526
2020	475,740	2044	569,807
2021	481,596	2045	571,981
2022	487,267	2046	574,052
2023	492,754	2047	576,024
2024	498,058	2048	577,901
2025	503,178	2049	579,688
2026	508,118	2050	581,387
2027	512,879	2051	583,003
2028	517,463	2052	584,539
2029	521,874	2053	585,999
2030	526,115	2054	587,387
2031	530,188	2055	588,705
2032	534,099	2056	589,956
2033	537,850	2057	591,145
2034	541,445	2058	592,273
2035	544,890	2059	593,344
2036	548,187	2060	594,359
2037	551,342		

Discussion

TPEM Series No. 4 describes prior population forecasting models and their results. This analysis is an update to prior studies, provides a review of population tend, and compares the most recent consensus and State Demographer's ("SD's") projections. Appendix A provides graphs of prior population projects for review.

Logistic Curve Model

The logistic curve model for Washoe County population was developed in TPEM No. 1 is defined as:

$$Pop_t = \alpha / \left(1 + \beta 1 * e^{-\beta 2 * t}\right)$$

Where t is time index (1950 = 1), Pop_t is population in time t, α is population ceiling, $\beta 1$ and $\beta 2$ are shape parameters.

Using population values from 1950 to 2014 the model was estimated as:

$$Pop_t = 612{,}579.8 / \left(1 + 11.93398 * e^{-0.0536284 * t}\right)$$

Where t is time in years starting at $t = 1$ for 1950. The $R^2 = 0.9995$ shows that this model is a very good fit to the historic data. Figure 1 plots the results of this model. This model estimates the long-run population ceiling of 612,579 persons estimated to occur after 2100 with a 95% confidence interval between 576,493 to 648,666 persons. Appendix A provides the historic population used, the population values predicted by the model, and the model regression results.

Figure 1, shows a comparison of TMWA's population model with historic population values. It can be seen over time that population closely follows the model with periods when the population trends above and below the model. The recent population levels are below the model and trending back towards the model. This requires that the population projections be calibrated in such a way that the first year of the projection is equal to observed population while holding the projected population ceiling constant. This is done by estimating the following model iteratively until the calibration parameter is less than 1.

$$Pop_t + Calibrate = 612{,}579 / \left(1 + 15.30176 * e^{-.0559722 * t}\right)$$

Calibrate is the difference between the predicted model population and the actual population in 2014. As the model is solved and the calibration term added to the population, the model converges to a shape that forces the model trend to pass through the observed 2014 population. The converged model has an $R^2 = 0.9992$. The 95% confidence interval is estimated using the same process and is provided for in Appendix B.

Figure 2 shows the population model, the calibrated model, the State Demographer's 2014 projection and the 2014 Consensus Forecast.

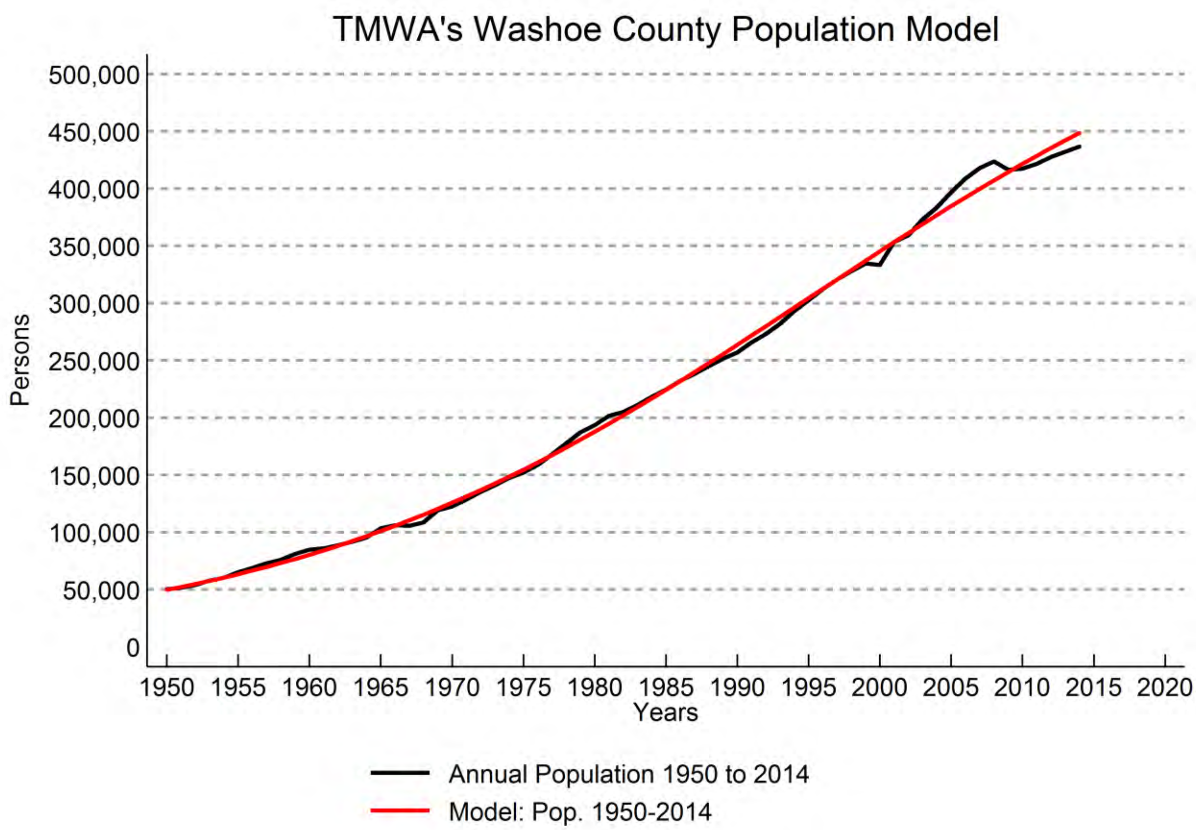


Figure 1: Washoe County Population Model 1950 to 2014.

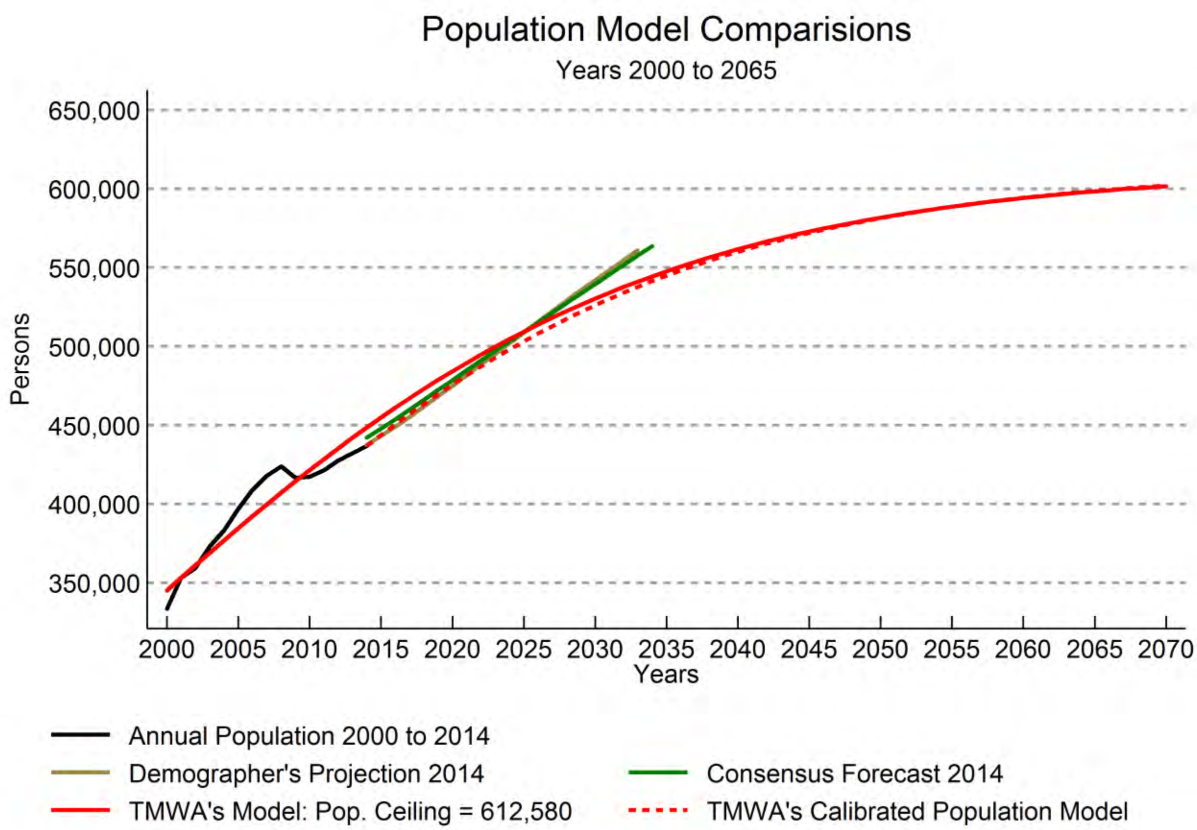


Figure 2: Comparisons of local population models.

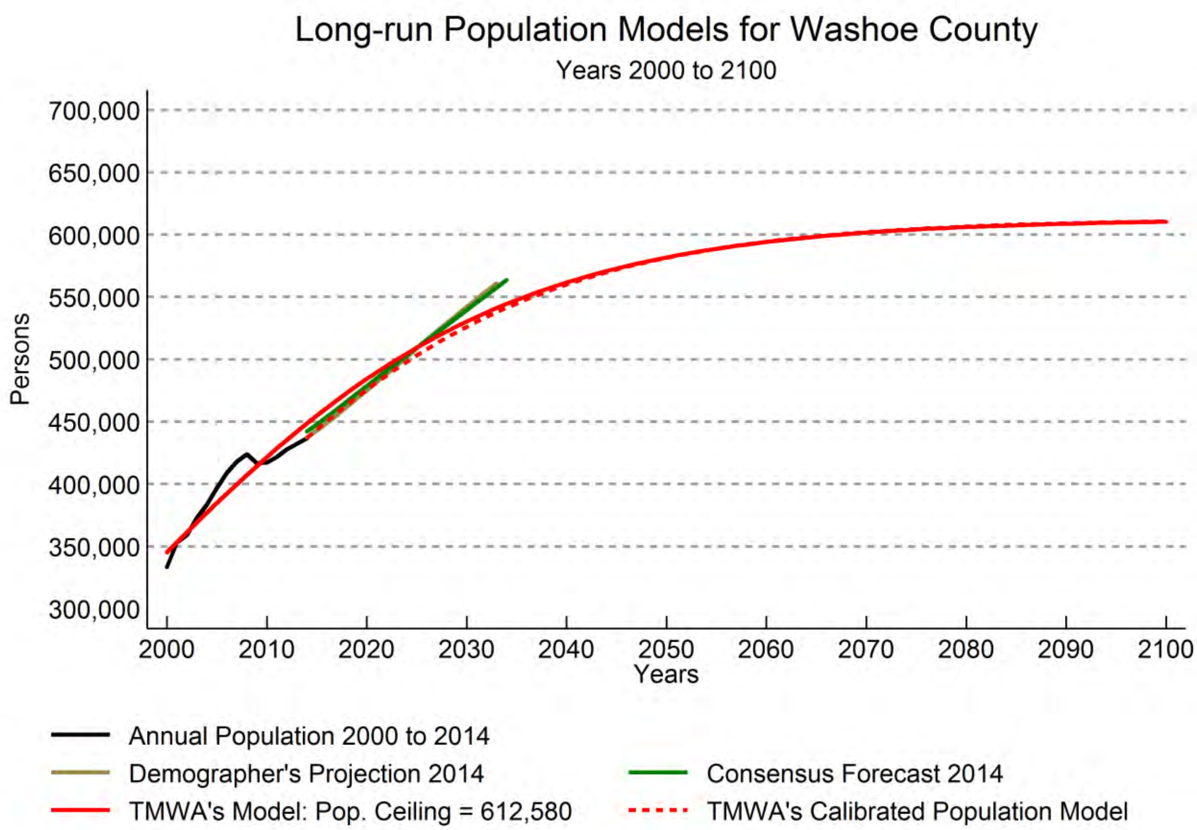


Figure 3: Long run population projection.

Figure 3 shows how the population is expected to level out at about 610,000 persons. This slowing of growth is expected to start occurring around year 2060. TMWA's and SD's projections intersect in the year 2025. For the first 10 years of the projection TMWA's and SD's projections are very similar, the SD projection includes estimated impacts of the Tesla plant, while the TMWA model is expected to capture those impacts as they happen over time. This result in TMWA's model predicting a slowing of growth after 2025 when compared with the SD model. Figure 4 shows that the SD's model is within TMWA's 95% confidence ranges and thus both models are statistically similar.

Figure 4 shows the 95% confidence level for the TMWA's model. In the long-run the population of Washoe County has a 95% probability of being between 576,493 and 648,666 persons.

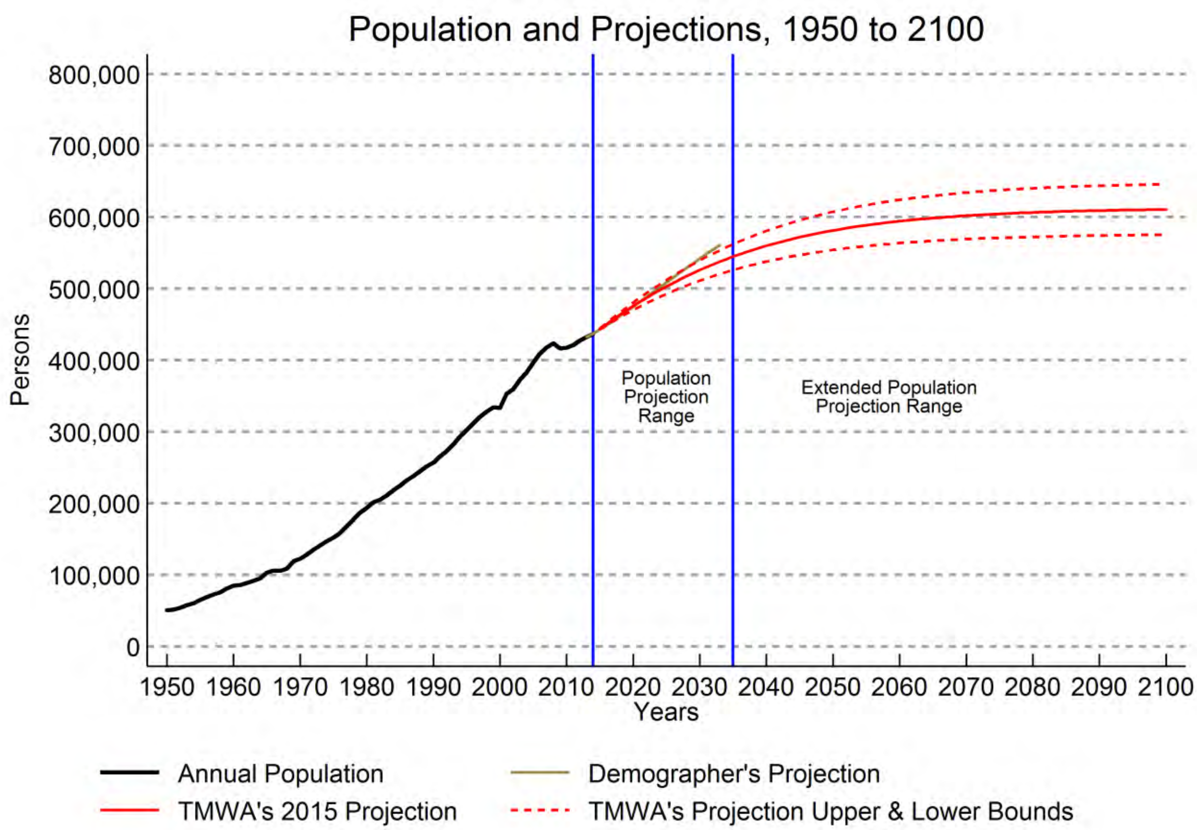


Figure 4: 95% Confidence Boundaries on Population Model.

Attached are appendices of supporting reference material.

Appendix A: Graphs of prior population projections.

Appendix B: Table of historic population, TMWA population model predicted population, and TMWA's projected population.

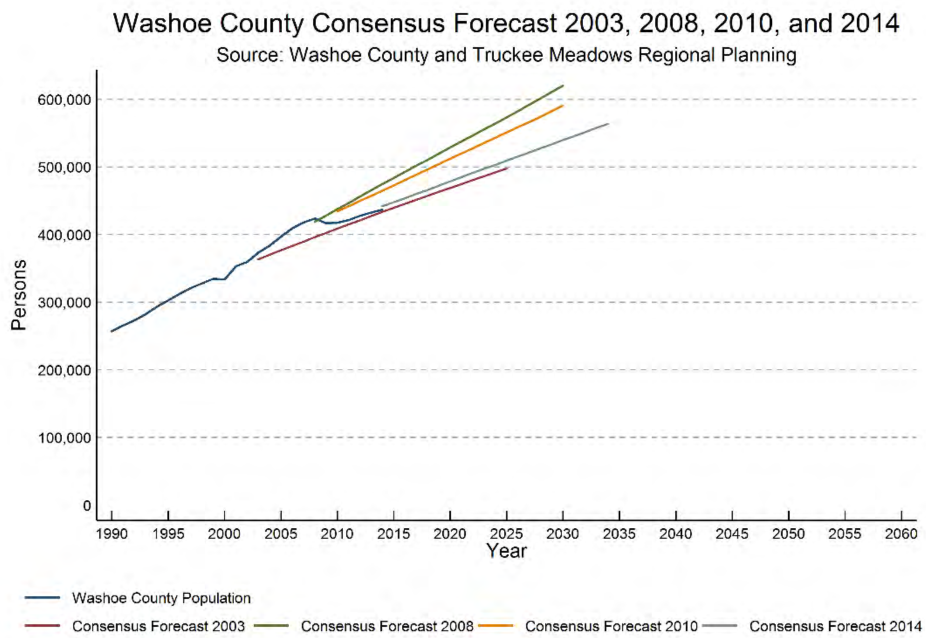
Appendix C: TMWA's nonlinear regression result for TMWA's population models.

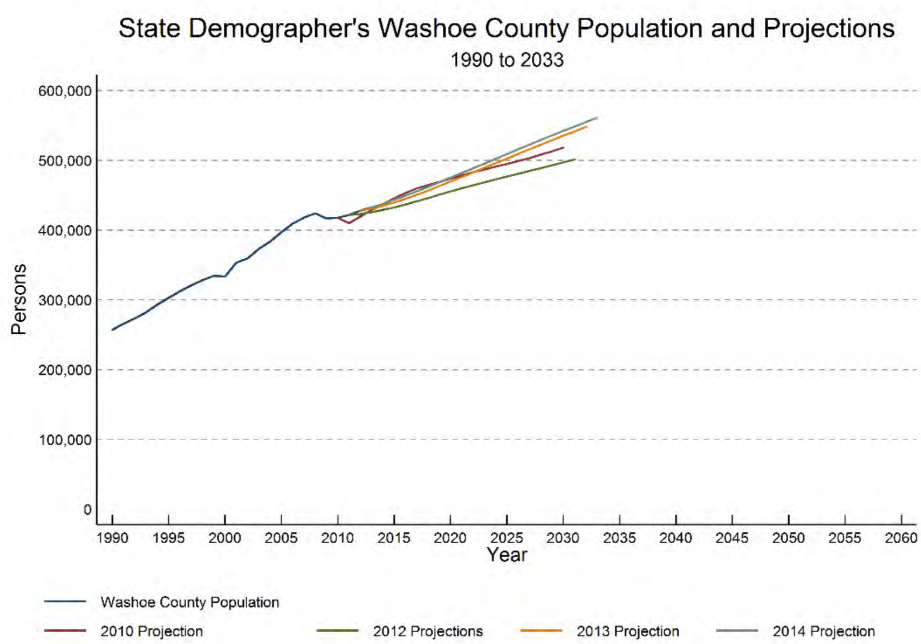
Appendix D: STATA source code used for estimating the population projection.

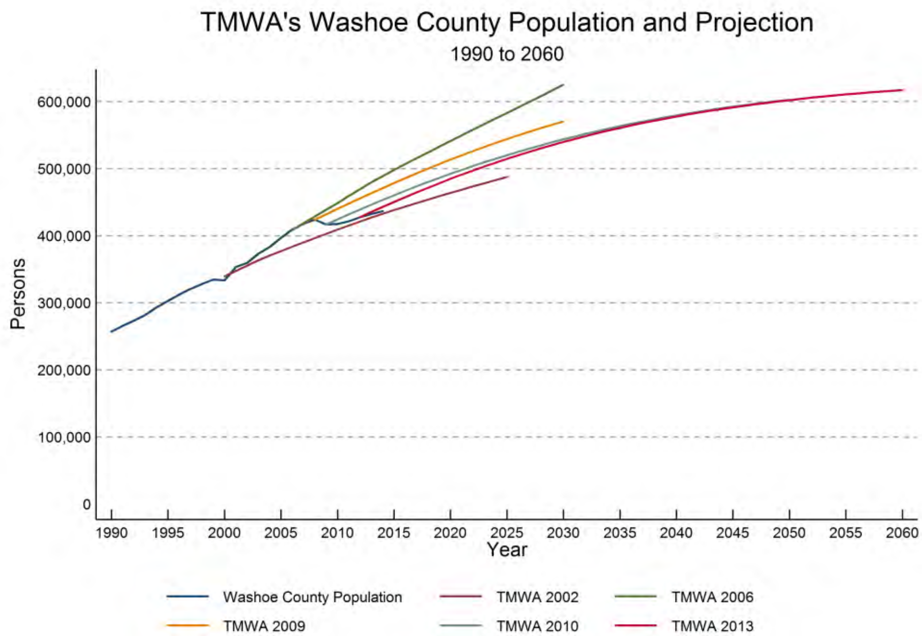
Appendix E: STATA Log file for model estimation.

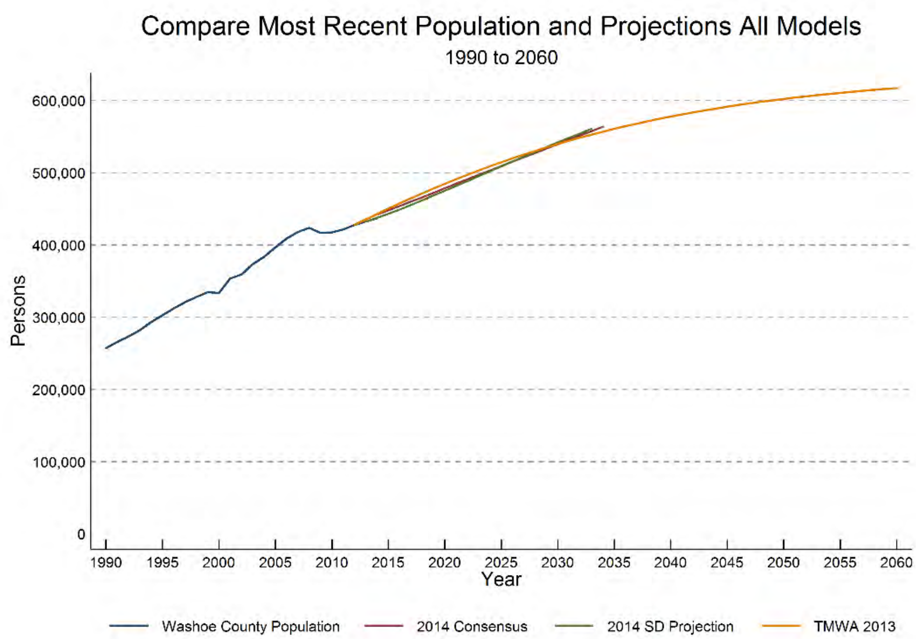
Appendix A: Graphical Review of Past Population Projections.

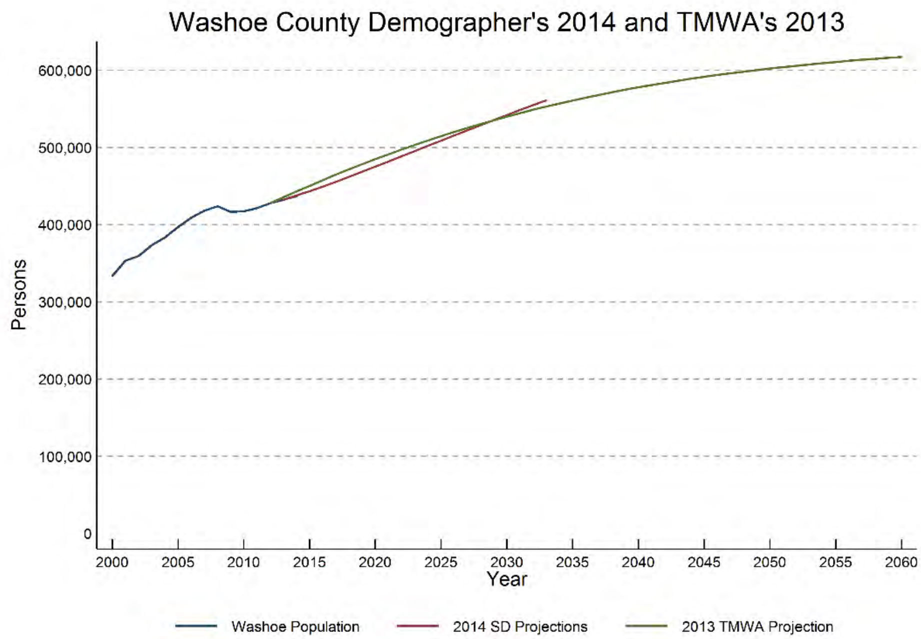
The following graphs compare past population projections prior to estimating TMWA's 2015 population projection.






TMWA's Washoe County Population and Projection
1990 to 2060
Persons
600,000
500,000
400,000
300,000
200,000
100,000
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year
Washoe County Population
TMWA 2002
TMWA 2006
TMWA 2009
TMWA 2010
TMWA 2013


Compare Most Recent Population and Projections All Models
1990 to 2060
Persons
600,000
500,000
400,000
300,000
200,000
100,000
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year
Washoe County Population
2014 Consensus
2014 SD Projection
TMWA 2013


Washoe County Demographer's 2014 and TMWA's 2013
Persons
600,000
500,000
400,000
300,000
200,000
100,000
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
Year
Washoe Population
2014 SD Projections
2013 TMWA Projection

Appendix B: Population Data and Population Model Results

Time Index	Year	Population	Population Model	Calibrated Model	Time Index	Year	Population Model	Calibrated Model
1	1950	50,484	49,759		77	2026	513,887	508,118
2	1951	51,600	52,267		78	2027	518,247	512,879
3	1952	54,000	54,888		79	2028	522,448	517,463
4	1953	58,100	57,628		80	2029	526,493	521,874
5	1954	60,500	60,489		81	2030	530,385	526,115
6	1955	65,200	63,476		82	2031	534,127	530,188
7	1956	68,900	66,593		83	2032	537,723	534,099
8	1957	73,000	69,844		84	2033	541,176	537,850
9	1958	76,000	73,232		85	2034	544,490	541,445
10	1959	81,300	76,761		86	2035	547,669	544,890
11	1960	84,988	80,434		87	2036	550,716	548,187
12	1961	85,969	84,256		88	2037	553,635	551,342
13	1962	88,648	88,229		89	2038	556,431	554,358
14	1963	91,705	92,357		90	2039	559,107	557,241
15	1964	95,289	96,643		91	2040	561,667	559,995
16	1965	103,420	101,088		92	2041	564,115	562,624
17	1966	106,356	105,697		93	2042	566,455	565,133
18	1967	105,541	110,470		94	2043	568,691	567,526
19	1968	108,776	115,409		95	2044	570,827	569,807
20	1969	119,192	120,516		96	2045	572,865	571,981
21	1970	122,574	125,792		97	2046	574,811	574,052
22	1971	128,600	131,238		98	2047	576,668	576,024
23	1972	135,400	136,853		99	2048	578,438	577,901
24	1973	141,000	142,637		100	2049	580,127	579,688
25	1974	147,400	148,589		101	2050	581,736	581,387
26	1975	152,200	154,708		102	2051	583,269	583,003
27	1976	158,700	160,991		103	2052	584,730	584,539
28	1977	167,800	167,436		104	2053	586,122	585,999
29	1978	177,600	174,040		105	2054	587,447	587,387
30	1979	187,200	180,798		106	2055	588,708	588,705
31	1980	193,623	187,707		107	2056	589,908	589,956
32	1981	201,680	194,760		108	2057	591,050	591,145
33	1982	205,130	201,953		109	2058	592,137	592,273
34	1983	210,990	209,278		110	2059	593,171	593,344
35	1984	218,320	216,728		111	2060	594,154	594,359
36	1985	224,580	224,296		112	2061	595,088	595,323
37	1986	232,270	231,974		113	2062	595,977	596,238
38	1987	238,360	239,752		114	2063	596,821	597,105
39	1988	244,890	247,621		115	2064	597,624	597,927
40	1989	251,580	255,572		116	2065	598,387	598,707
41	1990	257,120	263,593		117	2066	599,112	599,446
42	1991	265,762	271,675		118	2067	599,800	600,146
43	1992	273,178	279,806		119	2068	600,454	600,810
44	1993	282,214	287,974		120	2069	601,076	601,439
45	1994	293,141	296,169		121	2070	601,666	602,035
46	1995	302,748	304,378		122	2071	602,226	602,600
47	1996	312,366	312,590		123	2072	602,758	603,134
48	1997	320,828	320,793		124	2073	603,263	603,641
49	1998	327,899	328,975		125	2074	603,742	604,121
50	1999	334,601	337,125		126	2075	604,198	604,575
51	2000	333,566	345,231		127	2076	604,630	605,006
52	2001	353,271	353,282		128	2077	605,040	605,413
53	2002	359,423	361,266		129	2078	605,429	605,799
54	2003	373,233	369,175		130	2079	605,798	606,164
55	2004	383,453	376,997		131	2080	606,148	606,510
56	2005	396,844	384,722		132	2081	606,481	606,837
57	2006	409,085	392,342		133	2082	606,796	607,147
58	2007	418,061	399,849		134	2083	607,096	607,440
59	2008	423,833	407,233		135	2084	607,380	607,718
60	2009	416,632	414,488		136	2085	607,649	607,981
61	2010	417,379	421,607		137	2086	607,904	608,229
62	2011	421,593	428,584		138	2087	608,147	608,464
63	2012	427,704	435,412		139	2088	608,377	608,687
64	2013	432,324	442,089		140	2089	608,595	608,898
65	2014	436,797	448,608	436,798	141	2090	608,802	609,097
66	2015		454,967	443,729	142	2091	608,998	609,286
67	2016		461,163	450,488	143	2092	609,184	609,464
68	2017		467,193	457,072	144	2093	609,360	609,633
69	2018		473,055	463,476	145	2094	609,527	609,792
70	2019		478,749	469,699	146	2095	609,686	609,943
71	2020		484,273	475,740	147	2096	609,836	610,086
72	2021		489,628	481,596	148	2097	609,979	610,222
73	2022		494,814	487,267	149	2098	610,114	610,350
74	2023		499,831	492,754	150	2099	610,243	610,471
75	2024		504,682	498,058	151	2100	610,364	610,585
76	2025		509,366	503,178				

Appendix C: Regression Results

Population model estimation using population from 1950 to 2014.

```
nl (washoe = {a} / (1 + {b} * exp( -1* {c} * t) ) ),
>     variables(washoe t) initial(a 400000 b 5.0 c .5) vce(hc2);
(obs = 65)

Iteration 0:  residual SS =  9.92e+11
…
Iteration 10:  residual SS =  2.13e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9995
                                                    Root MSE      =   5867.404
                                                    Res. dev.     =   1309.422

------------------------------------------------------------------------------
             |             Robust HC2
      washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /a |   612579.8   18052.65    33.93   0.000     576493.1    648666.5
          /b |   11.93398   .2642083    45.17   0.000     11.40584    12.46213
          /c |   .0536284   .0009682    55.39   0.000     .0516931    .0555637
------------------------------------------------------------------------------
```

Final Population model calibration run.

```
Model run:  11
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.66e+12
…
Iteration 16:  residual SS =  2.98e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6872.086
                                                    Res. dev.     =    1331.01

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.30176   .3678767    41.59   0.000     14.56662    16.03691
          /c |   .0559722   .0006613    84.64   0.000     .0546507    .0572937
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -.625
```

Final population model calibration of lower boundary.

```
Model run:  10
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
…
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.476
                                                    Res. dev.     =   1307.642

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.48568   .2308535    58.42   0.000     13.02435      13.947
          /c |   .0575634   .0005257   109.49   0.000     .0565128     .058614
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = .71875
```

Final population model calibration of upper boundary.

```
Model run:  11
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
…
Iteration 11:  residual SS =  4.88e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8796.797
                                                    Res. dev.     =   1363.109

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.93727   .5465811    30.99   0.000     15.84501    18.02952
          /c |   .0546618   .0008361    65.38   0.000     .0529911    .0563326
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -.65625
```

Appendix D: STATA Source Code for Model Estimation.

```
/*       1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
*  Program Name:   Population2015_02.do
*  Created by:     Shawn Stoddard
*  Created on:     4/9/2014
*  Abstract:       Estimate the Logistic Curve model
*
*  Datafiles Used:
*  WashoeDataAll_01.dta: Historic population and all prior projections.
*
*  Datafiles Created:
*  WashoeDataAll_02.dta contains the new population projection
*
*  Updated on: 04/14/2015
*   New population projection for 2015 water resource plan
*
*
*******************************************************************************/
#delimit;
clear;
set more off;
capture log close;
set linesize 90;
local logpath Logs/ ;
local filename Population2015_02 ;
local logfile = "`logpath'" + "`filename'" ;
log using "`logfile'", replace text;
/*****************************************************************************/;
/* System variables and parameters                                           */;
local dpath Data/;
local gpath Graphs/;

local endyr = 2100;
scalar conv = 1;

/*****************************************************************************/;
/* Open and prep data file for projection                                    */;
/*****************************************************************************/;
use year washoe sdf2013 sdf2014 wcf2014 tmwa2013
  using `dpath'WashoeDataAll_01, clear;
/* expand the data to year 2100 as defined by endyr                          */;
local r = `endyr' - 1949;
set obs `r';
/* create a time index 1950 == 1                                             */;
gen t = _n ;
replace year = 1949 + t if year == .;
order t year washoe wcf2014 sdf2013 sdf2014 tmwa2013, first;

/*****************************************************************************/;
/* Population Logistic Curve Fitting                                         */;
/*****************************************************************************/;
/*****************************************************************************/;
/* Building this model requires three stages:                                */;
/* Stage 1: Estimate Logistic Curve using population start in 1950 to current*/;
/*          Store the steady state population estimate with 95% bounds.      */;
/*          This is the long run population model.                          */;
/* Stage 2: Remodel the population holding steady state population constant  */;
/*          and calibrate model by shifting population data and re-estimate  */;
/*          using a loop to converge the model population and launch year    */;
/*          population.  This creates a calibrated population model that     */;
```

```
/*          projects the population path that returns to the long-run model  */;
/*          The final population project is the calibrated model.            */;
/* Stage 3: Estimate 95% upper and lower bounds using the same calibrated    */;
/*          process as developed in stage 2.  95% bounds are forced to equal */;
/*          launch year.                                                     */;
/****************************************************************************/;
/* get row number of last year of population data                           */;
summarize t if washoe != ., meanonly;
local lrow = r(max);
display "last row of population data = `lrow'";

/****************************************************************************/;
/* Stage 1: Population model steady state estimates                         */;
/****************************************************************************/;
nl (washoe = {a} / (1 + {b} * exp( -1* {c} * t) ) ),
    variables(washoe t) initial(a 400000 b 5.0 c .5) vce(hc2);

/* Store the steady state population estimate with 95% upper and lower limits*/;
matrix rtable = r(table);
matrix list rtable;
global a   = string(rtable[1,1],"%10.0fc") /* Steady State */;
global lba = string(rtable[5,1],"%10.0fc") /* Lower Bound  */;
global uba = string(rtable[6,1],"%10.0fc") /* Upper Bound  */;
predict lrpop_mod;
label var lrpop_mod "Keyfitz Logistic Model: Long-Run";
replace lrpop_mod = round(lrpop_mod,1);
display "$a .. $lba .. $uba";

/****************************************************************************/;
/* Calibrate population trend for steady state                              */;
/****************************************************************************/;
local calib = washoe[`lrow'] - lrpop_mod[`lrow'];
display "Calib = `calib'";
* generate wpop_prj = round(wpop_model + `calib', 1);

/* calibrate model by shifting the data */;
gen _washoe = washoe;
local i = 1;
while `calib' <= -1*conv | `calib' >= conv {;
    local i = `i' + 1;
  display "Model run:  `i'";
  replace _washoe = _washoe + `calib';
  nl (_washoe = rtable[1,1] / (1 + {b} * exp( -1* {c} * t) ) ),
      variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  capture drop cpop_mod;
  predict cpop_mod;
  label var cpop_mod "Model Calibrate";
  local calib = washoe[`lrow'] - cpop_mod[`lrow'];
  display "Calib = `calib'";
};
replace cpop_mod = round(cpop_mod, 1);
replace cpop_mod = . if _n < `lrow';

/****************************************************************************/;
/* Calibrate the Lower population bound model                               */;
/****************************************************************************/;
replace _washoe = washoe;
local calib = washoe[`lrow'] - lrpop_mod[`lrow'];
display "Calib = `calib'";

local i = 1;
while `calib' <= -1*conv | `calib' >= conv {;
  local i = `i' + 1;
```

```
  display "Model run:  `i'";
  replace _washoe = _washoe + `calib';
nl (_washoe = rtable[5,1] / (1 + {b} * exp( -1* {c} * t) ) ),
      variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  capture drop llpop_mod;
  predict llpop_mod;
  label var llpop_mod "Model Calibrate Lower Bound";
  local calib = washoe[`lrow'] - llpop_mod[`lrow'];
  display "Calib = `calib'";
};
replace llpop_mod = round(llpop_mod, 1);
replace llpop_mod = . if _n < `lrow';

/******************************************************************************/;
/* Calibrate the upper population bound model                                */;
/******************************************************************************/;
replace _washoe = washoe;
local calib = washoe[`lrow'] - lrpop_mod[`lrow'];
display "Calib = `calib'";

local i = 1;
while `calib' <= -1*conv | `calib' >= conv {;
  local i = `i' + 1;
  display "Model run:  `i'";
  replace _washoe = _washoe + `calib';
nl (_washoe = rtable[6,1] / (1 + {b} * exp( -1* {c} * t) ) ),
      variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  capture drop ulpop_mod;
  predict ulpop_mod;
  label var ulpop_mod "Model Calibrate Upper Bound";
  local calib = washoe[`lrow'] - ulpop_mod[`lrow'];
  display "Calib = `calib'";
};

replace ulpop_mod = round(ulpop_mod, 1);
replace ulpop_mod = . if _n < `lrow';

drop _washoe;
/******************************************************************************/;
/* Document data file                                                         */;
/******************************************************************************/;
notes _dta: Started with WashoeDataAll_01.dta, kept only year, population
 wcf2010, sdf2013, and tmwa2010 projections.;
notes _dta: lrpop_mod is results of long-run population projection.;
notes _dta: cpop_mod is the calibrated results that match launch year and
 long-run trend. cpop_mod will be TMWA2014 projection.;
notes _dta: llpop_mod and lupop_mod are the 95% confidence ranges.;
notes _dta: This file updated on TS by S. Stoddard.;

save `dpath'WashoeDataAll_02, replace;
notes;
/******************************************************************************/;
/* Export Data for Excel Table                                                */;
/******************************************************************************/;
export excel t year washoe lrpop_mod cpop_mod using `dpath'ModelData.xls,
   firstrow(varl) datestring("%tyCCYY") replace;

log close;
exit;
******************************************************************************
```

Appendix E: STATA Log File.

```
------------------------------------------------------------------------------------
----
      name:  <unnamed>
       log:  S:\PrjStata\Population2015\Work\Logs/Population2015_02.log
  log type:  text
 opened on:   2 Sep 2015, 08:15:33

. /**************************************************************************/;
. /* System variables and parameters                                        */;
. local dpath Data/;

. local gpath Graphs/;

. local endyr = 2100;

. scalar conv = 1;

. /**************************************************************************/;
. /* Open and prep data file for projection                                 */;
. /**************************************************************************/;
. use year washoe sdf2013 sdf2014 wcf2014 tmwa2013
>   using `dpath'WashoeDataAll_01, clear;
(Demographer's Population Estimates 1950 to 2012)

. /* expand the data to year 2100 as defined by endyr                       */;
. local r = `endyr' - 1949;

. set obs `r';
number of observations (_N) was 151, now 151

. /* create a time index 1950 == 1                                          */;
. gen t = _n ;

. replace year = 1949 + t if year == .;
(0 real changes made)

. order t year washoe wcf2014 sdf2013 sdf2014 tmwa2013, first;

. /**************************************************************************/;
. /* Population Logistic Curve Fitting                                      */;
. /**************************************************************************/;
. /**************************************************************************/;
. /* Building this model requires three stages:                             */;
. /* Stage 1: Estimate Logistic Curve using population start in 1950 to current*/;
. /*          Store the steady state population estimate with 95% bounds.   */;
. /*          This is the long run population model.                        */;
. /* Stage 2: Remodel the population holding steady state population constant  */;
. /*          and calibrate model by shifting population data and re-estimate  */;
. /*          using a loop to converge the model population and launch year  */;
. /*          population.  This creates a calibrated population model that   */;
. /*          projects the population path that returns to the long-run model  */;
. /*          The final population project is the calibrated model.          */;
. /* Stage 3: Estimate 95% upper and lower bounds using the same calibrated  */;
. /*          process as developed in stage 2.  95% bounds are forced to equal */;
. /*          launch year.                                                   */;
. /**************************************************************************/;
. /* get row number of last year of population data                         */;
. summarize t if washoe != ., meanonly;

. local lrow = r(max);
```

```
. display "last row of population data = `lrow'";
last row of population data = 65

. /***************************************************************************/;
. /* Stage 1: Population model steady state estimates                       */;
. /***************************************************************************/;
. nl (washoe = {a} / (1 + {b} * exp( -1* {c} * t) ) ),
>      variables(washoe t) initial(a 400000 b 5.0 c .5) vce(hc2);
(obs = 65)

Iteration 0:  residual SS =  9.92e+11
Iteration 1:  residual SS =  4.76e+11
Iteration 2:  residual SS =  4.42e+11
Iteration 3:  residual SS =  1.13e+11
Iteration 4:  residual SS =  1.04e+11
Iteration 5:  residual SS =  8.96e+10
Iteration 6:  residual SS =  2.78e+10
Iteration 7:  residual SS =  2.20e+09
Iteration 8:  residual SS =  2.13e+09
Iteration 9:  residual SS =  2.13e+09
Iteration 10:  residual SS =  2.13e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9995
                                                    Root MSE      =   5867.404
                                                    Res. dev.     =   1309.422

------------------------------------------------------------------------------
             |             Robust HC2
      washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /a |   612579.8   18052.65    33.93   0.000     576493.1    648666.5
          /b |   11.93398   .2642083    45.17   0.000     11.40584    12.46213
          /c |   .0536284   .0009682    55.39   0.000     .0516931    .0555637
------------------------------------------------------------------------------

. /* Store the steady state population estimate with 95% upper and lower limits*/;
. matrix rtable = r(table);

. matrix list rtable;

rtable[9,3]
                a:          b:          c:
             _cons       _cons       _cons
     b  612579.81   11.933985   .05362839
    se  18052.648   .26420825   .00096817
     t  33.932962   45.168858   55.391673
pvalue  9.430e-42   3.727e-49   1.620e-54
    ll  576493.08    11.40584   .05169306
    ul  648666.54    12.46213   .05556373
    df         62          62          62
  crit  1.9989715   1.9989715   1.9989715
 eform          0           0           0

. global a   = string(rtable[1,1],"%10.0fc") /* Steady State */;

. global lba = string(rtable[5,1],"%10.0fc") /* Lower Bound  */;

. global uba = string(rtable[6,1],"%10.0fc") /* Upper Bound  */;
```

```
. predict lrpop_mod;
(option yhat assumed; fitted values)

. label var lrpop_mod "Keyfitz Logistic Model: Long-Run";

. replace lrpop_mod = round(lrpop_mod,1);
(143 real changes made)

. display "$a .. $lba .. $uba";
612,580 .. 576,493 .. 648,667

. /************************************************************************/;
. /* Calibrate population trend for steady state                          */;
. /************************************************************************/;
. local calib = washoe[`lrow'] - lrpop_mod[`lrow'];

. display "Calib = `calib'";
Calib = -11811

. * generate wpop_prj = round(wpop_model + `calib', 1);
. /* calibrate model by shifting the data */;
. gen _washoe = washoe;
(86 missing values generated)

. local i = 1;

. while `calib' <= -1*conv | `calib' >= conv {;
  2.     local i = `i' + 1;
  3.   display "Model run:  `i'";
  4.   replace _washoe = _washoe + `calib';
  5.   nl (_washoe = rtable[1,1] / (1 + {b} * exp( -1* {c} * t) ) ),
>       variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  6.   capture drop cpop_mod;
  7.            predict cpop_mod;
  8.   label var cpop_mod "Model Calibrate";
  9.   local calib = washoe[`lrow'] - cpop_mod[`lrow'];
 10.   display "Calib = `calib'";
 11. };
Model run:  2
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.85e+12
Iteration 1:  residual SS =  3.85e+12
Iteration 2:  residual SS =  3.85e+12
Iteration 3:  residual SS =  3.85e+12
Iteration 4:  residual SS =  2.84e+12
Iteration 5:  residual SS =  2.78e+12
Iteration 6:  residual SS =  2.66e+12
Iteration 7:  residual SS =  2.62e+12
Iteration 8:  residual SS =  2.24e+12
Iteration 9:  residual SS =  1.50e+12
Iteration 10:  residual SS =  2.97e+11
Iteration 11:  residual SS =  5.23e+10
Iteration 12:  residual SS =  3.85e+09
Iteration 13:  residual SS =  2.41e+09
Iteration 14:  residual SS =  2.40e+09
Iteration 15:  residual SS =  2.40e+09
Iteration 16:  residual SS =  2.40e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9994
```

```
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   6177.791
                                                    Res. dev.     =   1317.164

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.90555   .2754198    50.49   0.000     13.35516    14.45593
          /c |   .0550443   .0005758    95.60   0.000     .0538937    .0561949
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -4399.875
Model run:  3
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.73e+12
Iteration 1:  residual SS =  3.73e+12
Iteration 2:  residual SS =  3.73e+12
Iteration 3:  residual SS =  1.36e+12
Iteration 4:  residual SS =  4.13e+11
Iteration 5:  residual SS =  4.70e+10
Iteration 6:  residual SS =  4.38e+09
Iteration 7:  residual SS =  2.73e+09
Iteration 8:  residual SS =  2.72e+09
Iteration 9:  residual SS =  2.72e+09
Iteration 10:  residual SS =  2.72e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9993
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6574.637
                                                    Res. dev.     =   1325.257

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   14.75845   .3292868    44.82   0.000     14.10042    15.41648
          /c |   .0556181   .0006263    88.81   0.000     .0543666    .0568696
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -1642.625
Model run:  4
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.69e+12
Iteration 1:  residual SS =  3.69e+12
Iteration 2:  residual SS =  3.69e+12
Iteration 3:  residual SS =  3.69e+12
Iteration 4:  residual SS =  2.87e+12
Iteration 5:  residual SS =  1.44e+11
Iteration 6:  residual SS =  5.22e+10
Iteration 7:  residual SS =  4.83e+09
Iteration 8:  residual SS =  2.88e+09
Iteration 9:  residual SS =  2.88e+09
Iteration 10:  residual SS =  2.88e+09
Iteration 11:  residual SS =  2.88e+09
```

```
Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6756.012
                                                    Res. dev.     =   1328.795

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.09573   .3528773    42.78   0.000     14.39056     15.8009
          /c |   .0558389   .0006478    86.20   0.000     .0545444    .0571335
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -613.53125
Model run:  5
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.67e+12
Iteration 2:  residual SS =  3.65e+12
Iteration 3:  residual SS =  1.37e+12
Iteration 4:  residual SS =  1.32e+12
Iteration 5:  residual SS =  1.12e+12
Iteration 6:  residual SS =  8.15e+11
Iteration 7:  residual SS =  2.94e+11
Iteration 8:  residual SS =  8.72e+10
Iteration 9:  residual SS =  8.63e+09
Iteration 10:  residual SS =  2.99e+09
Iteration 11:  residual SS =  2.94e+09
Iteration 12:  residual SS =  2.94e+09
Iteration 13:  residual SS =  2.94e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6828.113
                                                    Res. dev.     =   1330.175

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.22447   .3621979    42.03   0.000     14.50068    15.94826
          /c |   .0559223   .0006562    85.22   0.000      .054611    .0572337
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -229.1875
Model run:  6
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.59e+12
Iteration 4:  residual SS =  1.18e+12
Iteration 5:  residual SS =  1.10e+12
Iteration 6:  residual SS =  1.03e+12
Iteration 7:  residual SS =  8.69e+11
Iteration 8:  residual SS =  6.37e+11
```

```
Iteration 9:  residual SS =  5.81e+11
Iteration 10:  residual SS =  9.79e+10
Iteration 11:  residual SS =  1.38e+10
Iteration 12:  residual SS =  3.11e+09
Iteration 13:  residual SS =  2.96e+09
Iteration 14:  residual SS =  2.96e+09
Iteration 15:  residual SS =  2.96e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6855.639
                                                    Res. dev.     =   1330.698

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.27296   .3657528    41.76   0.000     14.54206    16.00386
          /c |   .0559536   .0006594    84.86   0.000      .054636    .0572713
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -85.625
Model run:  7
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.64e+12
Iteration 4:  residual SS =  2.17e+12
Iteration 5:  residual SS =  2.07e+12
Iteration 6:  residual SS =  2.07e+12
Iteration 7:  residual SS =  1.76e+12
Iteration 8:  residual SS =  1.23e+12
Iteration 9:  residual SS =  1.41e+11
Iteration 10:  residual SS =  5.65e+10
Iteration 11:  residual SS =  4.99e+09
Iteration 12:  residual SS =  2.98e+09
Iteration 13:  residual SS =  2.97e+09
Iteration 14:  residual SS =  2.97e+09
Iteration 15:  residual SS =  2.97e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6866.005
                                                    Res. dev.     =   1330.894

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.29113   .3670913    41.65   0.000     14.55755     16.0247
          /c |   .0559653   .0006606    84.72   0.000     .0546453    .0572854
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -32
Model run:  8
(65 real changes made)
```

```
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.65e+12
Iteration 4:  residual SS =  2.93e+12
Iteration 5:  residual SS =  2.83e+12
Iteration 6:  residual SS =  2.67e+12
Iteration 7:  residual SS =  2.52e+12
Iteration 8:  residual SS =  2.28e+12
Iteration 9:  residual SS =  7.65e+11
Iteration 10:  residual SS =  3.25e+11
Iteration 11:  residual SS =  1.97e+10
Iteration 12:  residual SS =  3.93e+09
Iteration 13:  residual SS =  2.97e+09
Iteration 14:  residual SS =  2.97e+09
Iteration 15:  residual SS =  2.97e+09
Iteration 16:  residual SS =  2.97e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6869.891
                                                    Res. dev.     =   1330.968

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.29792   .3675933    41.62   0.000     14.56335     16.0325
          /c |   .0559697    .000661    84.67   0.000     .0546488    .0572907
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -11.9375
Model run:  9
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.65e+12
Iteration 4:  residual SS =  3.10e+12
Iteration 5:  residual SS =  3.00e+12
Iteration 6:  residual SS =  2.84e+12
Iteration 7:  residual SS =  2.68e+12
Iteration 8:  residual SS =  2.43e+12
Iteration 9:  residual SS =  9.44e+11
Iteration 10:  residual SS =  4.09e+11
Iteration 11:  residual SS =  1.66e+10
Iteration 12:  residual SS =  4.10e+09
Iteration 13:  residual SS =  2.98e+09
Iteration 14:  residual SS =  2.97e+09
Iteration 15:  residual SS =  2.97e+09
Iteration 16:  residual SS =  2.97e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6871.342
```

```
                                                    Res. dev.     =   1330.995

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.30046   .3677805    41.60   0.000     14.56551    16.03541
          /c |   .0559714   .0006612    84.65   0.000     .0546501    .0572926
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -4.46875
Model run:  10
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.67e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.65e+12
Iteration 4:  residual SS =  3.15e+12
Iteration 5:  residual SS =  3.05e+12
Iteration 6:  residual SS =  2.89e+12
Iteration 7:  residual SS =  2.74e+12
Iteration 8:  residual SS =  2.48e+12
Iteration 9:  residual SS =  1.00e+12
Iteration 10:  residual SS =  4.44e+11
Iteration 11:  residual SS =  1.55e+10
Iteration 12:  residual SS =  4.18e+09
Iteration 13:  residual SS =  2.98e+09
Iteration 14:  residual SS =  2.98e+09
Iteration 15:  residual SS =  2.98e+09
Iteration 16:  residual SS =  2.98e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6871.885
                                                    Res. dev.     =   1331.006

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.30141   .3678507    41.60   0.000     14.56632     16.0365
          /c |    .055972   .0006613    84.64   0.000     .0546505    .0572934
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -1.65625
Model run:  11
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.66e+12
Iteration 1:  residual SS =  3.66e+12
Iteration 2:  residual SS =  3.66e+12
Iteration 3:  residual SS =  3.65e+12
Iteration 4:  residual SS =  3.17e+12
Iteration 5:  residual SS =  3.07e+12
Iteration 6:  residual SS =  2.91e+12
Iteration 7:  residual SS =  2.75e+12
Iteration 8:  residual SS =  2.50e+12
Iteration 9:  residual SS =  1.02e+12
```

```
Iteration 10:  residual SS =  4.57e+11
Iteration 11:  residual SS =  1.52e+10
Iteration 12:  residual SS =  4.21e+09
Iteration 13:  residual SS =  2.98e+09
Iteration 14:  residual SS =  2.98e+09
Iteration 15:  residual SS =  2.98e+09
Iteration 16:  residual SS =  2.98e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6872.086
                                                    Res. dev.     =    1331.01

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.30176   .3678767    41.59   0.000     14.56662    16.03691
          /c |   .0559722   .0006613    84.64   0.000     .0546507    .0572937
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -.625

. replace cpop_mod = round(cpop_mod, 1);
(148 real changes made)

. replace cpop_mod = . if _n < `lrow';
(64 real changes made, 64 to missing)

. /***************************************************************************/;
. /* Calibrate the Lower population bound model                              */;
. /***************************************************************************/;
. replace _washoe = washoe;
(65 real changes made)

. local calib = washoe[`lrow'] - lrpop_mod[`lrow'];

. display "Calib = `calib'";
Calib = -11811

. local i = 1;

. while `calib' <= -1*conv | `calib' >= conv {;
  2.   local i = `i' + 1;
  3.   display "Model run:  `i'";
  4.   replace _washoe = _washoe + `calib';
  5. nl (_washoe = rtable[5,1] / (1 + {b} * exp( -1* {c} * t) ) ),
>       variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  6.   capture drop llpop_mod;
  7.            predict llpop_mod;
  8.   label var llpop_mod "Model Calibrate Lower Bound";
  9.   local calib = washoe[`lrow'] - llpop_mod[`lrow'];
 10.   display "Calib = `calib'";
 11. };
Model run:  2
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.85e+12
Iteration 1:  residual SS =  3.85e+12
Iteration 2:  residual SS =  3.85e+12
```

```
Iteration 3:  residual SS =  3.77e+12
Iteration 4:  residual SS =  7.95e+11
Iteration 5:  residual SS =  7.41e+11
Iteration 6:  residual SS =  7.17e+11
Iteration 7:  residual SS =  6.14e+11
Iteration 8:  residual SS =  4.90e+11
Iteration 9:  residual SS =  1.79e+11
Iteration 10:  residual SS =  4.04e+09
Iteration 11:  residual SS =  2.09e+09
Iteration 12:  residual SS =  2.08e+09
Iteration 13:  residual SS =  2.08e+09
Iteration 14:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5751.489
                                                    Res. dev.     =   1307.868

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.78389   .2421034    56.93   0.000     13.30008    14.26769
          /c |   .0577615   .0005333   108.32   0.000     .0566959    .0588272
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 954.78125
Model run:  3
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.88e+12
Iteration 1:  residual SS =  3.87e+12
Iteration 2:  residual SS =  3.87e+12
Iteration 3:  residual SS =  3.87e+12
Iteration 4:  residual SS =  3.87e+12
Iteration 5:  residual SS =  5.70e+11
Iteration 6:  residual SS =  5.29e+11
Iteration 7:  residual SS =  4.88e+11
Iteration 8:  residual SS =  4.72e+11
Iteration 9:  residual SS =  4.11e+11
Iteration 10:  residual SS =  3.82e+11
Iteration 11:  residual SS =  1.97e+11
Iteration 12:  residual SS =  4.77e+09
Iteration 13:  residual SS =  2.09e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =    5742.66
                                                    Res. dev.     =   1307.669

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.60605   .2352085    57.85   0.000     13.13603    14.07608
```

```
          /c |   .0576437   .0005285   109.06   0.000     .0565875    .0586999
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 389.34375
Model run:  4
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.89e+12
Iteration 1:  residual SS =  3.88e+12
Iteration 2:  residual SS =  3.88e+12
Iteration 3:  residual SS =  3.88e+12
Iteration 4:  residual SS =  5.73e+11
Iteration 5:  residual SS =  2.30e+11
Iteration 6:  residual SS =  1.74e+11
Iteration 7:  residual SS =  1.14e+11
Iteration 8:  residual SS =  2.77e+09
Iteration 9:  residual SS =  2.08e+09
Iteration 10:  residual SS =  2.08e+09
Iteration 11:  residual SS =  2.08e+09
Iteration 12:  residual SS =  2.08e+09


Nonlinear regression                               Number of obs =         65
                                                   R-squared     =     0.9995
                                                   Adj R-squared =     0.9994
                                                   Root MSE      =    5741.48
                                                   Res. dev.     =   1307.642

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.53445   .2325875    58.19   0.000     13.06967    13.99924
          /c |    .057596   .0005268   109.33   0.000     .0565432    .0586488
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 158.78125
Model run:  5
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.89e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.87e+12
Iteration 5:  residual SS =  9.97e+11
Iteration 6:  residual SS =  9.72e+11
Iteration 7:  residual SS =  9.24e+11
Iteration 8:  residual SS =  8.63e+11
Iteration 9:  residual SS =  8.30e+11
Iteration 10:  residual SS =  7.06e+11
Iteration 11:  residual SS =  5.41e+11
Iteration 12:  residual SS =  1.77e+11
Iteration 13:  residual SS =  3.91e+09
Iteration 14:  residual SS =  2.09e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09
Iteration 17:  residual SS =  2.08e+09


Nonlinear regression                               Number of obs =         65
```

```
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.399
                                                    Res. dev.     =    1307.64

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.50541   .2315499    58.33   0.000     13.04269    13.96812
          /c |   .0575766   .0005262   109.43   0.000     .0565251     .058628
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 64.75
Model run:  6
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.88e+12
Iteration 5:  residual SS =  5.03e+11
Iteration 6:  residual SS =  4.60e+11
Iteration 7:  residual SS =  4.51e+11
Iteration 8:  residual SS =  3.98e+11
Iteration 9:  residual SS =  3.31e+11
Iteration 10:  residual SS =  2.56e+11
Iteration 11:  residual SS =  1.23e+11
Iteration 12:  residual SS =  2.97e+09
Iteration 13:  residual SS =  2.08e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.433
                                                    Res. dev.     =   1307.641

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.49359   .2311318    58.38   0.000     13.03171    13.95547
          /c |   .0575687   .0005259   109.47   0.000     .0565177    .0586196
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 26.40625
Model run:  7
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.89e+12
Iteration 5:  residual SS =  6.89e+11
Iteration 6:  residual SS =  6.51e+11
```

```
Iteration 7:  residual SS =  6.06e+11
Iteration 8:  residual SS =  5.98e+11
Iteration 9:  residual SS =  5.19e+11
Iteration 10:  residual SS =  4.51e+11
Iteration 11:  residual SS =  1.94e+11
Iteration 12:  residual SS =  4.59e+09
Iteration 13:  residual SS =  2.09e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.457
                                                    Res. dev.     =   1307.641

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.48877   .2309622    58.40   0.000     13.02723    13.95031
          /c |   .0575655   .0005258   109.48   0.000     .0565147    .0586162
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 10.78125
Model run:  8
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.89e+12
Iteration 5:  residual SS =  7.38e+11
Iteration 6:  residual SS =  7.01e+11
Iteration 7:  residual SS =  6.54e+11
Iteration 8:  residual SS =  6.52e+11
Iteration 9:  residual SS =  5.65e+11
Iteration 10:  residual SS =  4.84e+11
Iteration 11:  residual SS =  1.95e+11
Iteration 12:  residual SS =  4.56e+09
Iteration 13:  residual SS =  2.09e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.469
                                                    Res. dev.     =   1307.642

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |    13.4868   .2308931    58.41   0.000      13.0254    13.94821
          /c |   .0575641   .0005258   109.49   0.000     .0565135    .0586148
------------------------------------------------------------------------------
```

```
(option yhat assumed; fitted values)
Calib = 4.40625
Model run:  9
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.89e+12
Iteration 5:  residual SS =  7.53e+11
Iteration 6:  residual SS =  7.15e+11
Iteration 7:  residual SS =  6.69e+11
Iteration 8:  residual SS =  6.67e+11
Iteration 9:  residual SS =  5.79e+11
Iteration 10:  residual SS =  4.93e+11
Iteration 11:  residual SS =  1.95e+11
Iteration 12:  residual SS =  4.55e+09
Iteration 13:  residual SS =  2.09e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9995
                                                    Adj R-squared =     0.9994
                                                    Root MSE      =   5741.474
                                                    Res. dev.     =   1307.642

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |     13.486   .2308649    58.42   0.000     13.02465    13.94735
          /c |   .0575636   .0005257   109.49   0.000      .056513    .0586142
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = 1.78125
Model run:  10
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.90e+12
Iteration 1:  residual SS =  3.89e+12
Iteration 2:  residual SS =  3.89e+12
Iteration 3:  residual SS =  3.89e+12
Iteration 4:  residual SS =  3.89e+12
Iteration 5:  residual SS =  7.58e+11
Iteration 6:  residual SS =  7.20e+11
Iteration 7:  residual SS =  6.73e+11
Iteration 8:  residual SS =  6.72e+11
Iteration 9:  residual SS =  5.83e+11
Iteration 10:  residual SS =  4.96e+11
Iteration 11:  residual SS =  1.96e+11
Iteration 12:  residual SS =  4.54e+09
Iteration 13:  residual SS =  2.09e+09
Iteration 14:  residual SS =  2.08e+09
Iteration 15:  residual SS =  2.08e+09
Iteration 16:  residual SS =  2.08e+09
```

```
Nonlinear regression                                  Number of obs =         65
                                                      R-squared     =     0.9995
                                                      Adj R-squared =     0.9994
                                                      Root MSE      =   5741.476
                                                      Res. dev.     =   1307.642

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   13.48568   .2308535    58.42   0.000     13.02435      13.947
          /c |   .0575634   .0005257   109.49   0.000     .0565128     .058614
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = .71875

. replace llpop_mod = round(llpop_mod, 1);
(143 real changes made)

. replace llpop_mod = . if _n < `lrow';
(64 real changes made, 64 to missing)

. /***************************************************************************/;
. /* Calibrate the upper population bound model                              */;
. /***************************************************************************/;
. replace _washoe = washoe;
(65 real changes made)

. local calib = washoe[`lrow'] - lrpop_mod[`lrow'];

. display "Calib = `calib'";
Calib = -11811

. local i = 1;

. while `calib' <= -1*conv | `calib' >= conv {;
  2.   local i = `i' + 1;
  3.   display "Model run:  `i'";
  4.   replace _washoe = _washoe + `calib';
  5. nl (_washoe = rtable[6,1] / (1 + {b} * exp( -1* {c} * t) ) ),
>       variables(_washoe t) initial( b 5.0 c .5) vce(hc2);
  6.   capture drop ulpop_mod;
  7.             predict ulpop_mod;
  8.   label var ulpop_mod "Model Calibrate Upper Bound";
  9.   local calib = washoe[`lrow'] - ulpop_mod[`lrow'];
 10.   display "Calib = `calib'";
 11. };
Model run:  2
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.85e+12
Iteration 1:  residual SS =  3.85e+12
Iteration 2:  residual SS =  3.85e+12
Iteration 3:  residual SS =  3.85e+12
Iteration 4:  residual SS =  3.08e+12
Iteration 5:  residual SS =  1.07e+12
Iteration 6:  residual SS =  1.94e+11
Iteration 7:  residual SS =  3.38e+10
Iteration 8:  residual SS =  4.03e+09
Iteration 9:  residual SS =  3.04e+09
Iteration 10:  residual SS =  3.04e+09
Iteration 11:  residual SS =  3.04e+09
```

```
Iteration 12:  residual SS =  3.04e+09

Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9992
                                                    Adj R-squared =     0.9992
                                                    Root MSE      =   6943.107
                                                    Res. dev.     =   1332.346

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   14.11662   .3195805    44.17   0.000     13.47798    14.75525
          /c |   .0528094   .0006376    82.83   0.000     .0515353    .0540835
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -8715.34375
Model run:  3
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.62e+12
Iteration 1:  residual SS =  3.62e+12
Iteration 2:  residual SS =  3.62e+12
Iteration 3:  residual SS =  3.61e+12
Iteration 4:  residual SS =  3.29e+12
Iteration 5:  residual SS =  4.44e+11
Iteration 6:  residual SS =  9.33e+10
Iteration 7:  residual SS =  8.26e+09
Iteration 8:  residual SS =  4.13e+09
Iteration 9:  residual SS =  4.10e+09
Iteration 10:  residual SS =  4.10e+09
Iteration 11:  residual SS =  4.10e+09

Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9989
                                                    Adj R-squared =     0.9988
                                                    Root MSE      =    8065.48
                                                    Res. dev.     =   1351.826

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   15.87439   .4530864    35.04   0.000     14.96897    16.77981
          /c |   .0539921   .0007594    71.09   0.000     .0524745    .0555097
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -3024.59375
Model run:  4
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.54e+12
Iteration 1:  residual SS =  3.54e+12
Iteration 2:  residual SS =  3.54e+12
Iteration 3:  residual SS =  3.54e+12
Iteration 4:  residual SS =  3.53e+12
Iteration 5:  residual SS =  3.46e+12
Iteration 6:  residual SS =  3.42e+12
Iteration 7:  residual SS =  1.42e+12
```

```
Iteration 8:  residual SS =  1.06e+12
Iteration 9:  residual SS =  2.99e+10
Iteration 10:  residual SS =  8.78e+09
Iteration 11:  residual SS =  4.60e+09
Iteration 12:  residual SS =  4.59e+09
Iteration 13:  residual SS =  4.59e+09
Iteration 14:  residual SS =  4.59e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9987
                                                    Adj R-squared =     0.9987
                                                    Root MSE      =   8532.949
                                                    Res. dev.     =    1359.15

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.55657   .5120767    32.33   0.000     15.53327    17.57987
          /c |   .0544256   .0008085    67.32   0.000     .0528099    .0560413
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -1052.25
Model run:  5
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.52e+12
Iteration 1:  residual SS =  3.51e+12
Iteration 2:  residual SS =  3.37e+12
Iteration 3:  residual SS =  2.38e+12
Iteration 4:  residual SS =  2.17e+12
Iteration 5:  residual SS =  1.84e+12
Iteration 6:  residual SS =  3.22e+11
Iteration 7:  residual SS =  2.02e+11
Iteration 8:  residual SS =  2.27e+10
Iteration 9:  residual SS =  5.26e+09
Iteration 10:  residual SS =  4.77e+09
Iteration 11:  residual SS =  4.77e+09
Iteration 12:  residual SS =  4.77e+09
Iteration 13:  residual SS =  4.77e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8703.947
                                                    Res. dev.     =    1361.73

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.80352   .5343357    31.45   0.000     15.73573     17.8713
          /c |   .0545793   .0008264    66.05   0.000     .0529279    .0562307
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -366.28125
Model run:  6
(65 real changes made)
(obs = 65)
```

```
Iteration 0:  residual SS =  3.51e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  2.71e+12
Iteration 5:  residual SS =  1.49e+12
Iteration 6:  residual SS =  5.12e+10
Iteration 7:  residual SS =  1.80e+10
Iteration 8:  residual SS =  4.98e+09
Iteration 9:  residual SS =  4.84e+09
Iteration 10:  residual SS =  4.84e+09
Iteration 11:  residual SS =  4.84e+09
Iteration 12:  residual SS =  4.84e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8764.444
                                                    Res. dev.     =    1362.63

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.89069   .5423027    31.15   0.000     15.80698    17.97439
          /c |   .0546331   .0008327    65.61   0.000     .0529691    .0562971
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -127.53125
Model run:  7
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  1.33e+12
Iteration 5:  residual SS =  1.13e+12
Iteration 6:  residual SS =  8.43e+11
Iteration 7:  residual SS =  5.90e+11
Iteration 8:  residual SS =  1.15e+11
Iteration 9:  residual SS =  1.69e+10
Iteration 10:  residual SS =  5.03e+09
Iteration 11:  residual SS =  4.86e+09
Iteration 12:  residual SS =  4.86e+09
Iteration 13:  residual SS =  4.86e+09
Iteration 14:  residual SS =  4.86e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8785.625
                                                    Res. dev.     =   1362.944

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.92118   .5451037    31.04   0.000     15.83188    18.01049
          /c |   .0546519   .0008349    65.46   0.000     .0529835    .0563203
```

```
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -44.40625
Model run:  8
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  7.16e+11
Iteration 5:  residual SS =  6.43e+11
Iteration 6:  residual SS =  2.93e+11
Iteration 7:  residual SS =  6.45e+09
Iteration 8:  residual SS =  4.88e+09
Iteration 9:  residual SS =  4.87e+09
Iteration 10:  residual SS =  4.87e+09
Iteration 11:  residual SS =  4.87e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8793.014
                                                    Res. dev.     =   1363.053

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.93182   .5460781    31.01   0.000     15.84057    18.02307
          /c |   .0546585   .0008357    65.41   0.000     .0529885    .0563284
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -15.46875
Model run:  9
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  5.59e+11
Iteration 5:  residual SS =  4.85e+11
Iteration 6:  residual SS =  2.45e+11
Iteration 7:  residual SS =  5.90e+09
Iteration 8:  residual SS =  4.88e+09
Iteration 9:  residual SS =  4.87e+09
Iteration 10:  residual SS =  4.87e+09
Iteration 11:  residual SS =  4.87e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8795.589
                                                    Res. dev.     =   1363.091

------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
          /b |   16.93553   .5464207    30.99   0.000      15.8436    18.02747
          /c |   .0546608   .0008359    65.39   0.000     .0529903    .0563313
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -5.375
Model run:  10
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  5.12e+11
Iteration 5:  residual SS =  4.40e+11
Iteration 6:  residual SS =  2.30e+11
Iteration 7:  residual SS =  5.75e+09
Iteration 8:  residual SS =  4.88e+09
Iteration 9:  residual SS =  4.87e+09
Iteration 10:  residual SS =  4.87e+09
Iteration 11:  residual SS =  4.87e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8796.485
                                                    Res. dev.     =   1363.105

------------------------------------------------------------------------------
             |             Robust HC2
      _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.93682   .5465396    30.99   0.000     15.84465    18.02899
          /c |   .0546616    .000836    65.38   0.000     .0529909    .0563322
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -1.875
Model run:  11
(65 real changes made)
(obs = 65)

Iteration 0:  residual SS =  3.50e+12
Iteration 1:  residual SS =  3.50e+12
Iteration 2:  residual SS =  3.50e+12
Iteration 3:  residual SS =  3.49e+12
Iteration 4:  residual SS =  4.96e+11
Iteration 5:  residual SS =  4.26e+11
Iteration 6:  residual SS =  2.25e+11
Iteration 7:  residual SS =  5.69e+09
Iteration 8:  residual SS =  4.88e+09
Iteration 9:  residual SS =  4.88e+09
Iteration 10:  residual SS =  4.88e+09
Iteration 11:  residual SS =  4.88e+09


Nonlinear regression                                Number of obs =         65
                                                    R-squared     =     0.9986
                                                    Adj R-squared =     0.9986
                                                    Root MSE      =   8796.797
                                                    Res. dev.     =   1363.109
```

```
------------------------------------------------------------------------------
             |             Robust HC2
     _washoe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          /b |   16.93727   .5465811    30.99   0.000     15.84501    18.02952
          /c |   .0546618   .0008361    65.38   0.000     .0529911    .0563326
------------------------------------------------------------------------------
(option yhat assumed; fitted values)
Calib = -.65625

. replace ulpop_mod = round(ulpop_mod, 1);
(146 real changes made)

. replace ulpop_mod = . if _n < `lrow';
(64 real changes made, 64 to missing)

. drop _washoe;

. /**************************************************************************/;
. /* Document data file                                                     */;
. /**************************************************************************/;
. notes _dta: Started with WashoeDataAll_01.dta, kept only year, population
>  wcf2010, sdf2013, and tmwa2010 projections.;

. notes _dta: lrpop_mod is results of long-run population projection.;

. notes _dta: cpop_mod is the calibrated results that match launch year and
>  long-run trend. cpop_mod will be TMWA2014 projection.;

. notes _dta: llpop_mod and lupop_mod are the 95% confidence ranges.;

. notes _dta: This file updated on TS by S. Stoddard.;

. save `dpath'WashoeDataAll_02, replace;
file Data/WashoeDataAll_02.dta saved

. notes;

_dta:
  1.  Years 1950 to 1986 is from an Excel file provide by the Demographer's office.
  2.  Years 1986 to 2008 is from Nevada County Populaton estimates 1986 to 2008.
  3.  Years 1950, 1960, 1970 data from U.S. Census only.
  4.  Year 2009 from State Demographer's Draft 2009 Estimates.
  5.  Year 2010 from State Demographer's Estimates for 2001 to 2010.
  6.  Estimate of population as of July 1 of each year.
  7.  Data from 2000 to 2012 from 2012 State Demographer's Estimates.
  8.  Some population values for year 2000 were updated using 2012 report.
  9.  This file contains all prior population projections.
 10.  This file was last updated on 21 Apr 2015 09:22 by S. Stoddard as part of TMWA
2015
      population projection
 11.  Started with WashoeDataAll_01.dta, kept only year, population wcf2010, sdf2013,
and
      tmwa2010 projections.
 12.  lrpop_mod is results of long-run population projection.
 13.  cpop_mod is the calibrated results that match launch year and long-run trend.
      cpop_mod will be TMWA2014 projection.
 14.  llpop_mod and lupop_mod are the 95% confidence ranges.
 15.  This file updated on 21 Apr 2015 09:23 by S. Stoddard.
 16.  This file was last updated on 21 Apr 2015 10:17 by S. Stoddard as part of TMWA
2015
      population projection
 17.  This file updated on 21 Apr 2015 10:17 by S. Stoddard.
```

```
 18.  This file contains all prior population projections.
 19.  This file was last updated on 1 Sep 2015 17:10 by S. Stoddard as part of TMWA
2015
      population projection
 20.  Started with WashoeDataAll_01.dta, kept only year, population wcf2010, sdf2013,
and
      tmwa2010 projections.
 21.  lrpop_mod is results of long-run population projection.
 22.  cpop_mod is the calibrated results that match launch year and long-run trend.
      cpop_mod will be TMWA2014 projection.
 23.  llpop_mod and lupop_mod are the 95% confidence ranges.
 24.  This file updated on 2 Sep 2015 08:15 by S. Stoddard.

. /**********************************************************************/;
. /* Export Data for Excel Table                                        */;
. /**********************************************************************/;
. export excel t year washoe lrpop_mod cpop_mod using `dpath'ModelData.xls,
>    firstrow(varl) datestring("%tyCCYY") replace;
file Data/ModelData.xls saved

. log close;
      name:  <unnamed>
       log:  S:\PrjStata\Population2015\Work\Logs/Population2015_02.log
  log type:  text
 closed on:   2 Sep 2015, 08:15:52
-------------------------------------------------------------------------------------
----
```

APPENDIX 4-2

TPEM Series No. 7: Washoe County Building Projections

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Memorandum

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TO: File

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

DATE: September 9, 2015

SUBJECT: TPEM Series No. 7: Washoe County Building Projections

Introduction

The memorandum "TPEM Series No. 6: Washoe County Population Projection 2014 to 2060", updated a population projection model based on the fitting of a logistic curve model to past population and project that population to the year 2100. 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 time series 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 will be described in TPEM Series No 8.

This report will present the results in the following manner:

1. Graphical presentation of projections of new dwellings and commercial building as a function of projected population resulting from a statistical vector autoregression ("VAR") model developed for projecting future dwelling units and commercial buildings as a function of current building inventory trends and projected population, and an ordinary least squares regression was estimated to provide a trend of developed land used as a function of projected population..
2. Tabular presentation of the County projection, and disaggregation to the TMWA service area and hydrographic basins.
3. Discussion of the methodology and statistic used to develop each of these models.
4. Appendices of statistical outputs.

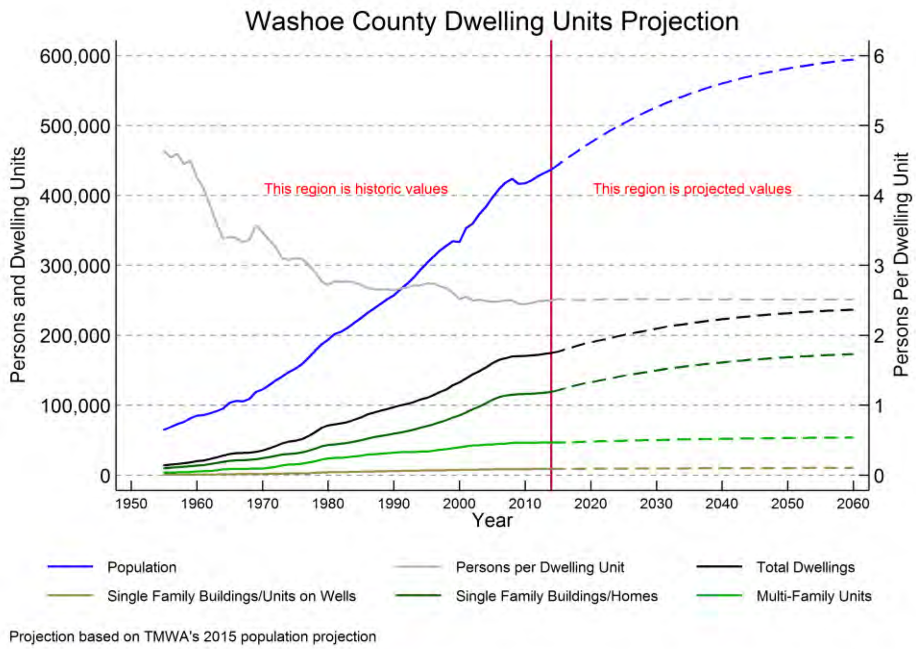

Figure : Washoe County Dwelling Unit Projections 2014 to 2060

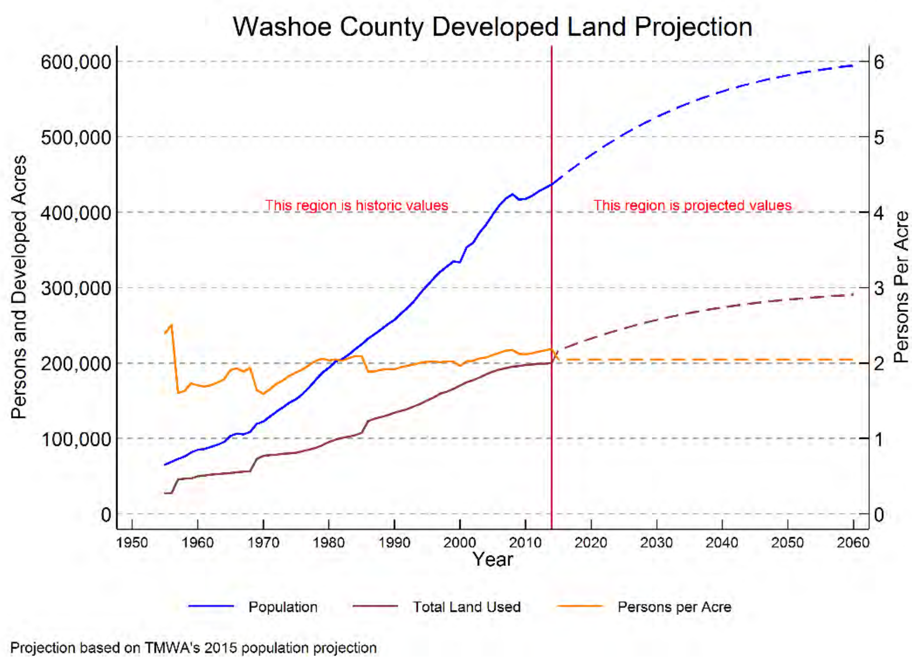

Figure 1: Washoe County Developed Land Projection 2014 to 2060

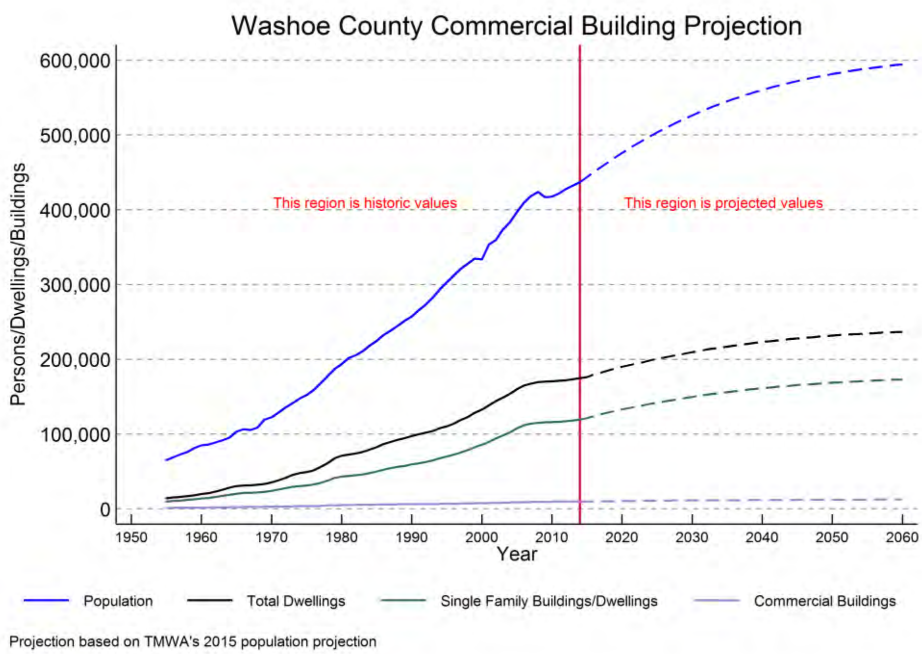

Figure 2: Washoe County Commercial Building Projection 2014 to 2060

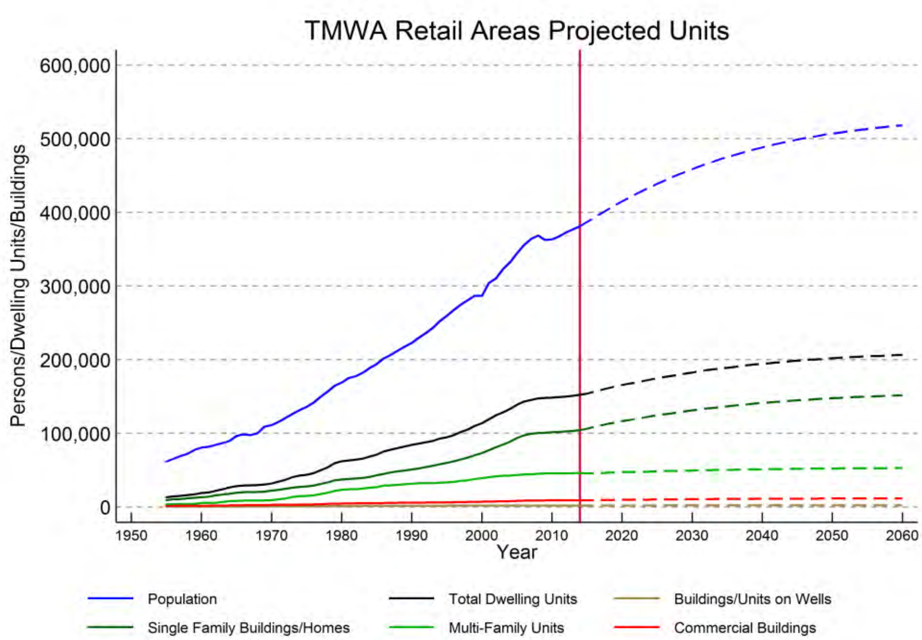

Figure 3: TMWA Retail Service Area Building Projection 2014 to 2060

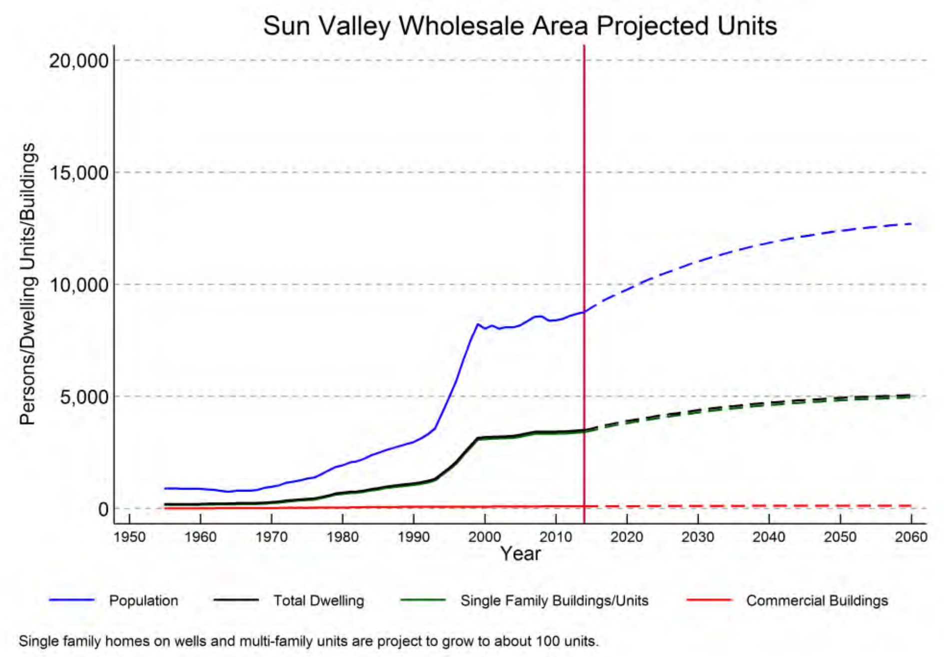

Figure 4: TMWA Wholesale Area (Sun Valley) Building Projections 2014 to 2060

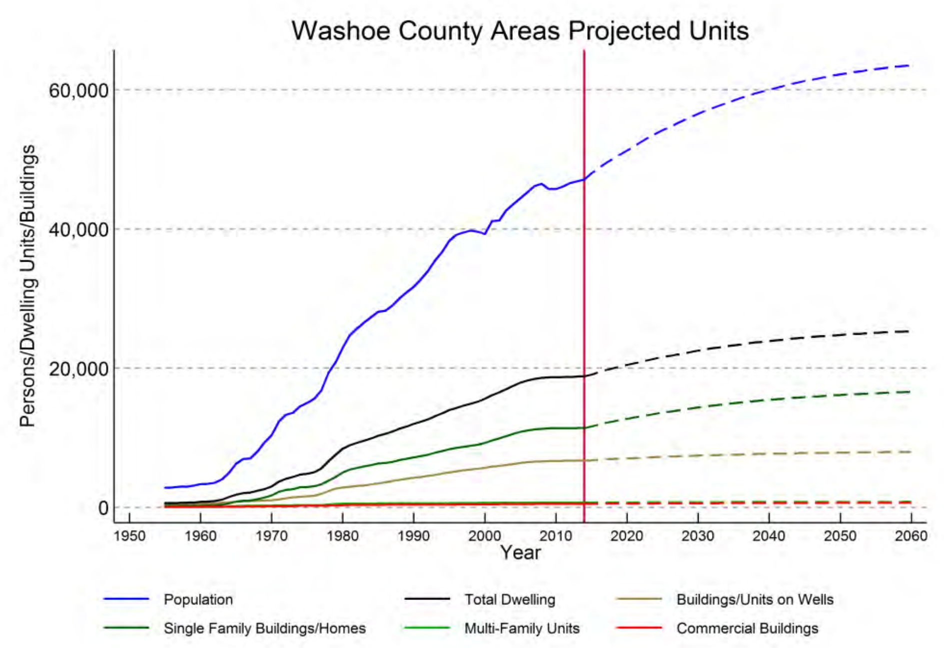

Figure 5: Washoe County/Non-TMWA Areas Building Projections 2014 to 2060

Table 1: Washoe County Population and Building Projections 2014 to 2060

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings	Developed Land ac.
2014	436,797	8,626	119,227	46,897	174,750	9,554	199,925
2015	443,729	8,676	121,297	46,383	176,356	9,632	216,837
2016	450,488	8,748	124,131	46,589	179,468	9,743	220,140
2017	457,072	8,824	126,728	46,729	182,281	9,884	223,357
2018	463,476	8,898	128,942	47,266	185,106	10,057	226,487
2019	469,699	8,964	130,987	47,769	187,720	10,172	229,528
2020	475,740	9,008	132,896	48,088	189,992	10,246	232,480
2021	481,596	9,052	134,713	48,251	192,016	10,306	235,341
2022	487,267	9,112	136,568	48,248	193,928	10,383	238,113
2023	492,754	9,175	138,482	48,438	196,095	10,499	240,794
2024	498,058	9,243	140,404	48,781	198,428	10,624	243,386
2025	503,178	9,296	142,086	49,080	200,462	10,732	245,888
2026	508,118	9,330	143,578	49,451	202,359	10,813	248,302
2027	512,879	9,368	145,056	49,660	204,084	10,867	250,629
2028	517,463	9,407	146,567	49,726	205,700	10,924	252,869
2029	521,874	9,458	148,190	49,924	207,572	11,004	255,024
2030	526,115	9,518	149,797	50,094	209,409	11,097	257,097
2031	530,188	9,564	151,253	50,380	211,197	11,198	259,087
2032	534,099	9,603	152,571	50,728	212,902	11,279	260,998
2033	537,850	9,632	153,732	50,884	214,248	11,334	262,831
2034	541,445	9,655	154,861	51,054	215,570	11,383	264,588
2035	544,890	9,691	156,059	51,151	216,901	11,431	266,271
2036	548,187	9,729	157,248	51,211	218,188	11,495	267,882
2037	551,342	9,767	158,414	51,446	219,627	11,571	269,424
2038	554,358	9,804	159,472	51,622	220,898	11,636	270,898
2039	557,241	9,826	160,375	51,798	221,999	11,692	272,307
2040	559,995	9,847	161,242	51,985	223,074	11,732	273,653
2041	562,624	9,869	162,087	52,006	223,962	11,764	274,937
2042	565,133	9,891	162,951	52,101	224,943	11,808	276,163
2043	567,526	9,923	163,850	52,219	225,992	11,856	277,333
2044	569,807	9,950	164,665	52,302	226,917	11,908	278,448
2045	571,981	9,970	165,410	52,508	227,888	11,958	279,510
2046	574,052	9,990	166,086	52,614	228,690	11,991	280,522
2047	576,024	10,002	166,694	52,675	229,371	12,020	281,486
2048	577,901	10,018	167,336	52,786	230,140	12,049	282,403
2049	579,688	10,039	167,977	52,792	230,808	12,078	283,276
2050	581,387	10,056	168,591	52,889	231,536	12,118	284,106
2051	583,003	10,077	169,187	53,019	232,283	12,154	284,896
2052	584,539	10,091	169,690	53,067	232,848	12,184	285,647
2053	585,999	10,100	170,154	53,193	233,447	12,211	286,360
2054	587,387	10,113	170,615	53,233	233,961	12,228	287,038
2055	588,705	10,123	171,049	53,240	234,412	12,249	287,682
2056	589,956	10,136	171,511	53,337	234,984	12,275	288,294
2057	591,145	10,152	171,948	53,356	235,456	12,299	288,875
2058	592,273	10,161	172,329	53,433	235,923	12,326	289,426
2059	593,344	10,172	172,698	53,532	236,402	12,346	289,949
2060	594,359	10,180	173,015	53,529	236,724	12,360	290,445

Table 2: Population and Building Data and Projection - TMWA Retail Areas (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	61,491	263	9,431	3,587	13,281	1,232
1956	65,171	269	10,297	3,773	14,339	1,283
1957	69,163	275	10,859	3,921	15,055	1,336
1958	72,166	294	11,819	4,104	16,217	1,382
1959	77,297	317	12,429	4,435	17,181	1,436
1960	80,762	337	13,369	5,279	18,985	1,582
1961	81,714	347	14,112	5,442	19,901	1,732
1962	84,305	378	15,620	5,871	21,869	1,794
1963	86,908	414	16,935	6,792	24,141	1,881
1964	89,584	445	18,070	7,997	26,512	1,999
1965	96,391	479	19,358	8,422	28,259	2,108
1966	98,629	509	19,971	8,597	29,077	2,381
1967	97,713	530	20,199	8,623	29,352	2,452
1968	99,944	549	20,442	8,710	29,701	2,517
1969	108,971	576	20,934	8,997	30,507	2,589
1970	111,253	594	22,160	9,289	32,043	2,715
1971	115,274	631	23,281	10,406	34,318	2,767
1972	120,966	661	24,892	11,576	37,129	2,839
1973	126,228	684	26,361	13,608	40,653	2,974
1974	131,665	713	27,214	14,877	42,804	3,293
1975	135,886	740	27,854	15,212	43,806	3,393
1976	141,706	791	29,109	15,930	45,830	3,492
1977	149,482	904	31,088	17,736	49,728	3,648
1978	156,571	1,056	33,496	19,308	53,860	4,289
1979	164,498	1,157	36,344	21,949	59,450	4,462
1980	168,813	1,210	37,380	23,428	62,018	4,658
1981	174,815	1,233	37,938	23,871	63,042	4,794
1982	177,340	1,253	38,649	24,166	64,068	4,875
1983	182,244	1,289	39,476	25,027	65,792	4,979
1984	188,638	1,320	41,037	26,164	68,521	5,095
1985	194,004	1,363	42,863	26,916	71,142	5,183
1986	201,454	1,399	44,950	28,989	75,338	5,313
1987	206,687	1,450	46,869	29,383	77,702	5,431
1988	212,092	1,485	48,377	30,052	79,914	5,577
1989	217,778	1,511	49,519	30,903	81,933	5,699
1990	222,491	1,526	51,087	31,600	84,213	5,814
1991	229,853	1,544	52,448	32,192	86,184	5,906
1992	235,896	1,560	54,035	32,262	87,857	5,962
1993	243,198	1,584	55,840	32,350	89,774	6,034
1994	252,147	1,605	58,184	33,083	92,872	6,126
1995	259,494	1,629	59,877	33,200	94,706	6,227
1996	267,480	1,643	61,903	34,110	97,656	6,439
1997	274,696	1,654	64,412	35,598	101,664	6,598
1998	280,650	1,662	67,024	36,269	104,955	6,756
1999	286,730	1,671	70,357	38,041	110,069	6,948
2000	286,324	1,679	73,144	38,933	113,756	7,099
2001	303,931	1,694	76,959	40,489	119,142	7,274
2002	310,164	1,713	81,052	41,599	124,364	7,428
2003	322,447	1,725	84,622	42,169	128,516	7,631
2004	331,855	1,743	88,580	42,845	133,168	7,899
2005	344,269	1,759	93,642	43,361	138,762	8,162
2006	355,417	1,774	97,353	44,013	143,140	8,484
2007	363,408	1,789	99,287	44,287	145,363	8,666

Table 3: Population and Building Data and Projection - TMWA Retail Areas (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	368,712	1,802	100,410	45,332	147,544	8,784
2009	362,588	1,816	100,922	45,378	148,116	8,828
2010	363,299	1,817	101,329	45,382	148,528	8,853
2011	367,083	1,819	101,803	45,538	149,160	8,876
2012	372,592	1,820	102,412	45,644	149,876	8,896
2013	376,749	1,825	103,328	45,909	151,062	8,938
2014	381,030	1,835	104,407	46,170	152,412	8,963
2015	386,752	1,845	106,208	45,664	153,717	9,036
2016	392,607	1,861	108,689	45,867	156,417	9,140
2017	398,383	1,877	110,963	46,005	158,845	9,272
2018	403,965	1,893	112,902	46,533	161,328	9,434
2019	409,397	1,907	114,692	47,029	163,628	9,542
2020	414,720	1,916	116,364	47,343	165,623	9,612
2021	419,797	1,925	117,955	47,503	167,383	9,668
2022	424,740	1,938	119,579	47,500	169,017	9,740
2023	429,457	1,952	121,255	47,687	170,894	9,849
2024	434,052	1,966	122,938	48,025	172,929	9,966
2025	438,515	1,977	124,411	48,319	174,707	10,068
2026	442,905	1,984	125,717	48,685	176,386	10,144
2027	447,048	1,993	127,011	48,890	177,894	10,194
2028	451,094	2,001	128,334	48,955	179,290	10,248
2029	454,825	2,012	129,755	49,150	180,917	10,323
2030	458,450	2,024	131,162	49,318	182,504	10,410
2031	462,016	2,034	132,437	49,599	184,070	10,505
2032	465,610	2,043	133,591	49,942	185,576	10,581
2033	468,748	2,049	134,608	50,095	186,752	10,632
2034	472,037	2,054	135,596	50,263	187,913	10,678
2035	474,929	2,061	136,645	50,358	189,064	10,723
2036	477,712	2,069	137,686	50,417	190,172	10,783
2037	480,497	2,077	138,707	50,649	191,433	10,855
2038	483,278	2,085	139,634	50,822	192,541	10,916
2039	485,708	2,090	140,424	50,995	193,509	10,968
2040	488,085	2,094	141,183	51,179	194,456	11,006
2041	490,398	2,099	141,923	51,200	195,222	11,036
2042	492,545	2,104	142,680	51,293	196,077	11,077
2043	494,637	2,111	143,467	51,410	196,988	11,122
2044	496,646	2,116	144,181	51,491	197,788	11,171
2045	498,606	2,121	144,833	51,694	198,648	11,218
2046	500,363	2,125	145,425	51,798	199,348	11,249
2047	502,057	2,127	145,957	51,859	199,943	11,276
2048	503,752	2,131	146,519	51,968	200,618	11,303
2049	505,389	2,135	147,081	51,974	201,190	11,330
2050	506,785	2,139	147,618	52,069	201,826	11,368
2051	508,225	2,143	148,140	52,197	202,480	11,402
2052	509,457	2,146	148,581	52,244	202,971	11,430
2053	510,795	2,148	148,987	52,369	203,504	11,455
2054	512,116	2,151	149,390	52,408	203,949	11,471
2055	513,095	2,153	149,771	52,415	204,339	11,491
2056	514,356	2,156	150,175	52,510	204,841	11,515
2057	515,373	2,159	150,558	52,529	205,246	11,538
2058	516,199	2,161	150,891	52,605	205,657	11,563
2059	517,261	2,164	151,214	52,702	206,080	11,582
2060	518,160	2,165	151,492	52,699	206,356	11,595

Table 4: Population and Building Data and Projection - Sun Valley Wholesale Area (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	889	2	153	37	192	5
1956	882	2	155	37	194	5
1957	891	2	155	37	194	5
1958	868	2	156	37	195	5
1959	877	2	156	37	195	5
1960	868	2	165	37	204	6
1961	854	2	169	37	208	6
1962	825	2	175	37	214	8
1963	778	2	177	37	216	8
1964	743	2	181	37	220	8
1965	791	2	187	43	232	11
1966	801	3	190	43	236	12
1967	792	3	192	43	238	12
1968	831	3	201	43	247	14
1969	922	3	212	43	258	16
1970	972	3	234	43	280	17
1971	1,024	4	258	43	305	20
1972	1,140	5	302	43	350	23
1973	1,195	5	337	43	385	26
1974	1,252	5	359	43	407	29
1975	1,331	5	380	44	429	30
1976	1,379	7	397	42	446	32
1977	1,527	8	457	43	508	32
1978	1,695	9	530	44	583	33
1979	1,851	10	616	43	669	36
1980	1,924	10	654	43	707	39
1981	2,058	11	687	44	742	52
1982	2,095	13	702	42	757	55
1983	2,216	14	742	44	800	59
1984	2,370	18	800	43	861	62
1985	2,476	19	845	44	908	62
1986	2,599	19	909	44	972	65
1987	2,689	23	946	42	1,011	67
1988	2,787	24	983	43	1,050	68
1989	2,873	25	1,012	44	1,081	68
1990	2,956	27	1,050	42	1,119	68
1991	3,126	27	1,102	43	1,172	70
1992	3,313	30	1,161	43	1,234	70
1993	3,579	31	1,247	43	1,321	70
1994	4,273	32	1,498	44	1,574	70
1995	4,962	32	1,735	44	1,811	70
1996	5,711	36	2,007	42	2,085	70
1997	6,666	39	2,385	43	2,467	72
1998	7,503	43	2,719	44	2,806	75
1999	8,214	44	3,066	43	3,153	76
2000	8,012	44	3,095	44	3,183	78
2001	8,161	46	3,112	41	3,199	81
2002	8,013	47	3,124	42	3,213	81
2003	8,094	47	3,136	43	3,226	81
2004	8,082	48	3,151	44	3,243	85
2005	8,167	49	3,199	44	3,292	87
2006	8,360	50	3,272	45	3,367	88
2007	8,550	51	3,324	45	3,420	89

Table 5: Population and Building Data and Projection - Sun Valley Wholesale Area (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	8,567	51	3,336	41	3,428	90
2009	8,375	51	3,329	41	3,421	91
2010	8,397	51	3,341	41	3,433	93
2011	8,458	51	3,344	42	3,437	94
2012	8,592	52	3,362	42	3,456	94
2013	8,692	53	3,390	42	3,485	94
2014	8,763	53	3,410	42	3,505	94
2015	8,967	53	3,469	42	3,564	94
2016	9,149	53	3,550	42	3,645	95
2017	9,330	54	3,624	42	3,720	97
2018	9,478	54	3,688	43	3,785	99
2019	9,618	55	3,746	43	3,844	100
2020	9,763	55	3,801	43	3,899	100
2021	9,909	55	3,853	43	3,951	101
2022	10,065	56	3,906	43	4,005	102
2023	10,205	56	3,961	44	4,061	103
2024	10,331	56	4,016	44	4,116	104
2025	10,454	57	4,064	44	4,165	105
2026	10,566	57	4,106	45	4,208	106
2027	10,683	57	4,149	45	4,251	106
2028	10,804	57	4,192	45	4,294	107
2029	10,913	58	4,238	45	4,341	108
2030	11,020	58	4,284	45	4,387	109
2031	11,117	58	4,326	45	4,429	110
2032	11,213	59	4,364	46	4,469	111
2033	11,300	59	4,397	46	4,502	111
2034	11,389	59	4,429	46	4,534	112
2035	11,475	59	4,463	46	4,568	112
2036	11,560	59	4,497	46	4,602	113
2037	11,639	60	4,531	46	4,637	113
2038	11,714	60	4,561	46	4,667	114
2039	11,782	60	4,587	47	4,694	115
2040	11,845	60	4,612	47	4,719	115
2041	11,914	60	4,636	47	4,743	115
2042	11,975	60	4,660	47	4,767	116
2043	12,038	61	4,686	47	4,794	116
2044	12,095	61	4,709	47	4,817	117
2045	12,146	61	4,731	47	4,839	117
2046	12,194	61	4,750	47	4,858	118
2047	12,241	61	4,767	47	4,875	118
2048	12,291	61	4,786	48	4,895	118
2049	12,341	61	4,804	48	4,913	118
2050	12,382	61	4,822	48	4,931	119
2051	12,419	61	4,839	48	4,948	119
2052	12,457	62	4,853	48	4,963	119
2053	12,490	62	4,866	48	4,976	120
2054	12,530	62	4,880	48	4,990	120
2055	12,560	62	4,892	48	5,002	120
2056	12,593	62	4,905	48	5,015	120
2057	12,625	62	4,918	48	5,028	121
2058	12,648	62	4,929	48	5,039	121
2059	12,673	62	4,939	48	5,049	121
2060	12,701	62	4,948	48	5,058	121

Table 6: Population and Building Data and Projection - Washoe County / Non-TMWA Served Areas (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	2,824	388	174	48	610	53
1956	2,845	402	176	48	626	55
1957	2,954	412	183	48	643	57
1958	2,977	431	190	48	669	57
1959	3,122	441	205	48	694	57
1960	3,361	494	242	54	790	61
1961	3,392	525	247	54	826	63
1962	3,520	587	272	54	913	69
1963	4,032	679	387	54	1,120	69
1964	4,954	743	578	145	1,466	75
1965	6,256	816	825	193	1,834	91
1966	6,937	864	954	227	2,045	99
1967	7,038	906	981	227	2,114	106
1968	8,002	945	1,194	239	2,378	126
1969	9,316	971	1,398	239	2,608	138
1970	10,364	1,021	1,704	260	2,985	148
1971	12,314	1,160	2,240	266	3,666	157
1972	13,306	1,307	2,492	285	4,084	161
1973	13,600	1,453	2,631	296	4,380	172
1974	14,503	1,527	2,877	311	4,715	220
1975	14,989	1,596	2,926	310	4,832	224
1976	15,608	1,688	3,047	313	5,048	229
1977	16,798	1,956	3,315	317	5,588	235
1978	19,326	2,360	3,853	435	6,648	258
1979	20,869	2,679	4,373	490	7,542	278
1980	22,903	2,863	5,025	526	8,414	296
1981	24,768	2,977	5,427	528	8,932	333
1982	25,648	3,081	5,653	532	9,266	349
1983	26,559	3,158	5,887	543	9,588	355
1984	27,335	3,311	6,075	543	9,929	358
1985	28,104	3,457	6,296	553	10,306	360
1986	28,256	3,603	6,396	568	10,567	364
1987	29,010	3,791	6,545	570	10,906	366
1988	30,027	3,955	6,789	570	11,314	367
1989	30,923	4,084	6,976	574	11,634	369
1990	31,670	4,237	7,170	580	11,987	385
1991	32,780	4,362	7,351	578	12,291	388
1992	33,987	4,509	7,570	579	12,658	391
1993	35,458	4,658	7,851	580	13,089	393
1994	36,737	4,851	8,100	580	13,531	396
1995	38,283	5,012	8,361	599	13,972	401
1996	39,146	5,157	8,534	601	14,292	408
1997	39,484	5,323	8,688	602	14,613	413
1998	39,781	5,425	8,850	602	14,877	417
1999	39,622	5,556	8,991	663	15,210	421
2000	39,288	5,689	9,258	662	15,609	433
2001	41,117	5,831	9,624	663	16,118	435
2002	41,218	5,946	9,917	664	16,527	441
2003	42,633	6,097	10,230	665	16,992	446
2004	43,558	6,248	10,569	662	17,479	468
2005	44,437	6,370	10,880	661	17,911	473
2006	45,275	6,493	11,057	684	18,234	474
2007	46,183	6,578	11,211	684	18,473	481

Table 7: Population and Building Data and Projection - Washoe County / Non-TMWA Served Areas (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	46,466	6,628	11,284	682	18,594	488
2009	45,712	6,650	11,341	682	18,673	488
2010	45,721	6,664	11,346	682	18,692	489
2011	46,095	6,686	11,359	685	18,730	489
2012	46,595	6,699	11,362	682	18,743	491
2013	46,852	6,720	11,385	681	18,786	496
2014	47,083	6,738	11,410	685	18,833	497
2015	47,993	6,778	11,620	677	19,075	502
2016	48,709	6,834	11,892	680	19,406	508
2017	49,448	6,893	12,141	682	19,716	515
2018	50,065	6,951	12,353	690	19,994	524
2019	50,663	7,003	12,549	697	20,249	530
2020	51,257	7,037	12,731	702	20,470	534
2021	51,868	7,071	12,906	704	20,681	537
2022	52,534	7,118	13,083	704	20,905	541
2023	53,130	7,168	13,267	707	21,142	547
2024	53,674	7,221	13,451	712	21,384	554
2025	54,193	7,262	13,612	717	21,591	559
2026	54,654	7,289	13,755	722	21,766	563
2027	55,133	7,318	13,896	725	21,939	566
2028	55,644	7,349	14,041	726	22,116	569
2029	56,100	7,389	14,197	729	22,315	573
2030	56,563	7,435	14,351	731	22,517	578
2031	56,969	7,471	14,490	736	22,697	583
2032	57,353	7,502	14,616	741	22,859	588
2033	57,720	7,525	14,728	743	22,996	591
2034	58,085	7,542	14,836	745	23,123	593
2035	58,449	7,571	14,950	747	23,268	596
2036	58,811	7,600	15,064	748	23,412	599
2037	59,128	7,630	15,176	751	23,557	603
2038	59,462	7,659	15,277	754	23,690	606
2039	59,728	7,676	15,364	756	23,796	609
2040	59,984	7,692	15,447	759	23,898	611
2041	60,280	7,710	15,528	759	23,997	613
2042	60,537	7,727	15,611	761	24,099	615
2043	60,794	7,752	15,697	762	24,211	618
2044	61,047	7,773	15,775	764	24,312	620
2045	61,249	7,789	15,846	767	24,402	623
2046	61,452	7,804	15,911	768	24,483	625
2047	61,650	7,814	15,969	769	24,552	626
2048	61,841	7,826	16,031	771	24,628	628
2049	62,059	7,842	16,092	771	24,705	629
2050	62,220	7,856	16,151	772	24,779	631
2051	62,384	7,872	16,208	774	24,854	633
2052	62,534	7,883	16,256	775	24,914	635
2053	62,670	7,890	16,301	777	24,968	636
2054	62,830	7,900	16,345	777	25,022	637
2055	62,953	7,908	16,386	777	25,071	638
2056	63,096	7,918	16,431	779	25,128	640
2057	63,235	7,931	16,473	779	25,183	641
2058	63,320	7,938	16,509	780	25,227	642
2059	63,433	7,946	16,544	782	25,272	643
2060	63,553	7,953	16,575	782	25,310	644

Table 8: Population and Building Data and Projection - Basin 83 Tracy Segment (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	245	28	18	7	53	8
1956	245	29	18	7	54	8
1957	248	29	18	7	54	8
1958	240	29	18	7	54	8
1959	252	31	18	7	56	8
1960	238	31	18	7	56	8
1961	226	31	17	7	55	8
1962	216	31	18	7	56	9
1963	202	32	17	7	56	9
1964	213	35	19	9	63	9
1965	211	35	18	9	62	9
1966	214	35	19	9	63	9
1967	203	35	17	9	61	9
1968	212	37	17	9	63	9
1969	232	38	18	9	65	9
1970	222	38	17	9	64	9
1971	218	38	18	9	65	9
1972	225	40	19	10	69	9
1973	205	40	18	8	66	9
1974	209	41	18	9	68	9
1975	217	42	19	9	70	10
1976	226	43	20	10	73	11
1977	216	46	17	9	72	11
1978	221	47	19	10	76	11
1979	213	51	17	9	77	12
1980	223	55	17	10	82	12
1981	236	57	18	10	85	12
1982	238	58	18	10	86	12
1983	238	58	18	10	86	12
1984	240	60	19	8	87	12
1985	245	62	20	8	90	12
1986	233	62	16	9	87	12
1987	231	62	16	9	87	12
1988	239	64	17	9	90	12
1989	239	64	17	9	90	12
1990	243	64	18	10	92	13
1991	245	64	18	10	92	13
1992	269	65	25	10	100	13
1993	274	65	26	10	101	14
1994	353	66	54	10	130	14
1995	364	67	56	10	133	14
1996	375	69	58	10	137	14
1997	373	71	60	7	138	14
1998	356	71	55	7	133	14
1999	359	72	58	8	138	15
2000	357	74	60	8	142	16
2001	352	76	54	8	138	18
2002	352	77	56	8	141	18
2003	364	77	59	9	145	19
2004	371	79	61	9	149	19
2005	355	80	54	9	143	19
2006	360	80	56	9	145	20
2007	368	81	57	9	147	20

Table 9: Population and Building Data and Projections - Basin 83 Tracy Segment (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	370	81	58	9	148	21
2009	367	83	58	9	150	21
2010	367	83	58	9	150	21
2011	369	83	58	9	150	21
2012	380	85	59	9	153	21
2013	397	91	59	9	159	21
2014	403	92	60	9	161	21
2015	410	93	61	9	163	21
2016	414	94	62	9	165	21
2017	416	94	63	9	166	22
2018	421	95	64	9	168	22
2019	428	96	65	10	171	22
2020	431	96	66	10	172	23
2021	436	97	67	10	174	23
2022	440	97	68	10	175	23
2023	445	98	69	10	177	23
2024	449	99	70	10	179	23
2025	452	99	71	10	180	24
2026	457	100	72	10	182	24
2027	460	100	73	10	183	24
2028	463	101	73	10	184	24
2029	465	101	74	10	185	24
2030	470	102	75	10	187	24
2031	472	102	76	10	188	25
2032	474	103	76	10	189	25
2033	477	103	77	10	190	25
2034	477	103	77	10	190	25
2035	482	104	78	10	192	25
2036	485	104	79	10	193	25
2037	487	105	79	10	194	25
2038	489	105	80	10	195	26
2039	489	105	80	10	195	26
2040	492	105	81	10	196	26
2041	495	106	81	10	197	26
2042	495	106	81	10	197	26
2043	497	106	82	10	198	26
2044	497	106	82	10	198	26
2045	505	107	83	11	201	26
2046	505	107	83	11	201	26
2047	505	107	83	11	201	26
2048	507	107	84	11	202	27
2049	507	107	84	11	202	27
2050	510	108	84	11	203	27
2051	512	108	85	11	204	27
2052	512	108	85	11	204	27
2053	512	108	85	11	204	27
2054	512	108	85	11	204	27
2055	515	108	86	11	205	27
2056	515	108	86	11	205	27
2057	517	109	86	11	206	27
2058	517	109	86	11	206	27
2059	517	109	86	11	206	27
2060	520	109	87	11	207	27

Table 10: Population and Building Data and Projection - Basin 85, Spanish Springs Valley (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	46	10	0	0	10	1
1956	50	11	0	0	11	1
1957	51	11	0	0	11	1
1958	49	11	0	0	11	1
1959	54	11	1	0	12	1
1960	55	12	1	0	13	1
1961	53	12	1	0	13	1
1962	54	12	2	0	14	1
1963	54	13	2	0	15	1
1964	51	13	2	0	15	1
1965	44	13	0	0	13	1
1966	44	13	0	0	13	1
1967	43	13	0	0	13	1
1968	44	13	0	0	13	1
1969	50	14	0	0	14	1
1970	49	14	0	0	14	1
1971	47	14	0	0	14	1
1972	49	15	0	0	15	1
1973	47	15	0	0	15	1
1974	46	15	0	0	15	1
1975	47	15	0	0	15	1
1976	46	15	0	0	15	1
1977	48	16	0	0	16	1
1978	58	20	0	0	20	1
1979	410	28	120	0	148	1
1980	702	34	224	0	258	2
1981	987	39	317	0	356	3
1982	1,107	44	356	0	400	3
1983	1,338	50	433	0	483	3
1984	1,655	60	541	0	601	3
1985	2,116	66	710	0	776	3
1986	2,254	75	768	0	843	4
1987	2,391	84	815	0	899	4
1988	2,670	96	910	0	1,006	4
1989	2,974	107	1,012	0	1,119	4
1990	3,604	113	1,251	0	1,364	6
1991	4,414	120	1,535	0	1,655	6
1992	5,681	126	1,990	0	2,116	6
1993	7,423	142	2,598	0	2,740	7
1994	9,524	173	3,335	0	3,508	8
1995	10,565	204	3,652	0	3,856	10
1996	12,304	232	4,260	0	4,492	16
1997	14,280	243	5,042	0	5,285	21
1998	16,271	253	5,832	0	6,085	24
1999	18,699	269	6,758	151	7,178	32
2000	19,610	279	7,361	151	7,791	37
2001	22,260	286	8,288	152	8,726	52
2002	25,010	297	9,579	152	10,028	52
2003	28,111	315	10,739	150	11,204	70
2004	31,020	336	11,960	152	12,448	74
2005	33,650	357	13,056	150	13,563	93
2006	37,034	362	14,217	336	14,915	147
2007	39,370	366	14,842	540	15,748	211

Table 11: Population and Building Projections - Basin 85, Spanish Springs Valley (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	40,901	368	15,161	838	16,367	232
2009	40,372	370	15,283	839	16,492	246
2010	40,503	371	15,349	839	16,559	248
2011	40,966	372	15,437	837	16,646	250
2012	41,653	372	15,544	839	16,755	253
2013	42,253	372	15,731	839	16,942	256
2014	42,938	372	15,964	839	17,175	262
2015	43,894	374	16,242	830	17,446	264
2016	44,758	377	16,621	834	17,832	267
2017	45,608	380	16,969	836	18,185	271
2018	46,311	384	17,265	846	18,495	276
2019	46,988	386	17,539	855	18,780	279
2020	47,686	388	17,795	861	19,044	281
2021	48,384	390	18,038	864	19,292	282
2022	49,112	393	18,286	864	19,543	284
2023	49,770	395	18,543	867	19,805	288
2024	50,378	398	18,800	873	20,071	291
2025	50,966	401	19,025	879	20,305	294
2026	51,506	402	19,225	885	20,512	296
2027	52,059	404	19,423	889	20,716	298
2028	52,635	405	19,625	890	20,920	299
2029	53,159	408	19,843	894	21,145	302
2030	53,669	410	20,058	897	21,365	304
2031	54,133	412	20,253	902	21,567	307
2032	54,573	414	20,429	908	21,751	309
2033	54,997	415	20,585	911	21,911	311
2034	55,430	416	20,736	914	22,066	312
2035	55,842	418	20,896	916	22,230	313
2036	56,249	419	21,056	917	22,392	315
2037	56,611	421	21,212	921	22,554	317
2038	56,977	423	21,353	924	22,700	319
2039	57,291	424	21,474	927	22,825	320
2040	57,592	424	21,590	931	22,945	321
2041	57,924	425	21,703	931	23,059	322
2042	58,223	426	21,819	933	23,178	324
2043	58,514	428	21,940	935	23,303	325
2044	58,793	429	22,049	936	23,414	326
2045	59,030	430	22,148	940	23,518	328
2046	59,266	431	22,239	942	23,612	329
2047	59,496	431	22,320	943	23,694	329
2048	59,719	432	22,406	945	23,783	330
2049	59,961	433	22,492	945	23,870	331
2050	60,148	433	22,574	947	23,954	332
2051	60,333	434	22,654	949	24,037	333
2052	60,506	435	22,721	950	24,106	334
2053	60,669	435	22,784	952	24,171	335
2054	60,852	436	22,845	953	24,234	335
2055	60,997	436	22,903	953	24,292	336
2056	61,160	437	22,965	955	24,357	336
2057	61,311	438	23,024	955	24,417	337
2058	61,417	438	23,075	956	24,469	338
2059	61,545	438	23,124	958	24,520	338
2060	61,680	439	23,167	958	24,564	339

Table 12: Population and Building Projections - Basin 86, Sun Valley (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	889	2	153	37	192	5
1956	882	2	155	37	194	5
1957	891	2	155	37	194	5
1958	868	2	156	37	195	5
1959	877	2	156	37	195	5
1960	868	2	165	37	204	6
1961	854	2	169	37	208	6
1962	825	2	175	37	214	9
1963	778	2	177	37	216	9
1964	743	2	181	37	220	9
1965	791	2	187	43	232	12
1966	807	3	192	43	238	13
1967	799	3	194	43	240	13
1968	838	3	203	43	249	15
1969	936	3	216	43	262	17
1970	996	3	241	43	287	18
1971	1,068	4	271	43	318	21
1972	1,192	5	318	43	366	24
1973	1,273	6	361	43	410	27
1974	1,341	6	387	43	436	30
1975	1,452	6	418	44	468	31
1976	1,503	8	436	42	486	33
1977	1,695	9	512	43	564	33
1978	1,898	10	599	44	653	34
1979	2,072	12	694	43	749	38
1980	2,153	12	736	43	791	41
1981	2,296	13	771	44	828	55
1982	2,392	16	806	42	864	58
1983	2,532	17	853	44	914	62
1984	2,827	21	963	43	1,027	65
1985	2,962	22	1,020	44	1,086	65
1986	3,126	22	1,103	44	1,169	68
1987	3,290	26	1,169	42	1,237	70
1988	3,434	27	1,224	43	1,294	71
1989	3,554	28	1,265	44	1,337	71
1990	3,746	30	1,346	42	1,418	71
1991	3,995	30	1,425	43	1,498	73
1992	4,232	33	1,500	43	1,576	74
1993	4,535	34	1,597	43	1,674	74
1994	5,237	35	1,850	44	1,929	74
1995	5,968	35	2,099	44	2,178	74
1996	6,973	38	2,383	125	2,546	74
1997	7,938	41	2,770	127	2,938	77
1998	8,966	45	3,120	188	3,353	80
1999	9,631	46	3,461	190	3,697	81
2000	9,396	46	3,497	190	3,733	83
2001	9,574	48	3,516	189	3,753	86
2002	9,395	49	3,528	190	3,767	86
2003	9,471	49	3,537	189	3,775	86
2004	9,475	50	3,560	192	3,802	90
2005	9,549	51	3,609	189	3,849	92
2006	9,776	52	3,697	188	3,937	93
2007	9,968	53	3,745	189	3,987	94

Table 13: Population and Building Projections - Basin 86, Sun Valley (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	10,003	53	3,761	189	4,003	95
2009	9,790	53	3,757	189	3,999	96
2010	9,816	53	3,771	189	4,013	99
2011	9,859	53	3,763	190	4,006	100
2012	10,011	54	3,783	190	4,027	100
2013	10,128	55	3,815	191	4,061	100
2014	10,185	55	3,827	192	4,074	100
2015	10,416	56	3,894	190	4,140	101
2016	10,622	56	3,985	191	4,232	102
2017	10,825	56	4,068	192	4,316	104
2018	10,993	57	4,139	194	4,390	106
2019	11,154	57	4,205	196	4,458	107
2020	11,321	58	4,266	197	4,521	108
2021	11,487	58	4,324	198	4,580	108
2022	11,660	58	4,384	198	4,640	109
2023	11,819	59	4,445	199	4,703	110
2024	11,963	59	4,507	200	4,766	112
2025	12,101	59	4,561	201	4,821	113
2026	12,234	60	4,609	203	4,872	114
2027	12,364	60	4,656	204	4,920	114
2028	12,502	60	4,705	204	4,969	115
2029	12,628	61	4,757	205	5,023	116
2030	12,746	61	4,808	205	5,074	117
2031	12,859	61	4,855	207	5,123	118
2032	12,964	61	4,898	208	5,167	118
2033	13,067	62	4,935	209	5,206	119
2034	13,168	62	4,971	209	5,242	120
2035	13,266	62	5,009	210	5,281	120
2036	13,364	62	5,048	210	5,320	121
2037	13,451	63	5,085	211	5,359	121
2038	13,539	63	5,119	212	5,394	122
2039	13,612	63	5,148	212	5,423	123
2040	13,685	63	5,176	213	5,452	123
2041	13,763	63	5,203	213	5,479	124
2042	13,836	63	5,231	214	5,508	124
2043	13,906	64	5,260	214	5,538	124
2044	13,971	64	5,286	214	5,564	125
2045	14,028	64	5,310	215	5,589	126
2046	14,084	64	5,331	216	5,611	126
2047	14,139	64	5,351	216	5,631	126
2048	14,190	64	5,371	216	5,651	127
2049	14,248	64	5,392	216	5,672	127
2050	14,295	64	5,412	217	5,693	127
2051	14,337	64	5,431	217	5,712	128
2052	14,382	65	5,447	218	5,730	128
2053	14,420	65	5,462	218	5,745	128
2054	14,463	65	5,477	218	5,760	128
2055	14,499	65	5,491	218	5,774	129
2056	14,539	65	5,506	219	5,790	129
2057	14,574	65	5,520	219	5,804	129
2058	14,598	65	5,532	219	5,816	129
2059	14,628	65	5,544	219	5,828	130
2060	14,659	65	5,554	219	5,838	130

Table 14: Populaton and Building Projections - Basin 87, Truckee Meadows (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	60,236	360	9,053	3,597	13,010	1,205
1956	63,935	366	9,918	3,783	14,067	1,255
1957	67,941	376	10,482	3,931	14,789	1,305
1958	69,856	400	11,184	4,114	15,698	1,351
1959	74,949	420	11,794	4,445	16,659	1,404
1960	78,554	451	12,726	5,289	18,466	1,532
1961	79,574	461	13,467	5,452	19,380	1,678
1962	82,250	497	14,958	5,881	21,336	1,740
1963	85,010	548	16,264	6,802	23,614	1,826
1964	87,817	588	17,394	8,007	25,989	1,944
1965	94,198	626	18,574	8,416	27,616	2,048
1966	96,207	663	19,109	8,591	28,363	2,321
1967	95,346	689	19,335	8,617	28,641	2,391
1968	97,575	716	19,577	8,704	28,997	2,453
1969	106,424	742	20,061	8,991	29,794	2,524
1970	108,111	770	21,085	9,283	31,138	2,647
1971	111,915	794	22,124	10,400	33,318	2,699
1972	117,278	820	23,607	11,570	35,997	2,768
1973	122,421	853	25,003	13,571	39,427	2,901
1974	127,854	879	25,844	14,842	41,565	3,219
1975	131,897	902	26,442	15,176	42,520	3,312
1976	137,427	931	27,621	15,894	44,446	3,406
1977	145,040	983	29,582	17,685	48,250	3,561
1978	150,690	1,044	31,534	19,259	51,837	4,201
1979	157,188	1,116	33,790	21,902	56,808	4,374
1980	161,238	1,163	34,697	23,375	59,235	4,565
1981	166,946	1,181	35,203	23,820	60,204	4,695
1982	169,141	1,207	35,854	24,045	61,106	4,771
1983	173,654	1,237	36,655	24,799	62,691	4,875
1984	179,628	1,273	38,038	25,937	65,248	4,989
1985	184,277	1,312	39,573	26,690	67,575	5,075
1986	191,581	1,365	41,517	28,764	71,646	5,202
1987	196,452	1,428	43,271	29,155	73,854	5,313
1988	201,399	1,481	44,637	29,767	75,885	5,454
1989	206,689	1,516	45,626	30,619	77,761	5,570
1990	210,575	1,557	46,829	31,317	79,703	5,679
1991	216,510	1,592	47,795	31,794	81,181	5,766
1992	220,959	1,623	48,806	31,865	82,294	5,815
1993	226,321	1,666	49,924	31,954	83,544	5,883
1994	232,608	1,695	51,331	32,649	85,675	5,968
1995	238,476	1,728	52,544	32,763	87,035	6,060
1996	244,105	1,754	53,877	33,491	89,122	6,259
1997	248,870	1,776	55,392	34,938	92,106	6,407
1998	252,083	1,794	56,933	35,545	94,272	6,552
1999	254,475	1,813	58,868	37,006	97,687	6,731
2000	252,614	1,835	60,629	37,899	100,363	6,870
2001	265,653	1,866	63,101	39,170	104,137	7,022
2002	268,122	1,894	65,385	40,228	107,507	7,171
2003	276,384	1,915	67,484	40,758	110,157	7,336
2004	281,352	1,947	69,612	41,343	112,902	7,598
2005	289,610	1,967	72,906	41,858	116,731	7,833
2006	295,986	1,989	74,894	42,322	119,205	8,092
2007	301,005	2,011	75,999	42,392	120,402	8,199

Table 15: Population and Building Projections - Basin 87, Truckee Meadow (2008 to 2006)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	304,548	2,017	76,725	43,126	121,868	8,295
2009	299,246	2,037	77,039	43,165	122,241	8,323
2010	299,774	2,039	77,349	43,169	122,557	8,344
2011	302,954	2,043	77,733	43,326	123,102	8,361
2012	307,501	2,044	78,212	43,437	123,693	8,379
2013	310,910	2,048	78,916	43,699	124,663	8,416
2014	314,170	2,057	79,715	43,896	125,668	8,435
2015	318,480	2,069	81,099	43,414	126,582	8,504
2016	323,004	2,086	82,994	43,607	128,687	8,602
2017	327,477	2,105	84,730	43,738	130,573	8,727
2018	331,965	2,122	86,211	44,241	132,574	8,879
2019	336,339	2,138	87,578	44,712	134,428	8,981
2020	340,574	2,148	88,854	45,010	136,012	9,046
2021	344,577	2,159	90,069	45,163	137,391	9,099
2022	348,407	2,173	91,309	45,160	138,642	9,167
2023	352,109	2,188	92,589	45,338	140,115	9,270
2024	355,760	2,204	93,874	45,659	141,737	9,380
2025	359,319	2,217	94,999	45,939	143,155	9,475
2026	362,857	2,225	95,996	46,286	144,507	9,547
2027	366,144	2,234	96,984	46,482	145,700	9,594
2028	369,306	2,244	97,995	46,544	146,783	9,645
2029	372,235	2,256	99,080	46,729	148,065	9,715
2030	375,072	2,270	100,154	46,888	149,312	9,798
2031	377,918	2,281	101,128	47,156	150,565	9,887
2032	380,816	2,290	102,009	47,481	151,780	9,958
2033	383,300	2,297	102,785	47,627	152,709	10,007
2034	385,919	2,303	103,540	47,787	153,630	10,050
2035	388,177	2,311	104,341	47,877	154,529	10,092
2036	390,337	2,320	105,136	47,933	155,389	10,149
2037	392,559	2,329	105,916	48,153	156,398	10,216
2038	394,770	2,338	106,623	48,318	157,279	10,273
2039	396,716	2,344	107,227	48,483	158,054	10,323
2040	398,621	2,349	107,806	48,658	158,813	10,358
2041	400,420	2,354	108,371	48,678	159,403	10,386
2042	402,108	2,359	108,949	48,767	160,075	10,425
2043	403,754	2,367	109,550	48,877	160,794	10,468
2044	405,333	2,373	110,095	48,955	161,423	10,514
2045	406,916	2,378	110,593	49,147	162,118	10,558
2046	408,314	2,383	111,045	49,247	162,675	10,587
2047	409,647	2,385	111,452	49,304	163,141	10,612
2048	410,995	2,389	111,881	49,408	163,678	10,638
2049	412,259	2,394	112,309	49,413	164,116	10,664
2050	413,366	2,398	112,720	49,504	164,622	10,699
2051	414,519	2,403	113,118	49,626	165,147	10,731
2052	415,488	2,407	113,455	49,671	165,533	10,757
2053	416,567	2,409	113,765	49,789	165,963	10,781
2054	417,607	2,412	114,073	49,826	166,311	10,796
2055	418,358	2,414	114,363	49,833	166,610	10,815
2056	419,367	2,417	114,672	49,923	167,012	10,838
2057	420,156	2,421	114,964	49,941	167,326	10,859
2058	420,814	2,423	115,219	50,013	167,655	10,883
2059	421,675	2,426	115,466	50,106	167,998	10,900
2060	422,373	2,428	115,678	50,103	168,209	10,913

Table 16: Population and Building Data and Projections - Basin 88E, Pleasant Valley East (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	106	20	1	2	23	0
1956	141	28	1	2	31	0
1957	147	29	1	2	32	0
1958	174	36	1	2	39	0
1959	189	39	1	2	42	0
1960	187	41	1	2	44	0
1961	255	59	1	2	62	0
1962	293	72	2	2	76	0
1963	320	85	2	2	89	0
1964	355	101	2	2	105	0
1965	409	118	0	2	120	0
1966	424	123	0	2	125	0
1967	459	134	2	2	138	0
1968	471	136	2	2	140	0
1969	507	138	2	2	142	0
1970	510	143	2	2	147	0
1971	534	154	3	2	159	0
1972	547	163	3	2	168	0
1973	553	174	3	1	178	0
1974	581	181	6	2	189	0
1975	605	187	6	2	195	0
1976	618	191	7	2	200	0
1977	658	207	10	2	219	0
1978	846	278	11	2	291	0
1979	836	292	8	2	302	0
1980	841	298	9	2	309	0
1981	868	302	9	2	313	0
1982	902	315	9	2	326	0
1983	914	318	9	3	330	1
1984	944	326	14	3	343	1
1985	968	332	20	3	355	1
1986	979	337	26	3	366	1
1987	998	339	33	3	375	1
1988	1,011	344	34	3	381	1
1989	1,026	348	35	3	386	1
1990	1,052	359	36	3	398	1
1991	1,075	363	37	3	403	1
1992	1,106	371	38	3	412	1
1993	1,146	381	39	3	423	1
1994	1,178	390	41	3	434	1
1995	1,189	396	35	3	434	1
1996	1,205	401	36	3	440	1
1997	1,208	405	38	4	447	1
1998	1,206	408	39	4	451	1
1999	1,196	414	41	4	459	1
2000	1,158	422	34	4	460	1
2001	1,217	441	36	0	477	1
2002	1,217	450	38	0	488	1
2003	1,242	456	39	0	495	1
2004	1,246	459	41	0	500	1
2005	1,275	471	43	0	514	1
2006	1,321	487	45	0	532	1
2007	1,350	494	46	0	540	1

Table 17: Population and Building Data and Projections - Basin 88E Pleasant Valley East (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	1,364	500	46	0	546	1
2009	1,337	500	46	0	546	1
2010	1,340	502	46	0	548	1
2011	1,351	502	47	0	549	1
2012	1,365	502	47	0	549	1
2013	1,377	505	47	0	552	1
2014	1,415	506	60	0	566	1
2015	1,434	509	61	0	570	1
2016	1,446	514	62	0	576	1
2017	1,457	518	63	0	581	1
2018	1,467	522	64	0	586	1
2019	1,479	526	65	0	591	1
2020	1,490	529	66	0	595	1
2021	1,500	531	67	0	598	1
2022	1,515	535	68	0	603	1
2023	1,528	539	69	0	608	1
2024	1,539	543	70	0	613	1
2025	1,549	546	71	0	617	1
2026	1,557	548	72	0	620	1
2027	1,566	550	73	0	623	1
2028	1,573	552	73	0	625	1
2029	1,581	555	74	0	629	1
2030	1,593	559	75	0	634	1
2031	1,599	561	76	0	637	1
2032	1,606	564	76	0	640	1
2033	1,611	565	77	0	642	1
2034	1,618	567	77	0	644	1
2035	1,625	569	78	0	647	1
2036	1,633	571	79	0	650	1
2037	1,637	573	79	0	652	1
2038	1,644	575	80	0	655	1
2039	1,649	577	80	0	657	1
2040	1,654	578	81	0	659	1
2041	1,658	579	81	0	660	1
2042	1,663	581	81	0	662	1
2043	1,667	582	82	0	664	1
2044	1,672	584	82	0	666	1
2045	1,677	585	83	0	668	1
2046	1,679	586	83	0	669	1
2047	1,682	587	83	0	670	1
2048	1,687	588	84	0	672	1
2049	1,691	589	84	0	673	1
2050	1,692	590	84	0	674	1
2051	1,699	592	85	0	677	1
2052	1,699	592	85	0	677	1
2053	1,702	593	85	0	678	1
2054	1,705	594	85	0	679	1
2055	1,707	594	86	0	680	1
2056	1,710	595	86	0	681	1
2057	1,713	596	86	0	682	1
2058	1,712	596	86	0	682	1
2059	1,714	597	86	0	683	1
2060	1,720	598	87	0	685	1

Table 18: Population and Building Data and Projections - Basin 88W, Pleasant Valley West (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	139	17	11	2	30	2
1956	136	17	11	2	30	2
1957	138	17	11	2	30	2
1958	134	17	11	2	30	2
1959	139	17	12	2	31	2
1960	149	19	14	2	35	2
1961	148	19	15	2	36	2
1962	158	25	14	2	41	3
1963	176	31	16	2	49	3
1964	169	33	15	2	50	3
1965	191	36	18	2	56	3
1966	197	37	19	2	58	3
1967	210	42	19	2	63	3
1968	215	42	20	2	64	3
1969	229	42	20	2	64	3
1970	233	43	22	2	67	4
1971	225	44	21	2	67	4
1972	225	45	22	2	69	4
1973	214	47	21	1	69	4
1974	255	57	24	2	83	4
1975	335	72	34	2	108	4
1976	402	82	46	2	130	4
1977	529	104	70	2	176	4
1978	637	134	83	2	219	4
1979	689	156	91	2	249	4
1980	724	165	99	2	266	4
1981	790	168	115	2	285	4
1982	853	175	131	2	308	4
1983	873	178	134	3	315	4
1984	939	185	153	3	341	4
1985	1,025	193	180	3	376	4
1986	1,054	198	193	3	394	4
1987	1,152	213	217	3	433	4
1988	1,213	218	236	3	457	4
1989	1,292	224	259	3	486	4
1990	1,379	234	285	3	522	4
1991	1,491	239	317	3	559	4
1992	1,606	250	345	3	598	4
1993	1,715	260	370	3	633	4
1994	1,873	267	420	3	690	4
1995	2,000	272	455	3	730	4
1996	2,128	274	500	3	777	6
1997	2,229	278	543	4	825	8
1998	2,350	278	597	4	879	8
1999	2,373	281	626	4	911	9
2000	2,419	282	675	4	961	10
2001	2,597	282	736	0	1,018	10
2002	2,636	285	772	0	1,057	10
2003	2,745	291	803	0	1,094	10
2004	2,903	295	870	0	1,165	10
2005	3,258	300	1,013	0	1,313	10
2006	3,451	307	1,083	0	1,390	11
2007	3,618	309	1,138	0	1,447	11

Table 19: Population and Building Data and Projections - Basin 88W Pleasant Valley West (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	3,689	314	1,162	0	1,476	11
2009	3,628	314	1,168	0	1,482	11
2010	3,635	314	1,172	0	1,486	11
2011	3,696	314	1,188	0	1,502	11
2012	3,751	314	1,195	0	1,509	11
2013	3,791	315	1,205	0	1,520	11
2014	3,865	318	1,228	0	1,546	11
2015	3,948	320	1,249	0	1,569	1
2016	4,021	323	1,279	0	1,602	1
2017	4,091	326	1,305	0	1,631	1
2018	4,147	328	1,328	0	1,656	1
2019	4,203	331	1,349	0	1,680	1
2020	4,259	332	1,369	0	1,701	1
2021	4,319	334	1,388	0	1,722	1
2022	4,380	336	1,407	0	1,743	1
2023	4,435	339	1,426	0	1,765	1
2024	4,485	341	1,446	0	1,787	1
2025	4,533	343	1,463	0	1,806	1
2026	4,578	344	1,479	0	1,823	1
2027	4,624	346	1,494	0	1,840	1
2028	4,672	347	1,510	0	1,857	1
2029	4,714	349	1,526	0	1,875	1
2030	4,758	351	1,543	0	1,894	1
2031	4,797	353	1,558	0	1,911	1
2032	4,830	354	1,571	0	1,925	1
2033	4,864	355	1,583	0	1,938	1
2034	4,901	356	1,595	0	1,951	1
2035	4,936	358	1,607	0	1,965	1
2036	4,971	359	1,620	0	1,979	1
2037	5,000	360	1,632	0	1,992	1
2038	5,033	362	1,643	0	2,005	1
2039	5,058	363	1,652	0	2,015	1
2040	5,080	363	1,661	0	2,024	1
2041	5,107	364	1,669	0	2,033	1
2042	5,132	365	1,678	0	2,043	1
2043	5,158	366	1,688	0	2,054	1
2044	5,180	367	1,696	0	2,063	1
2045	5,201	368	1,704	0	2,072	1
2046	5,221	369	1,711	0	2,080	1
2047	5,238	369	1,717	0	2,086	1
2048	5,258	370	1,724	0	2,094	1
2049	5,275	370	1,730	0	2,100	1
2050	5,291	371	1,736	0	2,107	1
2051	5,309	372	1,743	0	2,115	1
2052	5,321	372	1,748	0	2,120	1
2053	5,336	373	1,753	0	2,126	1
2054	5,348	373	1,757	0	2,130	1
2055	5,363	374	1,762	0	2,136	1
2056	5,376	374	1,767	0	2,141	1
2057	5,389	375	1,771	0	2,146	1
2058	5,397	375	1,775	0	2,150	1
2059	5,407	375	1,779	0	2,154	1
2060	5,419	376	1,782	0	2,158	1

Table 20: Population and Building Data and Projections - Basin 89, Washoe Valley (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	565	106	10	6	122	1
1956	568	109	10	6	125	1
1957	574	109	10	6	125	1
1958	570	112	10	6	128	1
1959	603	116	12	6	134	1
1960	642	134	11	6	151	1
1961	653	141	12	6	159	1
1962	713	168	11	6	185	1
1963	810	209	10	6	225	1
1964	841	232	11	6	249	1
1965	972	269	10	6	285	1
1966	1,045	291	11	6	308	1
1967	1,072	305	11	6	322	1
1968	1,117	315	11	6	332	2
1969	1,218	324	11	6	341	2
1970	1,240	339	12	6	357	2
1971	1,394	396	13	6	415	2
1972	1,593	472	11	6	489	2
1973	1,667	519	12	6	537	2
1974	1,726	543	12	6	561	2
1975	1,824	570	12	6	588	3
1976	1,936	606	13	7	626	3
1977	2,176	705	14	5	724	3
1978	2,427	814	15	6	835	4
1979	2,579	906	17	9	932	4
1980	2,640	943	17	10	970	4
1981	2,792	979	18	10	1,007	4
1982	2,859	1,005	18	10	1,033	4
1983	2,911	1,023	18	10	1,051	4
1984	2,973	1,053	19	8	1,080	4
1985	3,052	1,091	20	8	1,119	4
1986	3,123	1,126	21	21	1,168	4
1987	3,213	1,165	22	21	1,208	4
1988	3,323	1,209	22	21	1,252	4
1989	3,408	1,237	23	22	1,282	6
1990	3,495	1,276	24	23	1,323	6
1991	3,648	1,318	30	20	1,368	6
1992	3,756	1,348	31	20	1,399	6
1993	3,893	1,378	39	20	1,437	6
1994	4,040	1,421	47	20	1,488	6
1995	4,170	1,453	49	20	1,522	8
1996	4,276	1,482	58	21	1,561	9
1997	4,296	1,500	68	22	1,590	10
1998	4,297	1,514	71	22	1,607	10
1999	4,202	1,528	66	19	1,613	10
2000	4,158	1,555	77	20	1,652	11
2001	4,306	1,586	81	21	1,688	11
2002	4,272	1,607	85	21	1,713	11
2003	4,378	1,626	98	21	1,745	11
2004	4,401	1,642	102	22	1,766	11
2005	4,421	1,663	97	22	1,782	11
2006	4,497	1,688	101	22	1,811	11
2007	4,613	1,708	114	23	1,845	13

Table 21: Population and Building Data and Projections - Basin 89, Washoe Valley (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	4,641	1,719	115	23	1,857	13
2009	4,561	1,724	116	23	1,863	13
2010	4,564	1,727	116	23	1,866	13
2011	4,605	1,731	117	23	1,871	13
2012	4,659	1,734	117	23	1,874	13
2013	4,689	1,739	118	23	1,880	13
2014	4,705	1,744	119	19	1,882	13
2015	4,765	1,754	121	19	1,894	13
2016	4,799	1,769	124	19	1,912	14
2017	4,840	1,784	127	19	1,930	14
2018	4,875	1,799	129	19	1,947	14
2019	4,911	1,813	131	19	1,963	14
2020	4,940	1,821	133	19	1,973	14
2021	4,976	1,830	135	19	1,984	14
2022	5,021	1,842	137	19	1,998	15
2023	5,056	1,855	138	19	2,012	15
2024	5,093	1,869	140	20	2,029	15
2025	5,125	1,880	142	20	2,042	15
2026	5,150	1,887	144	20	2,051	15
2027	5,174	1,894	145	20	2,059	15
2028	5,206	1,902	147	20	2,069	15
2029	5,229	1,912	148	20	2,080	15
2030	5,263	1,925	150	20	2,095	16
2031	5,284	1,934	151	20	2,105	16
2032	5,307	1,942	153	20	2,115	16
2033	5,326	1,948	154	20	2,122	16
2034	5,343	1,952	155	20	2,127	16
2035	5,366	1,960	156	20	2,136	16
2036	5,386	1,967	157	20	2,144	16
2037	5,407	1,975	158	21	2,154	16
2038	5,427	1,982	159	21	2,162	16
2039	5,442	1,987	160	21	2,168	16
2040	5,454	1,991	161	21	2,173	16
2041	5,474	1,996	162	21	2,179	16
2042	5,486	2,000	163	21	2,184	17
2043	5,502	2,006	164	21	2,191	17
2044	5,519	2,012	165	21	2,198	17
2045	5,527	2,016	165	21	2,202	17
2046	5,540	2,020	166	21	2,207	17
2047	5,549	2,022	167	21	2,210	17
2048	5,559	2,026	167	21	2,214	17
2049	5,574	2,030	168	21	2,219	17
2050	5,582	2,033	169	21	2,223	17
2051	5,592	2,038	169	21	2,228	17
2052	5,600	2,040	170	21	2,231	17
2053	5,605	2,042	170	21	2,233	17
2054	5,617	2,045	171	21	2,237	17
2055	5,622	2,047	171	21	2,239	17
2056	5,630	2,049	172	21	2,242	17
2057	5,640	2,053	172	21	2,246	17
2058	5,642	2,055	172	21	2,248	17
2059	5,650	2,057	173	21	2,251	17
2060	5,655	2,058	173	21	2,252	17

Table 22: Population and Building Data and Projections - Basin 92 Lemmon Valley (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	2,236	47	426	10	483	26
1956	2,200	48	426	10	484	27
1957	2,233	51	425	10	486	30
1958	3,320	54	682	10	746	30
1959	3,379	58	683	10	751	31
1960	3,284	68	694	10	772	50
1961	3,199	72	697	10	779	54
1962	3,111	82	715	10	807	54
1963	2,992	95	726	10	831	55
1964	2,848	101	732	10	843	55
1965	3,326	112	837	26	975	60
1966	3,596	120	914	26	1,060	60
1967	3,559	126	917	26	1,069	62
1968	3,654	143	917	26	1,086	67
1969	3,947	157	922	26	1,105	68
1970	4,593	176	1,121	26	1,323	71
1971	4,985	257	1,201	26	1,484	71
1972	5,441	318	1,326	26	1,670	74
1973	5,729	387	1,402	56	1,845	78
1974	5,786	415	1,410	56	1,881	79
1975	6,021	436	1,449	56	1,941	86
1976	6,373	489	1,517	55	2,061	90
1977	6,857	659	1,551	71	2,281	92
1978	8,939	922	2,084	69	3,075	93
1979	10,230	1,092	2,533	72	3,697	95
1980	10,333	1,169	2,553	74	3,796	101
1981	10,712	1,214	2,573	76	3,863	106
1982	10,972	1,232	2,588	144	3,964	112
1983	11,459	1,266	2,623	248	4,137	112
1984	11,725	1,327	2,683	249	4,259	114
1985	12,081	1,385	2,795	250	4,430	116
1986	12,164	1,436	2,864	249	4,549	118
1987	12,473	1,505	2,935	249	4,689	125
1988	12,779	1,551	2,954	310	4,815	130
1989	12,931	1,589	2,967	309	4,865	136
1990	13,099	1,618	3,031	309	4,958	141
1991	13,730	1,646	3,082	420	5,148	146
1992	14,220	1,674	3,201	421	5,296	152
1993	14,829	1,701	3,351	422	5,474	154
1994	15,560	1,744	3,525	462	5,731	160
1995	16,232	1,763	3,701	460	5,924	166
1996	16,790	1,788	3,782	560	6,130	172
1997	17,287	1,822	3,978	598	6,398	177
1998	17,798	1,845	4,213	598	6,656	187
1999	18,928	1,859	4,648	759	7,266	190
2000	19,338	1,878	5,044	761	7,683	195
2001	21,416	1,891	5,462	1,042	8,395	201
2002	22,331	1,907	5,947	1,100	8,954	206
2003	23,311	1,933	6,222	1,136	9,291	225
2004	24,798	1,950	6,773	1,228	9,951	246
2005	25,976	1,963	7,282	1,225	10,470	255
2006	27,266	1,984	7,762	1,235	10,981	262
2007	27,818	1,995	7,899	1,233	11,127	275

Table 23: Population and Building Data and Projections - Basin 92, Lemmon Valley (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	28,024	2,006	7,960	1,248	11,214	279
2009	27,643	2,009	8,034	1,249	11,292	281
2010	27,635	2,009	8,040	1,249	11,298	282
2011	27,844	2,014	8,051	1,249	11,314	286
2012	28,149	2,017	8,059	1,247	11,323	287
2013	28,272	2,020	8,066	1,250	11,336	292
2014	28,555	2,025	8,084	1,313	11,422	293
2015	29,085	2,037	8,224	1,299	11,560	296
2016	29,553	2,054	8,416	1,304	11,774	299
2017	30,026	2,072	8,592	1,308	11,972	303
2018	30,434	2,089	8,742	1,323	12,154	309
2019	30,835	2,105	8,881	1,338	12,324	312
2020	31,227	2,115	9,010	1,346	12,471	315
2021	31,626	2,125	9,134	1,351	12,610	316
2022	32,038	2,139	9,259	1,351	12,749	319
2023	32,415	2,154	9,389	1,356	12,899	322
2024	32,768	2,170	9,519	1,366	13,055	326
2025	33,107	2,183	9,633	1,374	13,190	329
2026	33,424	2,191	9,735	1,385	13,311	332
2027	33,737	2,200	9,835	1,390	13,425	334
2028	34,062	2,209	9,937	1,392	13,538	335
2029	34,356	2,221	10,047	1,398	13,666	338
2030	34,651	2,235	10,156	1,403	13,794	341
2031	34,919	2,246	10,255	1,411	13,912	344
2032	35,174	2,255	10,344	1,420	14,019	346
2033	35,416	2,262	10,423	1,425	14,110	348
2034	35,663	2,267	10,500	1,430	14,197	349
2035	35,891	2,275	10,581	1,432	14,288	351
2036	36,120	2,284	10,661	1,434	14,379	353
2037	36,327	2,293	10,740	1,440	14,473	355
2038	36,543	2,302	10,812	1,445	14,559	357
2039	36,721	2,307	10,873	1,450	14,630	359
2040	36,897	2,312	10,932	1,456	14,700	360
2041	37,082	2,317	10,989	1,456	14,762	361
2042	37,250	2,322	11,048	1,459	14,829	363
2043	37,416	2,330	11,109	1,462	14,901	364
2044	37,575	2,336	11,164	1,464	14,964	366
2045	37,715	2,341	11,215	1,470	15,026	367
2046	37,851	2,346	11,261	1,473	15,080	368
2047	37,979	2,348	11,302	1,475	15,125	369
2048	38,104	2,352	11,345	1,478	15,175	370
2049	38,243	2,357	11,389	1,478	15,224	371
2050	38,348	2,361	11,430	1,481	15,272	372
2051	38,458	2,366	11,471	1,485	15,322	373
2052	38,554	2,369	11,505	1,486	15,360	374
2053	38,644	2,371	11,536	1,489	15,396	375
2054	38,755	2,375	11,568	1,491	15,434	375
2055	38,833	2,377	11,597	1,491	15,465	376
2056	38,923	2,380	11,628	1,493	15,501	377
2057	39,011	2,384	11,658	1,494	15,536	378
2058	39,071	2,386	11,684	1,496	15,566	378
2059	39,146	2,388	11,709	1,499	15,596	379
2060	39,219	2,390	11,730	1,499	15,619	379

Table 24: Population and Building Data and Projections - Basin 000, Rest of Washoe County (1955 to 2007)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
1955	741	63	86	11	160	42
1956	736	63	88	11	162	44
1957	781	65	94	11	170	46
1958	792	66	101	11	178	46
1959	864	66	115	11	192	46
1960	1,012	75	146	17	238	49
1961	1,006	77	151	17	245	51
1962	1,037	78	174	17	269	54
1963	1,368	80	283	17	380	54
1964	2,247	85	474	106	665	60
1965	3,271	86	719	154	959	76
1966	3,826	91	849	188	1,128	84
1967	3,842	92	874	188	1,154	90
1968	4,634	92	1,085	200	1,377	107
1969	5,640	92	1,287	200	1,579	119
1970	6,618	92	1,593	221	1,906	128
1971	8,223	94	2,127	227	2,448	137
1972	8,859	95	2,378	246	2,719	141
1973	8,899	101	2,508	257	2,866	150
1974	9,613	108	2,746	271	3,125	198
1975	9,818	111	2,783	271	3,165	200
1976	10,148	121	2,887	274	3,282	205
1977	10,584	139	3,103	279	3,521	210
1978	11,901	156	3,542	396	4,094	232
1979	12,977	193	4,050	447	4,690	248
1980	14,770	244	4,702	480	5,426	264
1981	16,036	268	5,031	484	5,783	300
1982	16,650	295	5,230	490	6,015	315
1983	17,085	314	5,357	497	6,168	320
1984	17,421	344	5,486	498	6,328	323
1985	17,875	376	5,670	509	6,555	325
1986	17,822	400	5,753	512	6,665	329
1987	18,200	442	5,887	513	6,842	331
1988	18,875	474	6,126	512	7,112	332
1989	19,475	507	6,303	517	7,327	332
1990	19,944	539	6,488	522	7,549	346
1991	20,659	561	6,663	522	7,746	349
1992	21,386	609	6,836	520	7,965	352
1993	22,089	646	6,987	521	8,154	354
1994	22,817	697	7,185	522	8,404	357
1995	23,737	755	7,367	541	8,663	361
1996	24,188	798	7,491	542	8,831	366
1997	24,367	880	7,594	544	9,018	368
1998	24,625	922	7,741	546	9,209	372
1999	24,695	989	7,887	604	9,480	376
2000	24,566	1,041	8,113	606	9,760	387
2001	25,801	1,095	8,413	606	10,114	389
2002	26,060	1,140	8,704	605	10,449	395
2003	27,140	1,207	9,005	605	10,817	400
2004	27,978	1,281	9,341	605	11,227	403
2005	28,735	1,326	9,652	604	11,582	408
2006	29,327	1,368	9,817	626	11,811	409
2007	29,995	1,401	9,971	626	11,998	412

Table 25: Population and Building Data and Projections - Basin 000, Rest of Washoe County (2008 to 2060)

Year	Population	Units on Wells	Single Family	Multi-Family Units	Total Dwelling	Commercial Buildings
2008	30,215	1,423	10,042	626	12,091	415
2009	29,763	1,427	10,104	627	12,158	415
2010	29,758	1,434	10,105	627	12,166	416
2011	29,980	1,444	10,113	625	12,182	416
2012	30,319	1,449	10,121	626	12,196	416
2013	30,454	1,453	10,133	625	12,211	418
2014	30,628	1,457	10,170	624	12,251	418
2015	31,281	1,464	10,347	622	12,433	431
2016	31,847	1,476	10,588	624	12,688	436
2017	32,416	1,489	10,810	626	12,925	442
2018	32,885	1,501	10,999	633	13,133	450
2019	33,339	1,512	11,173	640	13,325	455
2020	33,804	1,520	11,336	644	13,500	458
2021	34,272	1,527	11,491	647	13,665	461
2022	34,762	1,537	11,649	647	13,833	464
2023	35,207	1,548	11,813	649	14,010	469
2024	35,614	1,559	11,976	654	14,189	475
2025	36,008	1,568	12,120	658	14,346	480
2026	36,369	1,574	12,247	663	14,484	483
2027	36,735	1,580	12,373	665	14,618	486
2028	37,124	1,587	12,502	666	14,755	488
2029	37,474	1,596	12,641	669	14,906	492
2030	37,818	1,606	12,778	671	15,055	496
2031	38,127	1,613	12,902	675	15,190	501
2032	38,423	1,620	13,014	680	15,314	504
2033	38,704	1,625	13,113	682	15,420	507
2034	38,994	1,629	13,210	684	15,523	509
2035	39,268	1,635	13,312	685	15,632	511
2036	39,539	1,641	13,413	686	15,740	514
2037	39,784	1,648	13,513	689	15,850	517
2038	40,032	1,654	13,603	692	15,949	520
2039	40,240	1,658	13,680	694	16,032	523
2040	40,441	1,661	13,754	697	16,112	524
2041	40,664	1,665	13,826	697	16,188	526
2042	40,863	1,669	13,900	698	16,267	528
2043	41,055	1,674	13,976	700	16,350	530
2044	41,246	1,679	14,046	701	16,426	532
2045	41,402	1,682	14,109	704	16,495	535
2046	41,558	1,685	14,167	705	16,557	536
2047	41,713	1,687	14,219	706	16,612	537
2048	41,861	1,690	14,274	707	16,671	539
2049	42,023	1,694	14,328	707	16,729	540
2050	42,150	1,696	14,381	709	16,786	542
2051	42,273	1,700	14,432	710	16,842	543
2052	42,389	1,702	14,475	711	16,888	545
2053	42,497	1,704	14,514	713	16,931	546
2054	42,617	1,706	14,553	713	16,972	547
2055	42,715	1,708	14,590	713	17,011	548
2056	42,825	1,710	14,630	715	17,055	549
2057	42,926	1,713	14,667	715	17,095	550
2058	42,996	1,714	14,700	716	17,130	551
2059	43,082	1,716	14,731	717	17,164	552
2060	43,169	1,717	14,758	717	17,192	552

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 2035 Water Resource plan is 22 years, 2014 to 2035. Building off the model developed for the 2010 tot 2030 Water Resource Plan, the Washoe County Assessor's data was again used to construct the required annualized data using building 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. 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 the 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 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 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 Quickinfo 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. Overlaying the Nevada State Engineer hydrographic and TMWA's service area boundaries on the parcel allows assignment of service areas and basins names.

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 with each parcel; 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 one 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 6 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 2014. This line is consistent with the other measures of year developed and provides the longest time series for analysis.

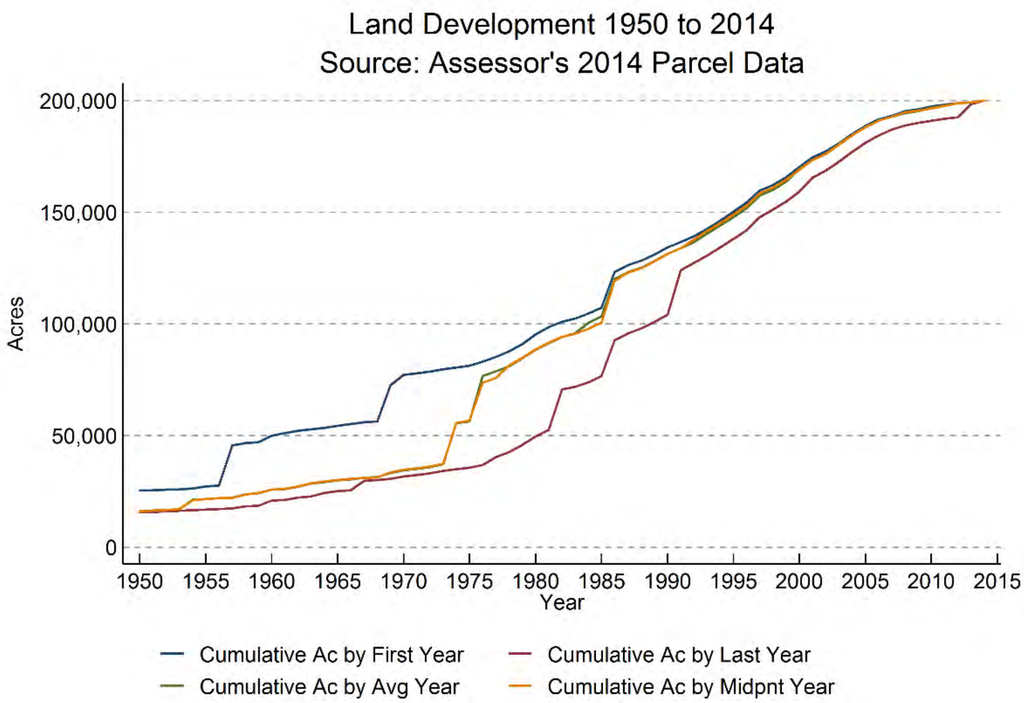

Figure 6: Land development trends by year of buildings.

Figure 7 is a view of population, dwelling, and developed land data. The historic and projected population is shown to determine how its trend might relate to the developed land 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 also 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.

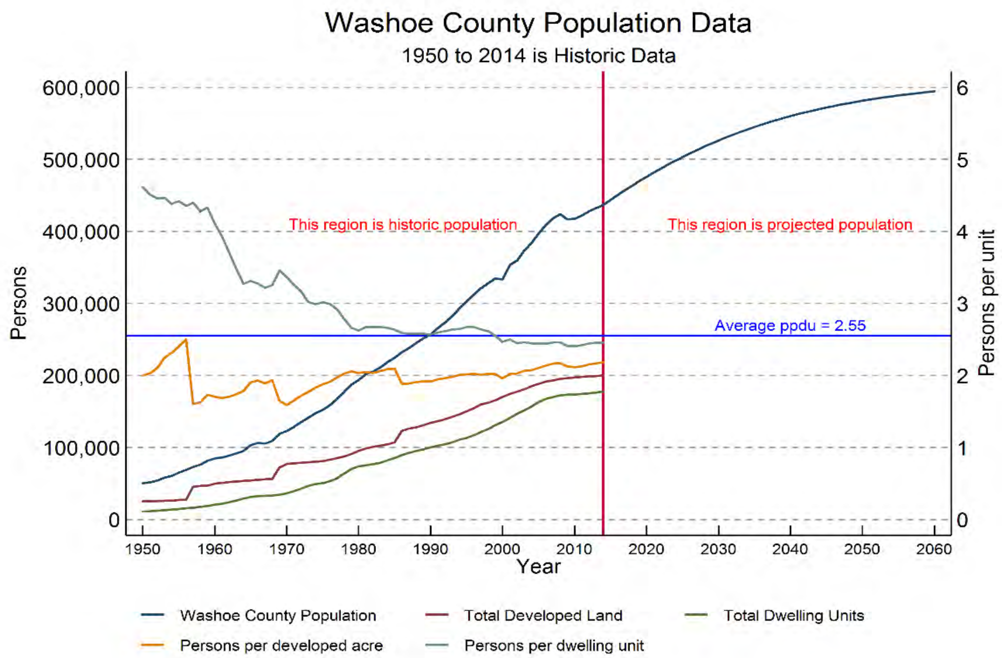

Figure 7: Washoe County population, dwelling units, and developed land data.

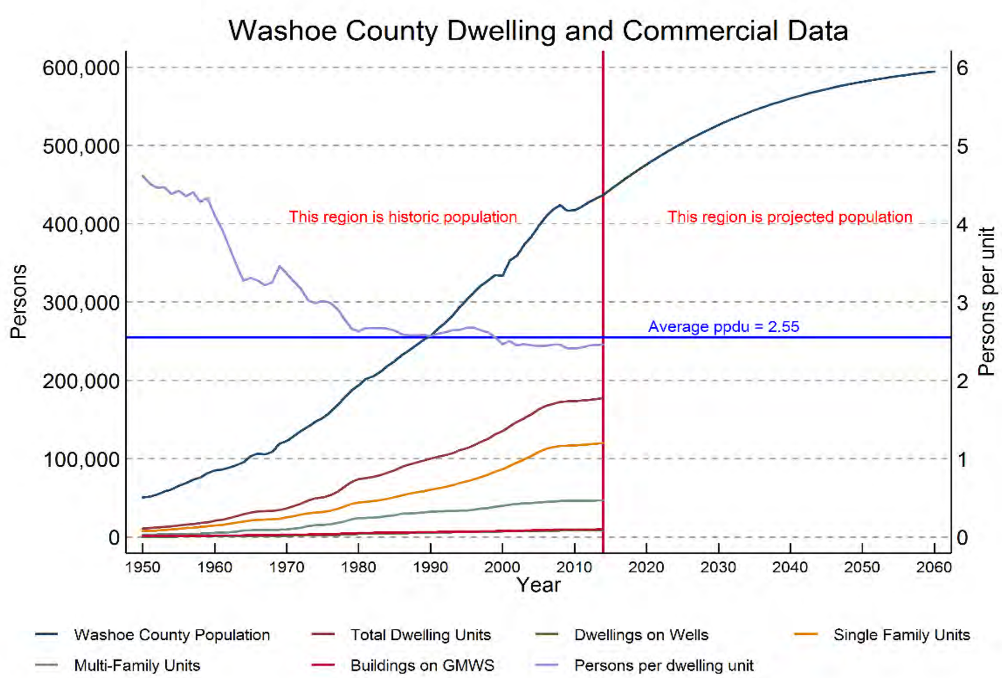

Figure 8: Washoe County population, dwelling units, and commercial buildings data.

The parcel and building data was reclassified into four major classes of building: dwellings on well, single family buildings/units, multi-family dwelling units, and commercial buildings (Figure 8). These classifications correspond to TMWA's classes of water customer. 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 relationship between population and the defined classes of dwelling units and commercial buildings.

The review of the data graphs clearly shows 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.

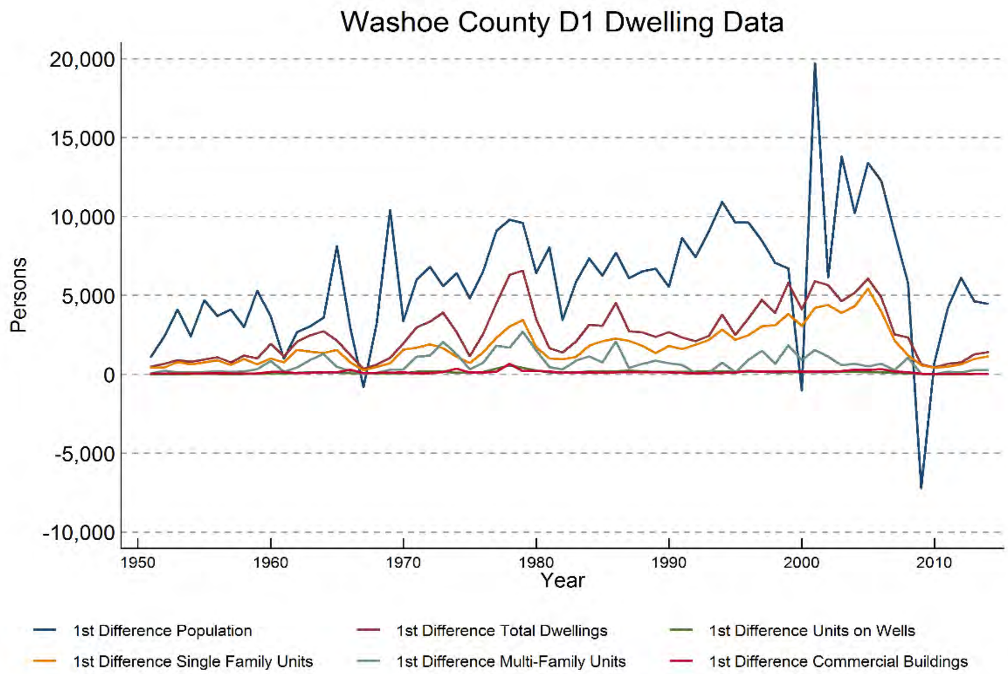

Figure 9: First difference or annual change in Washoe County dwelling units.

Figure 9 show the results of first differencing the dwelling and commercial building data presented in Figure 8. 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 in 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. To simplify the discussion of the modeling process, this memo will skip the mathematical notation and describe the commands used and an explanation of the model results. All data processing and statistical estimations were performed 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 version 14 on Windows 8.0 64-bit platform

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 such as population.

Three models were estimated in the process of building a model that provides 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 was not corrected for autocorrelation and thus had a clear time trend. While this could not be used for any projections, it was useful in diagnostic of the data to determine the extent of autocorrelation and other starting parameters useful in fitting the VAR models. The results of model 1 (Apendix A) suggested using only the data from 1980 to 2014 in the projection model. While this model did have an adjusted R^2 equal 0.9999, it confirmed the existence of autocorrelation and was found to be unstable, these results were expected.

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 9 shows the data used in Model 2 for the years 1955 to 2009. Full statistical output is shown Appendix B. This model is the result of a number of different statistical trials used to fine tune the model parameters. Through the testing it was found that the model performed best with first, second, and third year lags with current year d1 population and third year lag on d1 population.

```
var d1cdwell0 d1cdwell1 d1cdwell2 if tin(1979, 2014), lags(1 2 3) exog(d1pop
L3.d1pop) noconstant
```

The model results did show lower performance for multi-family dwelling units. The selection-order criteria show that the model did require lags 1 and 3. The Lagrange-multiplier test for autocorrelation show no autocorrelation was found. The last test, Jarque-Bera test for normality in the residuals found that the residuals are normally distributed.

Summary of final form of Model 2 is presented below. The full regression model is provided in Appendix 2.

```
. var d1cdwell0 d1cdwell1 d1cdwell2 if tin(1979,2014),
>     lags(1 2 3) exog( d1pop L3.d1pop ) noconstant;

Vector autoregression

Sample:  1979 - 2014                              Number of obs     =        36
Log likelihood =  -706.0762                       AIC               =  41.05979
FPE            =   1.45e+14                       HQIC              =  41.56642
Det(Sigma_ml)  =   2.18e+13                       SBIC              =  42.51135

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
d1cdwell0            11     33.2177   0.9687   1113.525   0.0000
d1cdwell1            11     563.631   0.9672   1060.375   0.0000
d1cdwell2            11     493.333   0.8197   163.6727   0.0000
```

Figure 10 shows that Model 2 fits the data well and provides what appears to be a reasonable projection of future dwelling units. There is no autocorrelation at any of the lags and the VAR satisfies stability conditions. 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.

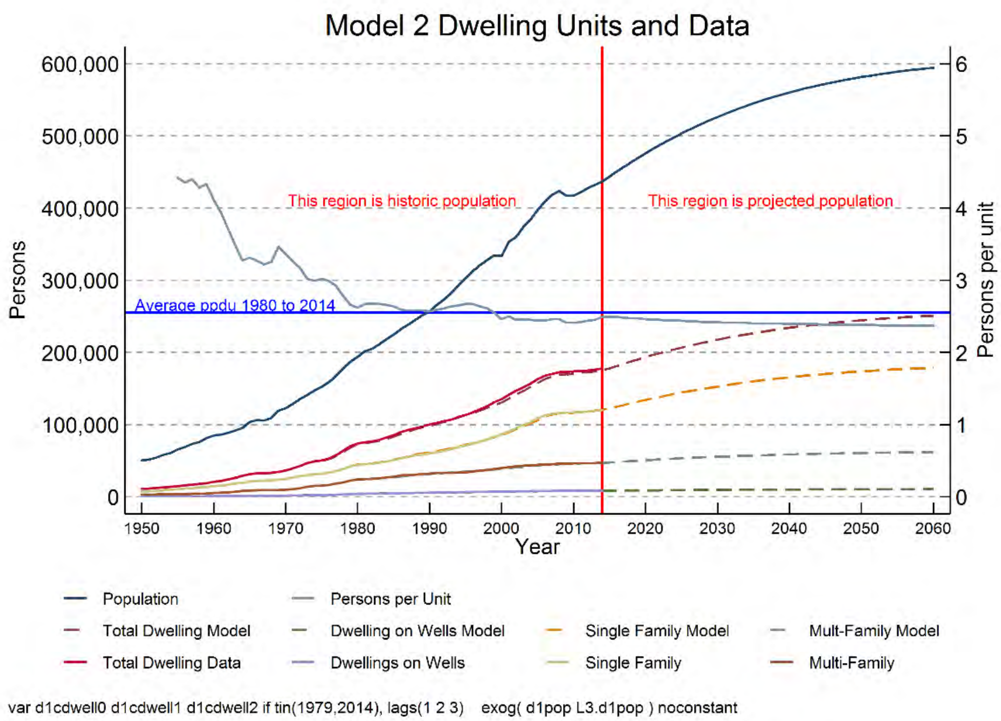

Figure 10: Results of Model 2.

Model 3 Estimation

Model 3 started with Model 2 and was expanded to include both commercial buildings and developed land. This initial model did not perform well, was generally unstable and could not be used for projections. As a result of these trials, dwelling units were replaced with buildings for units on wells and single family units. The assumption is that most parcels had a one to one relationship between units and buildings and thus, should still provide good results. As a result of this change a various, different VAR models were estimated with the following model found to provide the best fit to the data.
This model uses buildings on wells (d1build0), single family buildings (d1build1), multi-family dwelling units (d1cdwell2), commercial buildings (d1build4) and population (d1pop). The independent variables are lagged one to five years, because of the recent economic recession, it was necessary to include longer lags to connect to the relationships that can model the economic recovery. Population is the exogenous variable that drives the projection and includes lags for 1 to 4 years.

Final form for Model 3 is:

```
. var d1build0 d1build1 d1cdwell2 d1build4 if tin(1979,2014),
>     lags(1 2 3 4 5)
>     exog(d1pop L1.d1pop L2.d1pop L3.d1pop l4.d1pop)
>     noconstant;

Vector autoregression

Sample:  1979 - 2014                             Number of obs     =         36
Log likelihood =  -807.7143                      AIC               =   50.42857
FPE            =   3.42e+17                      HQIC              =   51.96382
Det(Sigma_ml)  =   3.62e+14                      SBIC              =   54.82723

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
d1build0             25      27.088   0.9916   4264.812   0.0000
d1build1             25     569.135   0.9852   2402.234   0.0000
d1cdwell2            25     499.769   0.9186     406.19   0.0000
d1build4             25     29.6007   0.9891   3272.902   0.0000
----------------------------------------------------------------
```

This model shows very high R^2 values for all variables indicating good ability to explain the historic data and thus provide a good projecting model. Full model results are provided in Appendix 3. Testing for stability condition found the model to be stable. The test for autocorrelation did not find any autocorrelation, but the test for normally distributed residuals found that for all but the multi-family units, the residuals were normally distributed. The multi-family was on the margin and the effects do not directly affect the predictions.

Model 4 Estimation

Model 4 is a simple ordinary least squares regression of population and developed land use. This is not very precise and only serves to provide an indication of the relationship between population and developed land. Figure 11 shows the graphical projections using Models 3 and 4.

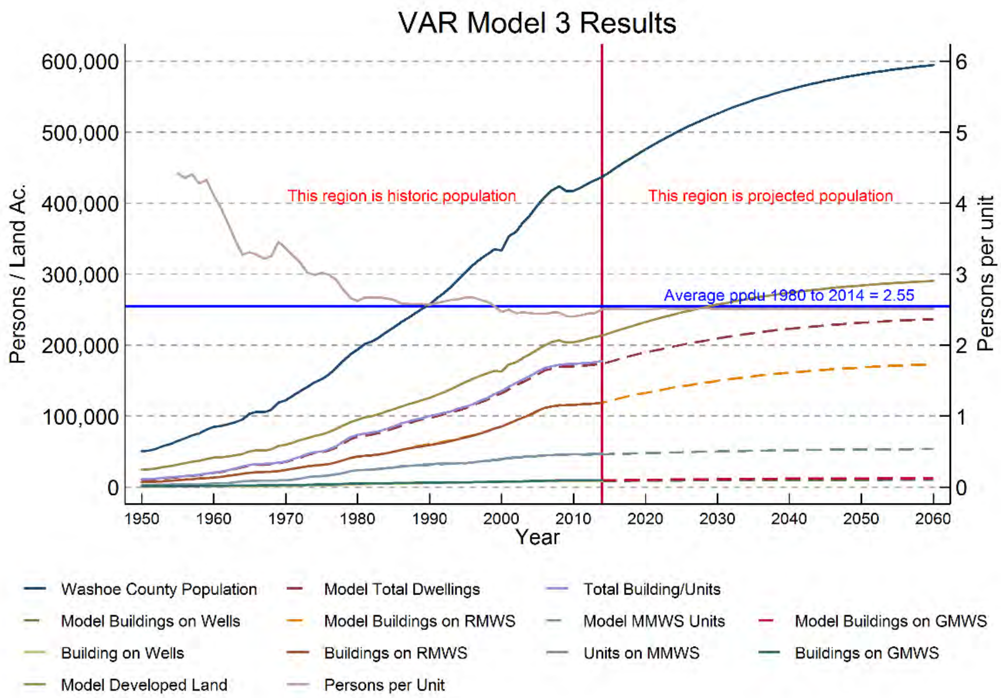

Figure 11: Results of Models 3 and 4.

The model 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 models 3 and 4 is included in Appendix C.

Appendix A: Statistical Output for Model 1.

Variables used:

- cdwell0
- cdwell1
- cdwell2
- population

Stata commands:

```
1. var  cdwell0 cdwell1 cdwell2 if tin(1980,2014), lags(1/4) exog(population)
2. varlmar, mlag(5)
3. varstable
```

```
. var  cdwell0 cdwell1 cdwell2 if tin(1980,2014), lags(1/4) exog(population);


Vector autoregression

Sample:  1980 - 2014                              Number of obs     =        35
Log likelihood =  -649.7748                       AIC               =  39.52999
FPE            =   3.40e+13                       HQIC              =  40.17427
Det(Sigma_ml)  =   2.68e+12                       SBIC              =  41.39641

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
cdwell0              14     22.2495   0.9999    239089   0.0000
cdwell1              14     491.143   0.9998   170769.2   0.0000
cdwell2              14     332.303   0.9988   30055.63   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
cdwell0      |
     cdwell0 |
         L1. |   1.078319   .1471932     7.33   0.000     .7898258    1.366812
         L2. |  -.0317921   .2467712    -0.13   0.897    -.5154548    .4518706
         L3. |  -.2750804   .1716857    -1.60   0.109    -.6115782    .0614174
         L4. |   .1559313   .0782609     1.99   0.046     .0025427    .3093199
             |
     cdwell1 |
         L1. |   .0025842   .0077737     0.33   0.740    -.0126519    .0178203
         L2. |  -.0001537   .0133747    -0.01   0.991    -.0263676    .0260603
         L3. |  -.0101541   .0134363    -0.76   0.450    -.0364887    .0161805
         L4. |   .0004115   .0061814     0.07   0.947    -.0117039    .0125269
             |
     cdwell2 |
         L1. |    .012974   .0089008     1.46   0.145    -.0044712    .0304192
         L2. |  -.0110775   .0100011    -1.11   0.268    -.0306793    .0085243
         L3. |   .0097696   .0102326     0.95   0.340    -.0102859    .0298251
         L4. |   .0045926   .0077428     0.59   0.553    -.0105831    .0197683
             |
  population |   .0015695   .0011481     1.37   0.172    -.0006807    .0038197
       _cons |   35.58218    91.5261     0.39   0.697    -143.8057      214.97
-------------+----------------------------------------------------------------
```

```
cdwell1      |
     cdwell0 |
         L1. |  -7.419519   3.249183    -2.28   0.022     -13.7878   -1.051238
         L2. |   7.878678   5.447297     1.45   0.148    -2.797828    18.55518
         L3. |  -6.413637   3.789839    -1.69   0.091    -13.84158    1.014311
         L4. |   4.011426   1.727554     2.32   0.020      .625483    7.397369
             |
     cdwell1 |
         L1. |   1.590175   .1715981     9.27   0.000     1.253849    1.926501
         L2. |   -1.29197   .2952371    -4.38   0.000    -1.870624   -.7133161
         L3. |   .7193505   .2965961     2.43   0.015     .1380328    1.300668
         L4. |   -.287041   .1364509    -2.10   0.035    -.5544798   -.0196021
             |
     cdwell2 |
         L1. |   .2396577   .1964782     1.22   0.223    -.1454325    .6247479
         L2. |   .3964238   .2207676     1.80   0.073    -.0362728    .8291204
         L3. |  -.1885468    .225877    -0.83   0.404    -.6312576    .2541639
         L4. |  -.2599827   .1709175    -1.52   0.128    -.5949749    .0750094
             |
  population |   .1040675   .0253427     4.11   0.000     .0543968    .1537382
       _cons |   -5485.95   2020.373    -2.72   0.007    -9445.808   -1526.091
-------------+----------------------------------------------------------------
cdwell2      |
     cdwell0 |
         L1. |  -6.311204   2.198374    -2.87   0.004    -10.61994   -2.002471
         L2. |   13.32098   3.685602     3.61   0.000     6.097332    20.54463
         L3. |  -14.33884   2.564178    -5.59   0.000    -19.36454   -9.313149
         L4. |    8.38945    1.16885     7.18   0.000     6.098545    10.68035
             |
     cdwell1 |
         L1. |   .1099244    .116102     0.95   0.344    -.1176313    .3374802
         L2. |  -.1678668   .1997553    -0.84   0.401      -.55938    .2236464
         L3. |    .264159   .2006748     1.32   0.188    -.1291563    .6574744
         L4. |  -.2052309   .0923217    -2.22   0.026    -.3861781   -.0242837
             |
     cdwell2 |
         L1. |   .8400319   .1329357     6.32   0.000     .5794827    1.100581
         L2. |   .1644702   .1493698     1.10   0.271    -.1282892    .4572296
         L3. |  -.2381601   .1528267    -1.56   0.119     -.537695    .0613749
         L4. |  -.1604853   .1156415    -1.39   0.165    -.3871386    .0661679
             |
  population |   .0107912   .0171467     0.63   0.529    -.0228156    .0443981
       _cons |   4968.228    1366.97     3.63   0.000     2289.017    7647.439
------------------------------------------------------------------------------

. /* test for autocorrelation                                                 */;
. varlmar, mlag(5);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   15.7684     9     0.07188   |
  |   2  |    6.5602     9     0.68280   |
  |   3  |    8.6257     9     0.47251   |
  |   4  |    8.0047     9     0.53367   |
  |   5  |    4.4081     9     0.88256   |
  +--------------------------------------+
   H0: no autocorrelation at lag order


There is autocorrelation found at lag 1
. varstable;
```

Eigenvalue stability condition

Eigenvalue		Modulus
1.007817		1.00782
.8685095 +	.3757166i	.946294
.8685095 -	.3757166i	.946294
.3596037 +	.673815i	.763768
.3596037 -	.673815i	.763768
.6369474 +	.3876514i	.745638
.6369474 -	.3876514i	.745638
-.4623924 +	.4366802i	.636
-.4623924 -	.4366802i	.636
-.00243245 +	.3939851i	.393993
-.00243245 -	.3939851i	.393993
-.2997625		.299763

At least one eigenvalue is at least 1.0.
VAR does not satisfy stability condition.

Appendix B: Model 2 Estimation Results

```
. var d1cdwell0 d1cdwell1 d1cdwell2 if tin(1979,2014),
>     lags(1 2 3) exog( d1pop L3.d1pop ) noconstant;

Vector autoregression

Sample:  1979 - 2014                              Number of obs     =        36
Log likelihood =  -706.0762                       AIC               =  41.05979
FPE            =   1.45e+14                       HQIC              =  41.56642
Det(Sigma_ml)  =   2.18e+13                       SBIC              =  42.51135

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
d1cdwell0            11     33.2177   0.9687   1113.525   0.0000
d1cdwell1            11     563.631   0.9672   1060.375   0.0000
d1cdwell2            11     493.333   0.8197   163.6727   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1cdwell0    |
   d1cdwell0 |
         L1. |   .8336061   .1123906     7.42   0.000     .6133246    1.053888
         L2. |  -.3864635   .1457355    -2.65   0.008    -.6720998   -.1008271
         L3. |   .1219205   .1002136     1.22   0.224    -.0744946    .3183356
             |
   d1cdwell1 |
         L1. |   .0026101   .0096279     0.27   0.786    -.0162603    .0214805
         L2. |  -.0032765   .0131974    -0.25   0.804    -.0291428    .0225899
         L3. |  -.0116734   .0094168    -1.24   0.215      -.03013    .0067833
             |
   d1cdwell2 |
         L1. |   .0164624   .0121691     1.35   0.176    -.0073885    .0403133
         L2. |  -.0078004   .0108819    -0.72   0.473    -.0291284    .0135277
         L3. |    .013668   .0103259     1.32   0.186    -.0065703    .0339063
             |
       d1pop |
         --. |   .0051843   .0014062     3.69   0.000     .0024282    .0079405
         L3. |   .0033337   .0014454     2.31   0.021     .0005007    .0061667
-------------+----------------------------------------------------------------
d1cdwell1    |
   d1cdwell0 |
         L1. |   .7021808    1.90702     0.37   0.713     -3.03551    4.439872
         L2. |  -2.630972    2.47281    -1.06   0.287    -7.477591    2.215646
         L3. |  -2.158563   1.700405    -1.27   0.204    -5.491295    1.174169
             |
   d1cdwell1 |
         L1. |   .9212032   .1633647     5.64   0.000     .6010144    1.241392
         L2. |  -.5880104   .2239302    -2.63   0.009    -1.026906   -.1491152
         L3. |   .2278987   .1597828     1.43   0.154    -.0852697    .5410672
             |
   d1cdwell2 |
         L1. |   .2046417    .206482     0.99   0.322    -.2000556    .6093389
         L2. |     .31407   .1846412     1.70   0.089    -.0478201    .6759601
         L3. |   .1210757    .175207     0.69   0.490    -.2223237    .4644751
             |
       d1pop |
         --. |   .1151728   .0238604     4.83   0.000     .0684072    .1619384
         L3. |     .03953   .0245257     1.61   0.107    -.0085395    .0875995
```

```
-------------+----------------------------------------------------------------
d1cdwell2    |
   d1cdwell0 |
         L1. |   1.170182    1.66917     0.70   0.483    -2.101332    4.441696
         L2. |   2.968292   2.164393     1.37   0.170    -1.273841    7.210424
         L3. |  -4.502716   1.488324    -3.03   0.002    -7.419778   -1.585653
             |
   d1cdwell1 |
         L1. |   .0225646   .1429893     0.16   0.875    -.2576893    .3028184
         L2. |  -.2240753   .1960009    -1.14   0.253    -.6082301    .1600794
         L3. |    .098917   .1398541     0.71   0.479    -.1751921     .373026
             |
   d1cdwell2 |
         L1. |    .199871   .1807289     1.11   0.269    -.1543511    .5540931
         L2. |   .2957038   .1616121     1.83   0.067    -.0210502    .6124577
         L3. |   .1141029   .1533546     0.74   0.457    -.1864665    .4146724
             |
       d1pop |
         --. |   .0397847   .0208845     1.90   0.057    -.0011481    .0807175
         L3. |   .0372385   .0214668     1.73   0.083    -.0048356    .0793126
------------------------------------------------------------------------------

. /* that model is stable */;

varstable;

   Eigenvalue stability condition
  +----------------------------------------+
  |        Eigenvalue         |   Modulus   |
  |--------------------------+-------------|
  |   .8479512                |   .847951   |
  |   .3430737 +  .5821517i   |   .675722   |
  |   .3430737 -  .5821517i   |   .675722   |
  |   .6001586 +  .2736383i   |   .659597   |
  |   .6001586 -  .2736383i   |   .659597   |
  |  -.4120117 +  .4176205i   |   .586652   |
  |  -.4120117 -  .4176205i   |   .586652   |
  |   .0221439 +    .52989i   |   .530353   |
  |   .0221439 -    .52989i   |   .530353   |
  +----------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.

. /* lag selection */;
. varsoc, maxlag(5) exog(d1pop L3.d1pop);

   Selection-order criteria
   Sample:  1979 - 2014                         Number of obs      =        36
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -773.508                        1.3e+15   43.306   43.3981   43.5699  |
  |  1 | -723.493  100.03    9  0.000  1.3e+14*  41.0274*  41.2577*  41.6872* |
  |  2 | -714.853  17.281    9  0.044  1.4e+14   41.0474   41.4158    42.103  |
  |  3 | -706.076  17.553*   9  0.041  1.4e+14   41.0598   41.5664   42.5113  |
  |  4 | -700.077  11.999    9  0.213  1.8e+14   41.2265   41.8713   43.0739  |
  |  5 | -694.984  10.185    9  0.336  2.6e+14   41.4436   42.2265   43.6869  |
  +---------------------------------------------------------------------------+
   Endogenous:  d1cdwell0 d1cdwell1 d1cdwell2
    Exogenous:  d1pop L3.d1pop

. /* test for autocorrelation */;
. varlmar, mlag(5);
```

```
   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   11.8730     9     0.22056   |
  |   2  |   11.1370     9     0.26643   |
  |   3  |    8.3157     9     0.50267   |
  |   4  |    3.5692     9     0.93742   |
  |   5  |    3.7157     9     0.92911   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. /* test for normality in the residuals */;
. varnorm, jbera;

   Jarque-Bera test
  +-------------------------------------------------------+
  |           Equation |            chi2   df  Prob > chi2 |
  |--------------------+----------------------------------|
  |          d1cdwell0 |           1.082   2    0.58225   |
  |          d1cdwell1 |           0.225   2    0.89365   |
  |          d1cdwell2 |           0.351   2    0.83900   |
  |                ALL |           1.658   6    0.94834   |
  +-------------------------------------------------------+

. /* test that lags are significant */;
. varwle;

   Equation: d1cdwell0
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  81.16623     3     0.000    |
  |   2 |  9.603486     3     0.022    |
  |   3 |  4.318308     3     0.229    |
  +------------------------------------+

   Equation: d1cdwell1
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  61.71784     3     0.000    |
  |   2 |   11.5781     3     0.009    |
  |   3 |   3.84709     3     0.278    |
  +------------------------------------+

   Equation: d1cdwell2
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  3.431322     3     0.330    |
  |   2 |  4.838764     3     0.184    |
  |   3 |  9.199165     3     0.027    |
  +------------------------------------+

   Equation: All
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |   133.987     9     0.000    |
  |   2 |  27.02197     9     0.001    |
  |   3 |  20.33796     9     0.016    |
```

```
  +-------------------------------------+

. /* Granger causality test */;
. vargranger;

   Granger causality Wald tests
  +------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+---------------------------|
  |         d1cdwell0          d1cdwell1 |  5.7876     3    0.122    |
  |         d1cdwell0          d1cdwell2 |   3.906     3    0.272    |
  |         d1cdwell0                ALL |   9.492     6    0.148    |
  |--------------------------------------+---------------------------|
  |         d1cdwell1          d1cdwell0 |  9.2175     3    0.027    |
  |         d1cdwell1          d1cdwell2 |  5.2781     3    0.153    |
  |         d1cdwell1                ALL |  10.224     6    0.116    |
  |--------------------------------------+---------------------------|
  |         d1cdwell2          d1cdwell0 |  15.095     3    0.002    |
  |         d1cdwell2          d1cdwell1 |  2.3408     3    0.505    |
  |         d1cdwell2                ALL |  19.868     6    0.003    |
  +------------------------------------------------------------------+
```

Appendix C: Models 3 and 4 Estimation Results

```
. var d1build0 d1build1 d1cdwell2 d1build4 if tin(1979,2014),
>     lags(1 2 3 4 5)
>     exog(d1pop L1.d1pop L2.d1pop L3.d1pop l4.d1pop)
>     noconstant;

Vector autoregression

Sample:  1979 - 2014                              Number of obs     =        36
Log likelihood =  -807.7143                       AIC               =  50.42857
FPE            =   3.42e+17                       HQIC              =  51.96382
Det(Sigma_ml)  =   3.62e+14                       SBIC              =  54.82723

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
d1build0             25     27.088   0.9916   4264.812   0.0000
d1build1             25    569.135   0.9852   2402.234   0.0000
d1cdwell2            25    499.769   0.9186     406.19   0.0000
d1build4             25    29.6007   0.9891   3272.902   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d1build0     |
    d1build0 |
         L1. |   .5941005   .1468572     4.05   0.000     .3062657    .8819352
         L2. |   .0977356   .1734473     0.56   0.573    -.2422149    .4376861
         L3. |   .1869275   .1929796     0.97   0.333    -.1913055    .5651606
         L4. |  -.6249921   .2029267    -3.08   0.002    -1.022721   -.2272631
         L5. |   .5119232   .1300753     3.94   0.000     .2569803    .7668661
             |
    d1build1 |
         L1. |  -.0028178   .0083646    -0.34   0.736    -.0192121    .0135765
         L2. |   .0134421   .0102205     1.32   0.188    -.0065897    .0334739
         L3. |  -.0119531   .0114881    -1.04   0.298    -.0344694    .0105633
         L4. |   .0133259    .013646     0.98   0.329    -.0134198    .0400717
         L5. |  -.0142157   .0080656    -1.76   0.078    -.0300239    .0015926
             |
   d1cdwell2 |
         L1. |   .0103977   .0086295     1.20   0.228    -.0065158    .0273111
         L2. |   .0088104   .0089421     0.99   0.324    -.0087157    .0263366
         L3. |    .004399   .0096782     0.45   0.649    -.0145699    .0233678
         L4. |   .0009963   .0103592     0.10   0.923    -.0193074    .0212999
         L5. |   .0017667   .0080727     0.22   0.827    -.0140554    .0175888
             |
    d1build4 |
         L1. |   .0178609    .054243     0.33   0.742    -.0884535    .1241752
         L2. |  -.3163983   .0551551    -5.74   0.000    -.4245004   -.2082963
         L3. |  -.0947074   .0686035    -1.38   0.167    -.2291678     .039753
         L4. |   .2109803   .0555655     3.80   0.000     .1020739    .3198867
         L5. |   -.084773   .0581754    -1.46   0.145    -.1987947    .0292487
             |
       d1pop |
         --. |   .0036275   .0013117     2.77   0.006     .0010566    .0061984
         L1. |  -.0007272   .0013539    -0.54   0.591    -.0033808    .0019265
         L2. |    .001018   .0011559     0.88   0.379    -.0012476    .0032836
         L3. |   .0028659   .0013041     2.20   0.028     .0003098     .005422
         L4. |  -.0004465   .0012976    -0.34   0.731    -.0029897    .0020967
-------------+----------------------------------------------------------------
d1build1     |
```

d1build0						
L1.	-8.141603	3.085558	-2.64	0.008	-14.18919	-2.09402
L2.	7.283505	3.644233	2.00	0.046	.1409398	14.42607
L3.	-6.662869	4.054618	-1.64	0.100	-14.60977	1.284036
L4.	-.8950379	4.263612	-0.21	0.834	-9.251564	7.461489
L5.	2.182606	2.732961	0.80	0.425	-3.173898	7.539111
d1build1						
L1.	.8846254	.1757454	5.03	0.000	.5401707	1.22908
L2.	-.6406204	.2147388	-2.98	0.003	-1.061501	-.2197401
L3.	.3803938	.2413725	1.58	0.115	-.0926877	.8534752
L4.	-.118682	.2867116	-0.41	0.679	-.6806265	.4432624
L5.	-.0758752	.1694627	-0.45	0.654	-.4080161	.2562656
d1cdwell2						
L1.	.2586554	.1813104	1.43	0.154	-.0967065	.6140172
L2.	.8026186	.1878783	4.27	0.000	.4343839	1.170853
L3.	.0256669	.2033443	0.13	0.900	-.3728806	.4242143
L4.	.2866401	.2176531	1.32	0.188	-.1399522	.7132324
L5.	-.0807196	.1696113	-0.48	0.634	-.4131517	.2517125
d1build4						
L1.	2.12417	1.139679	1.86	0.062	-.1095595	4.357899
L2.	-4.240287	1.158842	-3.66	0.000	-6.511576	-1.968998
L3.	-2.087136	1.441401	-1.45	0.148	-4.91223	.7379587
L4.	-.7124648	1.167465	-0.61	0.542	-3.000655	1.575725
L5.	-.0068534	1.222301	-0.01	0.996	-2.402519	2.388812
d1pop						
--.	.0860509	.0275594	3.12	0.002	.0320354	.1400664
L1.	.0467117	.0284469	1.64	0.101	-.0090432	.1024667
L2.	.0089418	.0242871	0.37	0.713	-.03866	.0565436
L3.	.0727159	.0274009	2.65	0.008	.0190112	.1264206
L4.	.0558441	.027263	2.05	0.041	.0024097	.1092785
d1cdwell2						
d1build0						
L1.	-5.011775	2.70949	-1.85	0.064	-10.32228	.2987284
L2.	11.16452	3.200074	3.49	0.000	4.892494	17.43655
L3.	-8.523174	3.560441	-2.39	0.017	-15.50151	-1.544838
L4.	3.434697	3.743963	0.92	0.359	-3.903336	10.77273
L5.	3.468661	2.399868	1.45	0.148	-1.234993	8.172314
d1build1						
L1.	.3000806	.1543256	1.94	0.052	-.002392	.6025531
L2.	-.3041549	.1885664	-1.61	0.107	-.6737383	.0654285
L3.	.6668568	.211954	3.15	0.002	.2514345	1.082279
L4.	-.4156555	.2517672	-1.65	0.099	-.9091101	.0777991
L5.	.0293241	.1488086	0.20	0.844	-.2623354	.3209836
d1cdwell2						
L1.	.2027929	.1592123	1.27	0.203	-.1092574	.5148432
L2.	.3880183	.1649797	2.35	0.019	.0646641	.7113725
L3.	-.344873	.1785607	-1.93	0.053	-.6948455	.0050994
L4.	-.1769812	.1911256	-0.93	0.354	-.5515805	.197618
L5.	-.114859	.1489391	-0.77	0.441	-.4067743	.1770563
d1build4						
L1.	1.588567	1.000775	1.59	0.112	-.3729156	3.550049
L2.	-1.847792	1.017603	-1.82	0.069	-3.842257	.1466721
L3.	-.4151842	1.265723	-0.33	0.743	-2.895956	2.065587
L4.	-1.136777	1.025175	-1.11	0.267	-3.146083	.872528
L5.	1.275034	1.073327	1.19	0.235	-.8286475	3.378716

```
             |
       d1pop |
         --. |     -.0065   .0242005    -0.27   0.788    -.0539321    .0409321
         L1. |  -.0338317   .0249798    -1.35   0.176    -.0827912    .0151278
         L2. |  -.0162485    .021327    -0.76   0.446    -.0580486    .0255516
         L3. |  -.0036758   .0240613    -0.15   0.879     -.050835    .0434834
         L4. |  -.0199645   .0239401    -0.83   0.404    -.0668863    .0269573
-------------+----------------------------------------------------------------
d1build4     |
    d1build0 |
         L1. |  -1.001085   .1604797    -6.24   0.000    -1.315619   -.6865502
         L2. |   .9230398   .1895363     4.87   0.000     .5515554    1.294524
         L3. |  -.0932834   .2108804    -0.44   0.658    -.5066014    .3200346
         L4. |   .1497549   .2217502     0.68   0.499    -.2848675    .5843772
         L5. |  -.2013494   .1421411    -1.42   0.157    -.4799409     .077242
             |
    d1build1 |
         L1. |   .0455232   .0091405     4.98   0.000     .0276082    .0634383
         L2. |   .0059296   .0111685     0.53   0.595    -.0159604    .0278195
         L3. |   .0173929   .0125538     1.39   0.166    -.0072121    .0419978
         L4. |  -.0344817   .0149119    -2.31   0.021    -.0637084    -.005255
         L5. |   .0030601   .0088137     0.35   0.728    -.0142145    .0203348
             |
   d1cdwell2 |
         L1. |  -.0037205   .0094299    -0.39   0.693    -.0222028    .0147619
         L2. |   .0352696   .0097715     3.61   0.000     .0161178    .0544215
         L3. |  -.0253628   .0105759    -2.40   0.016    -.0460912   -.0046344
         L4. |   .0360503   .0113201     3.18   0.001     .0138633    .0582373
         L5. |   .0359599   .0088215     4.08   0.000     .0186702    .0532497
             |
    d1build4 |
         L1. |   .2025828   .0592746     3.42   0.001     .0864067    .3187589
         L2. |  -.1640768   .0602713    -2.72   0.006    -.2822064   -.0459472
         L3. |   -.367475   .0749672    -4.90   0.000    -.5144079    -.220542
         L4. |  -.1970927   .0607198    -3.25   0.001    -.3161013   -.0780841
         L5. |   .2345407   .0635718     3.69   0.000     .1099423    .3591391
             |
       d1pop |
         --. |  -.0033581   .0014334    -2.34   0.019    -.0061675   -.0005488
         L1. |   .0010993   .0014795     0.74   0.457    -.0018006    .0039991
         L2. |   .0010016   .0012632     0.79   0.428    -.0014741    .0034774
         L3. |    .005465   .0014251     3.83   0.000     .0026718    .0082582
         L4. |   .0035323   .0014179     2.49   0.013     .0007531    .0063114
------------------------------------------------------------------------------

. varstable ;

   Eigenvalue stability condition
  +----------------------------------------+
  |        Eigenvalue        |   Modulus   |
  |--------------------------+-------------|
  |  -.6851594 +  .7159409i  |   .990967   |
  |  -.6851594 -  .7159409i  |   .990967   |
  |   .5520444 +  .7591526i  |   .938651   |
  |   .5520444 -  .7591526i  |   .938651   |
  |   .9137428               |   .913743   |
  |   .8196103 +  .3065398i  |   .875059   |
  |   .8196103 -  .3065398i  |   .875059   |
  |   .5315896 +  .6228696i  |   .818874   |
  |   .5315896 -  .6228696i  |   .818874   |
  |  -.7258782 +   .305657i  |   .787607   |
  |  -.7258782 -   .305657i  |   .787607   |
  |   -.264619 +  .6902049i  |   .739193   |
```

```
  |   -.264619 -  .6902049i  |   .739193   |
  |  .02126862 +  .6967377i  |   .697062   |
  |  .02126862 -  .6967377i  |   .697062   |
  |   .4387303 +  .4001748i  |   .593822   |
  |   .4387303 -  .4001748i  |   .593822   |
  |  -.4444522 +  .2304609i  |    .50065   |
  |  -.4444522 -  .2304609i  |    .50065   |
  |   .4840899               |    .48409   |
  +-----------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.

.         varlmar, mlag(6);

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   15.6094    16     0.48054   |
  |   2  |   20.4841    16     0.19920   |
  |   3  |   19.4348    16     0.24676   |
  |   4  |   14.6698    16     0.54894   |
  |   5  |   21.6999    16     0.15315   |
  |   6  |   13.0215    16     0.67119   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varsoc, maxlag(6) exog(d1pop L1.d1pop L2.d1pop L3.d1pop l4.d1pop);

   Selection-order criteria
   Sample:  1979 - 2014                         Number of obs      =        36
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -944.937                      2.3e+18   53.6076   53.9147   54.4874  |
  |  1 | -891.871  106.13   16  0.000  3.0e+17   51.5484   52.1011   53.1319* |
  |  2 | -870.038  43.667   16  0.000  2.4e+17*  51.2243   52.0227   53.5116  |
  |  3 | -856.392  27.292   16  0.038  3.3e+17   51.3551   52.3991   54.3462  |
  |  4 | -830.126  52.532   16  0.000  2.6e+17   50.7848   52.0744   54.4796  |
  |  5 | -807.714  44.823   16  0.000  3.4e+17   50.4286   51.9638   54.8272  |
  |  6 | -766.212  83.004*  16  0.000  2.7e+17   49.0118*  50.7927*  54.1142  |
  +---------------------------------------------------------------------------+
   Endogenous:  d1build0 d1build1 d1cdwell2 d1build4
    Exogenous:  d1pop L.d1pop L2.d1pop L3.d1pop L4.d1pop

. varnorm, jbera;

   Jarque-Bera test
  +--------------------------------------------------------+
  |           Equation |           chi2   df  Prob > chi2 |
  |--------------------+-----------------------------------|
  |           d1build0 |          0.230   2    0.89139    |
  |           d1build1 |          1.226   2    0.54183    |
  |          d1cdwell2 |          7.239   2    0.02679    |
  |           d1build4 |          1.499   2    0.47265    |
  |                ALL |         10.193   8    0.25171    |
  +--------------------------------------------------------+

. varwle;

   Equation: d1build0
  +--------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
```

```
  |-----+----------------------------------|
  |   1 |  34.24709     4     0.000    |
  |   2 |   51.3959     4     0.000    |
  |   3 |  2.791147     4     0.593    |
  |   4 |  22.95005     4     0.000    |
  |   5 |   18.1731     4     0.001    |
  +------------------------------------+

   Equation: d1build1
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  50.01865     4     0.000    |
  |   2 |  45.19877     4     0.000    |
  |   3 |  11.46389     4     0.022    |
  |   4 |  4.116811     4     0.390    |
  |   5 |   1.07002     4     0.899    |
  +------------------------------------+

   Equation: d1cdwell2
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  14.17138     4     0.007    |
  |   2 |  18.42308     4     0.001    |
  |   3 |  12.66918     4     0.013    |
  |   4 |  9.681341     4     0.046    |
  |   5 |  12.37026     4     0.015    |
  +------------------------------------+

   Equation: d1build4
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  68.26491     4     0.000    |
  |   2 |  42.15841     4     0.000    |
  |   3 |  32.60828     4     0.000    |
  |   4 |  26.45316     4     0.000    |
  |   5 |  25.49967     4     0.000    |
  +------------------------------------+

   Equation: All
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  132.6547    16     0.000    |
  |   2 |  147.0807    16     0.000    |
  |   3 |  56.72874    16     0.000    |
  |   4 |  70.24753    16     0.000    |
  |   5 |   57.6402    16     0.000    |
  +------------------------------------+

. vargranger;

   Granger causality Wald tests
  +------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+---------------------------|
  |          d1build0           d1build1 |  4.0736     5    0.539    |
  |          d1build0          d1cdwell2 |  3.0537     5    0.692    |
  |          d1build0           d1build4 |  57.625     5    0.000    |
  |          d1build0                ALL |  85.545    15    0.000    |
  |--------------------------------------+---------------------------|
```

```
  |          d1build1          d1build0 |  25.799     5    0.000    |
  |          d1build1         d1cdwell2 |  24.265     5    0.000    |
  |          d1build1          d1build4 |  22.895     5    0.000    |
  |          d1build1               ALL |  63.864    15    0.000    |
  |-------------------------------------+--------------------------|
  |         d1cdwell2          d1build0 |  35.863     5    0.000    |
  |         d1cdwell2          d1build1 |  12.107     5    0.033    |
  |         d1cdwell2          d1build4 |  13.364     5    0.020    |
  |         d1cdwell2               ALL |  72.749    15    0.000    |
  |-------------------------------------+--------------------------|
  |          d1build4          d1build0 |  44.786     5    0.000    |
  |          d1build4          d1build1 |  41.118     5    0.000    |
  |          d1build4         d1cdwell2 |  47.347     5    0.000    |
  |          d1build4               ALL |     142    15    0.000    |
  +----------------------------------------------------------------+

. /**************************************************************************/;
. /* Model 4 is created to provide an estimate of land development as f(pop)   */;
. /**************************************************************************/;
. regress cdevland population, noconstant;

      Source |       SS           df       MS      Number of obs   =        65
-------------+----------------------------------   F(1, 64)        =  18653.52
       Model |  9.9772e+11         1  9.9772e+11   Prob > F        =    0.0000
    Residual |  3.4232e+09        64  53486805.3   R-squared       =    0.9966
-------------+----------------------------------   Adj R-squared   =    0.9965
       Total |  1.0011e+12        65  1.5402e+10   Root MSE        =    7313.5

------------------------------------------------------------------------------
    cdevland |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  population |   .4886699    .003578   136.58   0.000     .4815221    .4958177
------------------------------------------------------------------------------
```

APPENDIX 4-3

TPEM Series No. 3: TMWA Water Demand Projections

TRUCKEE MEADOWS WATER
AUTHORITY
www.tmh2o.com

Memorandum

1355 Capital Blvd. • PO Box 30013 • Reno, NV 89520-3013
775.834.8080 • 775.834.8003

TO: File

FROM: **Laine Christman, Resource Economist**

DATE: Sept., 29, 2015

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

SUMMARY

- Water demand projections for TMWA's Retail Service are estimated from 2015 to 2060 and are broken out by hydrographic basin.
- Water demand projections are a function of current active services, average water demand, and future building projections.
- Total demand for water is expected to increase from approximately 81,700 acre feet in 2015 to 101,400 by 2035.
- Residential Metered Water Services ("RMWS") account for approximately 95 percent of single-family unit counts.
- Multi-family Metered Water Services ("MMWS") account for approximately 95 percent of multi-family unit counts.
- General Metered Water Services ("GMWS") account for approximately 75 percent of commercial building counts.
- RMWS and MMWS account for approximately 57.9 and 7.4 percent of the total projected demand, respectively, through 2035.
- Water demand by RMWS is expected to increase by 2 percent by 2035.
- MMWS, GMWS, and MIS water demands are expected to decrease by 1 percent by 2035.
- Figure 1 illustrates water demands between 2015 and 2060
- Table 1 provides water demands, between 2015 and 2060 for the entire TMWA service area
- Table 2 breaks out total water demands projections for hydrographic basins in the Truckee River Resource Area (TRA) and non-TRA basins.
- Table 3 breaks out water demand projections by service type of each hydrographic basin.

DISCUSSION

TPEM memo no. 1 provides a population projection for Washoe County. Memo no. 1's projections are used in memo no. 2 with the Washoe County Assessors data to model building construction and create projections 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 no. 1 and 2, combined with the recent active billing histories to 1) project new retail water services; 2) estimate annual water use per water service; and 3) project water demand through the year 2060.

Data for projecting water services

The data used to project the water demands include service connection data, billing history data, assessor information, and future building projections.

Active Service Counts - data on the location (i.e., hydrographic basin) of each service connection is merged with billing history data to identify active services for each basin, between 2003 and 2014. Table 4 provides the active service counts within each basin in TMWA's service area.

Active Service Ratios – The number of dwellings/buildings within each hydrographic basin is merged with active service information. The associated tax assessor information on the building attributes is also merged with MMWS to capture the number of units within each multi-family service. Since MMWS provide water to more than one dwelling unit, this information is used to determine the average number of units multi-family water connections serve. Since the number of active water services is generally less than total number of buildings, a percentage of active service, based on previous services, is calculate. This information allows the projection of future active service for residential metered services, multi-family dwelling units, and general metered water services. Table 5 provides the service ratios by year and Table provides the service ratios by basin.

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. Since it is assumed no MIS would result if no GMWS or MMWS services exist, the intercept is suppressed in each model. The regression output for all three models can be found in Table 7. Table 4 provides the MIS projections by basin.

Demand Coefficients - using the billing history information on active services, average water demand coefficients are calculates by taking the average, per-service, water usage between 2009 and 2014. Water usage prior to 2009 is not considered in this calculation, since pre-2009 there were higher levels of flat-rate customers. Moreover, water usage, in general, has been on the decline in the last ten years. Therefore, water usage in 2009 forward more accurately reflects future water consumption.

Active Service Projections – active service projections are estimate by multiplying building projections and ratios. Table 8 provides the individual service projections for TMWA's service area. Tables 9.1 – 9.8 provide the projections within each basin.

Water Demand Projections – future demands are estimated by multiplying the water demand coefficients by their associated service projections within each respective basin. Table 1 provides the water demand projections for each of the following metered services: RMWS, MMWS, GMWS, and MIS. Table 2 provides the total demand projections for each basin within the TRA and non-TRA areas. Tables 3.1 – 3.8 provide the projections, per service type, for each basin within TMWA service area.

Estimating Water Use Projections by Service Type

RMWS Projection Steps:

1. Identify active service counts in each year, 2003 to 2014, for each basin.
2. Calculate an active service ratio equal to (active services/total number of RMWS dwellings) in each year, 2003 to 2014, for each basin.
3. Calculate the average active service ratio across years for each basin.
4. Estimate a water demand coefficient equal to the average annual use, 'per RMWS service', for each year, 2009 to 2014, for each basin.
5. Calculate the average of the annual water demand coefficients within the five years for each basin.
6. Estimate the annual number of active service projections as equal to (average active service ratio * building projects) for each basin for 2015 through 2060.
7. For each basin, estimate projections on annual water use for 2015 through 2060 as equal to (average water demand coefficient * service projections).

MMWS Projection Steps:

1. Identify active service counts between 2003 and 2014 for each basin.
2. Calculate a active service ratio equal to [active services / (total number of MMWS dwellings/average number of units)] for each year, 2003 to 2014, for each basin.
3. Calculate the average active service ratio across years for each basin.
4. Estimate water demand coefficient as the average annual use, 'per MMWS service', for each year, 2009 to 2014, for each basin.
5. Calculate the average of the water demand coefficients within the five years.
6. Estimate the annual number of active service projections as equal to (average active service ratio * building projects) for each basin for 2015 through 2060.
7. For each basin, estimate projections on annual water use for 2015 through 2060 as equal to (average water demand coefficient * service projections).

GMWS Projection Steps:

1. Identify active service counts in each year, 2003 to 2014, for each basin.
2. Calculate an active service ratio equal to (active services/total number of GMWS dwellings) in each year, 2003 to 2014, for each basin.
3. Calculate the average active service ratio across years for each basin.

4. Estimate a water demand coefficient equal to the average annual use, ‘per GMWS service’, for each year, 2009 to 2014, for each basin.
5. Calculate the average of the annual water demand coefficients within the five years for each basin.
6. Estimate the annual number of active service projections as equal to (average active service ratio * building projects) for each basin for 2015 through 2060.
7. For each basin, estimate projections on annual water use for 2015 through 2060 as equal to (average water demand coefficient * service projections).

MIS Projection Steps:

1. Estimate the amount of MIS services as a function of GMWS and MMWS active services between 2003 and 2014 using an ordinary least square regression model.
2. Estimate a water demand coefficient as the average annual use, ‘per MIS service’, in each year, 2009 to 2014, within each basin.
3. For each basin, calculate the average water demand coefficient across the five years.
4. Estimate the annual number of active MIS service projections as equal to (0.323* number of active GMWS services) + (0.289 * number of active MMWS services) for each basin for 2015 through 2060.
5. For each basin, estimate projections on annual water use for 2015 through 2060 as equal to (average water demand coefficient * service projections).

Wholesale Water Service (LVS) Use Projection Steps:

1. Determine the annual water usage for LVS service in 2015
2. Assume use will increase till a demand of 4180 acre feet is achieved in 2060. This demand is the maximum possible under the water rights for this service.
3. Calculate percent increase in the demand, annually, until 2060.
4. Project water use between 2015 and 2060 as constant percentage increase until total demand is reached in 2060.

System Loss Projection Steps:

1. Sum all water demand projections (RMWS, MMWS, GMWS, MIS, LVS) on an annual basis.
2. Assume an average of 6% water loss.
3. Estimate water loss as equal to (total water demand * 0.06) between 2015 through 2060.

Total System Production Projection Steps:

1. Sum total water demand + system loss on an annual basis between 2015 through 2060.

Figure 1: TMWA Projected Water Demand (2015 to 2060)

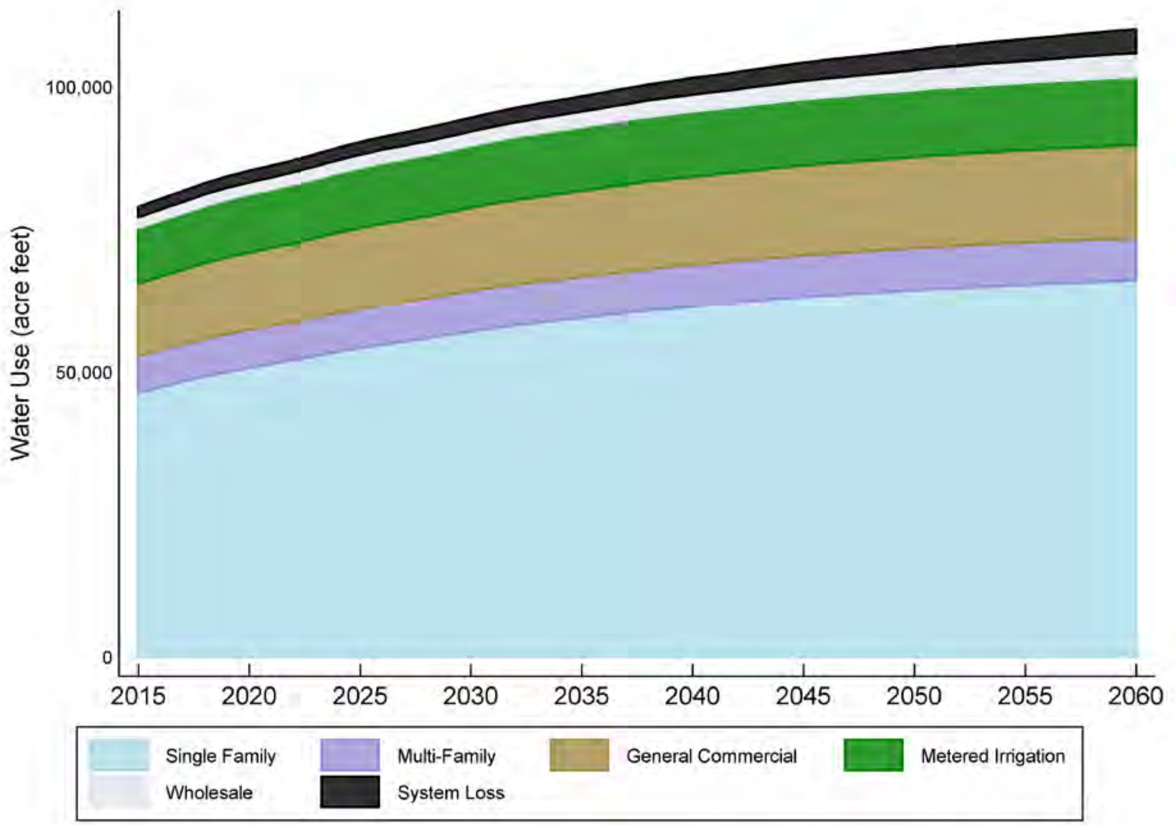

Table 1: Water Demand Projections for Truckee Meadows Service Area (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	LVS	Total Retail	System Loss	Total Production
2015	46,252	6,494	12,716	9,777	1,869	77,108	4,626	81,735
2016	47,332	6,523	12,864	9,860	1,903	78,481	4,709	83,190
2017	48,321	6,541	13,050	9,952	1,937	79,801	4,788	84,589
2018	49,165	6,617	13,277	10,101	1,972	81,131	4,868	85,999
2019	49,945	6,687	13,429	10,209	2,007	82,277	4,937	87,213
2020	50,674	6,730	13,527	10,283	2,043	83,259	4,996	88,254
2021	51,366	6,755	13,604	10,330	2,080	84,136	5,048	89,184
2022	52,074	6,755	13,707	10,374	2,118	85,028	5,102	90,129
2023	52,803	6,782	13,860	10,458	2,156	86,058	5,163	91,221
2024	53,537	6,829	14,026	10,563	2,195	87,150	5,229	92,379
2025	54,178	6,870	14,167	10,649	2,234	88,098	5,286	93,383
2026	54,747	6,924	14,275	10,726	2,274	88,947	5,337	94,283
2027	55,311	6,951	14,345	10,779	2,315	89,701	5,382	95,083
2028	55,886	6,962	14,420	10,814	2,357	90,440	5,426	95,866
2029	56,504	6,988	14,526	10,879	2,399	91,296	5,478	96,774
2030	57,118	7,013	14,651	10,947	2,443	92,172	5,530	97,703
2031	57,673	7,052	14,784	11,030	2,486	93,026	5,582	98,608
2032	58,175	7,099	14,888	11,108	2,531	93,802	5,628	99,431
2033	58,619	7,123	14,964	11,155	2,577	94,438	5,666	100,105
2034	59,049	7,147	15,027	11,196	2,623	95,042	5,703	100,745
2035	59,506	7,160	15,090	11,232	2,670	95,658	5,739	101,398
2036	59,959	7,168	15,175	11,274	2,718	96,294	5,778	102,072
2037	60,403	7,202	15,274	11,340	2,767	96,987	5,819	102,806
2038	60,807	7,228	15,360	11,392	2,817	97,603	5,856	103,459
2039	61,151	7,252	15,434	11,442	2,868	98,147	5,889	104,036
2040	61,482	7,277	15,488	11,484	2,920	98,652	5,919	104,571
2041	61,803	7,280	15,530	11,501	2,972	99,086	5,945	105,031
2042	62,134	7,295	15,588	11,533	3,026	99,576	5,975	105,550
2043	62,477	7,310	15,651	11,573	3,080	100,092	6,005	106,097
2044	62,787	7,322	15,721	11,608	3,135	100,574	6,034	106,608
2045	63,071	7,351	15,787	11,658	3,192	101,059	6,064	107,122
2046	63,330	7,367	15,830	11,686	3,249	101,462	6,088	107,549
2047	63,561	7,375	15,867	11,705	3,308	101,815	6,109	107,924
2048	63,806	7,389	15,907	11,736	3,367	102,204	6,132	108,337
2049	64,049	7,389	15,944	11,749	3,428	102,560	6,154	108,714
2050	64,284	7,404	15,998	11,782	3,490	102,957	6,177	109,135
2051	64,511	7,422	16,045	11,816	3,553	103,347	6,201	109,547
2052	64,703	7,430	16,083	11,838	3,616	103,671	6,220	109,891
2053	64,880	7,447	16,121	11,863	3,682	103,992	6,240	110,232
2054	65,056	7,452	16,142	11,876	3,748	104,274	6,256	110,531
2055	65,222	7,453	16,170	11,891	3,815	104,551	6,273	110,825
2056	65,398	7,467	16,205	11,915	3,884	104,869	6,292	111,162
2057	65,564	7,469	16,237	11,929	3,954	105,153	6,309	111,463
2058	65,709	7,480	16,271	11,948	4,025	105,433	6,326	111,759
2059	65,851	7,494	16,298	11,968	4,098	105,708	6,342	112,050
2060	65,972	7,494	16,316	11,979	4,171	105,933	6,356	112,289

Table 2: Total Demand (acre feet) per Hydrographic Basin (2015 to 2060)

	Truckee River Resource Ares (TRA) Basins						Non- TRA Basins			
Year	85	86	87	88W	92	TRA Total	83	88E	89	Non-TRA Total
2015	8,961	224	64,940	1,030	4,388	79,543	25	46	140	211
2016	9,160	228	66,042	1,054	4,473	80,957	26	46	144	216
2017	9,343	233	67,115	1,075	4,550	82,315	27	46	147	220
2018	9,506	239	68,221	1,094	4,625	83,685	27	47	150	224
2019	9,652	242	69,163	1,112	4,690	84,858	28	48	152	228
2020	9,786	245	69,946	1,128	4,751	85,856	28	49	154	232
2021	9,911	248	70,641	1,143	4,802	86,745	28	50	156	234
2022	10,042	251	71,339	1,159	4,857	87,647	29	51	158	237
2023	10,179	255	72,173	1,174	4,916	88,696	29	51	159	240
2024	10,321	258	73,059	1,191	4,980	89,809	30	52	162	244
2025	10,441	261	73,829	1,205	5,034	90,769	30	53	164	247
2026	10,545	263	74,514	1,218	5,084	91,623	30	53	166	250
2027	10,651	265	75,105	1,230	5,126	92,378	31	54	166	251
2028	10,753	268	75,682	1,243	5,169	93,115	31	54	169	253
2029	10,875	271	76,355	1,256	5,218	93,975	31	55	170	256
2030	10,985	273	77,055	1,271	5,269	94,853	31	56	174	260
2031	11,091	276	77,740	1,282	5,320	95,709	32	56	175	263
2032	11,185	278	78,364	1,293	5,362	96,482	32	56	177	265
2033	11,271	279	78,855	1,303	5,398	97,105	32	57	178	268
2034	11,348	281	79,321	1,312	5,433	97,695	32	57	180	269
2035	11,429	283	79,790	1,323	5,470	98,296	33	58	181	271
2036	11,516	285	80,280	1,333	5,504	98,918	33	59	181	272
2037	11,601	287	80,826	1,343	5,542	99,599	33	59	182	274
2038	11,675	292	81,301	1,352	5,578	100,197	34	60	183	277
2039	11,740	293	81,716	1,359	5,609	100,718	34	60	184	278
2040	11,806	294	82,096	1,367	5,633	101,196	34	61	186	280
2041	11,863	296	82,411	1,373	5,656	101,599	34	61	187	281
2042	11,924	297	82,773	1,381	5,685	102,060	34	61	188	283
2043	11,989	298	83,161	1,389	5,710	102,548	35	61	189	284
2044	12,045	300	83,519	1,395	5,739	102,999	35	61	190	286
2045	12,102	302	83,883	1,402	5,763	103,452	35	61	190	286
2046	12,149	303	84,173	1,408	5,784	103,818	35	61	192	288
2047	12,190	304	84,421	1,412	5,802	104,129	35	61	193	289
2048	12,238	305	84,694	1,418	5,822	104,477	35	62	193	290
2049	12,282	306	84,938	1,423	5,841	104,790	35	62	193	290
2050	12,325	307	85,221	1,429	5,863	105,144	35	62	194	291
2051	12,371	308	85,497	1,434	5,880	105,489	36	63	194	293
2052	12,406	308	85,712	1,438	5,900	105,764	36	63	195	294
2053	12,438	309	85,932	1,442	5,913	106,035	36	63	195	294
2054	12,469	310	86,113	1,446	5,925	106,263	36	63	196	295
2055	12,503	311	86,283	1,450	5,938	106,484	36	64	196	296
2056	12,534	311	86,492	1,453	5,956	106,747	36	64	198	297
2057	12,565	312	86,671	1,457	5,969	106,974	36	64	198	297
2058	12,592	313	86,852	1,460	5,979	107,195	36	64	198	297
2059	12,618	313	87,024	1,464	5,990	107,408	36	64	199	299
2060	12,644	314	87,146	1,466	5,998	107,568	36	65	199	300

Table 3.1: Water Demand (acre feet) by Service Type for Basin 83 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	21	-	2	0	24	1	24	25
2016	22	-	2	0	24	1	24	26
2017	22	-	3	1	25	2	25	27
2018	22	-	3	1	26	2	26	27
2019	22	-	3	1	26	2	26	28
2020	23	-	3	1	27	2	27	28
2021	23	-	3	1	27	2	27	28
2022	23	-	3	1	27	2	27	29
2023	24	-	3	1	28	2	28	29
2024	24	-	3	1	28	2	28	30
2025	24	-	3	1	28	2	28	30
2026	25	-	3	1	28	2	28	30
2027	25	-	3	1	29	2	29	31
2028	25	-	3	1	29	2	29	31
2029	26	-	3	1	29	2	29	31
2030	26	-	3	1	29	2	29	31
2031	26	-	3	1	30	2	30	32
2032	26	-	3	1	30	2	30	32
2033	27	-	3	1	30	2	30	32
2034	27	-	3	1	30	2	30	32
2035	27	-	3	1	31	2	31	33
2036	27	-	3	1	31	2	31	33
2037	27	-	3	1	31	2	31	33
2038	28	-	3	1	32	2	32	34
2039	28	-	3	1	32	2	32	34
2040	28	-	3	1	32	2	32	34
2041	28	-	3	1	32	2	32	34
2042	28	-	3	1	32	2	32	34
2043	28	-	3	1	33	2	33	35
2044	28	-	3	1	33	2	33	35
2045	28	-	3	1	33	2	33	35
2046	28	-	3	1	33	2	33	35
2047	28	-	3	1	33	2	33	35
2048	29	-	3	1	33	2	33	35
2049	29	-	3	1	33	2	33	35
2050	29	-	3	1	33	2	33	35
2051	29	-	3	1	34	2	34	36
2052	29	-	3	1	34	2	34	36
2053	29	-	3	1	34	2	34	36
2054	29	-	3	1	34	2	34	36
2055	30	-	3	1	34	2	34	36
2056	30	-	3	1	34	2	34	36
2057	30	-	3	1	34	2	34	36
2058	30	-	3	1	34	2	34	36
2059	30	-	3	1	34	2	34	36
2060	30	-	3	1	34	2	34	36

Table 3.2: Water Demand (acre feet) by Service Type for Basin 85 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	7,710	96	274	374	8,454	507	8,454	8,961
2016	7,890	97	277	378	8,642	518	8,642	9,160
2017	8,055	97	281	381	8,814	529	8,814	9,343
2018	8,195	98	286	388	8,968	538	8,968	9,506
2019	8,325	99	289	392	9,105	546	9,105	9,652
2020	8,447	99	291	395	9,233	554	9,233	9,786
2021	8,562	101	292	395	9,350	561	9,350	9,911
2022	8,680	101	294	399	9,473	568	9,473	10,042
2023	8,802	101	298	402	9,603	576	9,603	10,179
2024	8,924	102	302	409	9,737	584	9,737	10,321
2025	9,030	102	305	413	9,850	591	9,850	10,441
2026	9,125	103	307	413	9,948	597	9,948	10,545
2027	9,220	103	309	416	10,048	603	10,048	10,651
2028	9,315	103	310	416	10,144	609	10,144	10,753
2029	9,419	104	313	423	10,259	616	10,259	10,875
2030	9,521	104	315	423	10,363	622	10,363	10,985
2031	9,613	105	318	427	10,463	628	10,463	11,091
2032	9,697	105	320	430	10,552	633	10,552	11,185
2033	9,771	106	322	434	10,633	638	10,633	11,271
2034	9,842	106	323	434	10,705	642	10,705	11,348
2035	9,919	106	324	434	10,783	647	10,783	11,429
2036	9,995	106	326	437	10,864	652	10,864	11,516
2037	10,069	107	328	441	10,945	657	10,945	11,601
2038	10,136	107	330	441	11,014	661	11,014	11,675
2039	10,193	107	331	444	11,076	665	11,076	11,740
2040	10,248	108	333	448	11,137	668	11,137	11,806
2041	10,302	108	334	448	11,192	672	11,192	11,863
2042	10,357	108	336	448	11,249	675	11,249	11,924
2043	10,414	108	337	451	11,311	679	11,311	11,989
2044	10,466	108	338	451	11,364	682	11,364	12,045
2045	10,513	109	340	455	11,417	685	11,417	12,102
2046	10,556	109	341	455	11,462	688	11,462	12,149
2047	10,594	109	341	455	11,500	690	11,500	12,190
2048	10,635	109	342	458	11,545	693	11,545	12,238
2049	10,676	109	343	458	11,587	695	11,587	12,282
2050	10,715	109	344	458	11,627	698	11,627	12,325
2051	10,753	110	345	462	11,671	700	11,671	12,371
2052	10,785	110	346	462	11,703	702	11,703	12,406
2053	10,815	110	347	462	11,734	704	11,734	12,438
2054	10,844	110	347	462	11,763	706	11,763	12,469
2055	10,871	110	348	465	11,795	708	11,795	12,503
2056	10,901	110	348	465	11,825	709	11,825	12,534
2057	10,929	110	349	465	11,854	711	11,854	12,565
2058	10,953	110	350	465	11,879	713	11,879	12,592
2059	10,976	112	350	465	11,903	714	11,903	12,618
2060	10,997	112	351	469	11,928	716	11,928	12,644

Table 3.3: Water Demand (acre feet) by Service Type for Basin 86 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	182	8	5	16	211	13	211	224
2016	186	8	5	16	215	13	215	228
2017	190	8	5	16	219	13	219	233
2018	193	8	6	18	225	14	225	239
2019	196	8	6	18	229	14	229	242
2020	199	8	6	18	231	14	231	245
2021	202	8	6	18	234	14	234	248
2022	205	8	6	18	237	14	237	251
2023	208	9	6	18	240	14	240	255
2024	210	9	6	18	243	15	243	258
2025	213	9	6	18	246	15	246	261
2026	215	9	6	18	248	15	248	263
2027	217	9	6	18	250	15	250	265
2028	220	9	6	18	253	15	253	268
2029	222	9	6	18	255	15	255	271
2030	225	9	6	18	258	15	258	273
2031	227	9	6	18	260	16	260	276
2032	229	9	6	18	262	16	262	278
2033	230	9	6	18	264	16	264	279
2034	232	9	6	18	265	16	265	281
2035	234	9	6	18	267	16	267	283
2036	236	9	6	18	269	16	269	285
2037	237	9	6	18	271	16	271	287
2038	239	9	6	20	275	17	275	292
2039	240	9	6	20	276	17	276	293
2040	242	9	6	20	278	17	278	294
2041	243	9	6	20	279	17	279	296
2042	244	9	6	20	280	17	280	297
2043	246	9	6	20	282	17	282	298
2044	247	9	7	20	283	17	283	300
2045	248	9	7	20	285	17	285	302
2046	249	9	7	20	285	17	285	303
2047	250	9	7	20	286	17	286	304
2048	251	9	7	20	288	17	288	305
2049	252	9	7	20	288	17	288	306
2050	253	9	7	20	289	17	289	307
2051	254	9	7	20	290	17	290	308
2052	254	9	7	20	291	17	291	308
2053	255	9	7	20	292	18	292	309
2054	256	9	7	20	292	18	292	310
2055	257	9	7	20	293	18	293	311
2056	257	9	7	20	294	18	294	311
2057	258	9	7	20	294	18	294	312
2058	258	9	7	20	295	18	295	313
2059	259	9	7	20	295	18	295	313
2060	260	9	7	20	296	18	296	314

Table 3.4: Water Demand (acre feet) by Service Type for Basin 87 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	34,308	6,040	11,899	9,018	61,264	3,676	61,264	64,940
2016	35,109	6,066	12,037	9,092	62,304	3,738	62,304	66,042
2017	35,844	6,084	12,211	9,177	63,316	3,799	63,316	67,115
2018	36,470	6,155	12,423	9,312	64,360	3,862	64,360	68,221
2019	37,048	6,220	12,566	9,413	65,248	3,915	65,248	69,163
2020	37,589	6,261	12,658	9,479	65,987	3,959	65,987	69,946
2021	38,102	6,283	12,731	9,526	66,643	3,999	66,643	70,641
2022	38,627	6,283	12,826	9,564	67,301	4,038	67,301	71,339
2023	39,168	6,308	12,970	9,641	68,087	4,085	68,087	72,173
2024	39,712	6,352	13,125	9,735	68,924	4,135	68,924	73,059
2025	40,188	6,390	13,257	9,814	69,650	4,179	69,650	73,829
2026	40,610	6,440	13,358	9,889	70,296	4,218	70,296	74,514
2027	41,028	6,467	13,424	9,935	70,854	4,251	70,854	75,105
2028	41,455	6,476	13,496	9,971	71,398	4,284	71,398	75,682
2029	41,914	6,500	13,593	10,026	72,033	4,322	72,033	76,355
2030	42,369	6,523	13,709	10,092	72,693	4,362	72,693	77,055
2031	42,781	6,560	13,834	10,166	73,340	4,400	73,340	77,740
2032	43,154	6,605	13,932	10,238	73,928	4,436	73,928	78,364
2033	43,482	6,626	14,002	10,281	74,391	4,463	74,391	78,855
2034	43,801	6,648	14,062	10,320	74,831	4,490	74,831	79,321
2035	44,140	6,660	14,121	10,353	75,274	4,516	75,274	79,790
2036	44,476	6,668	14,200	10,391	75,736	4,544	75,736	80,280
2037	44,806	6,699	14,293	10,452	76,251	4,575	76,251	80,826
2038	45,105	6,722	14,373	10,499	76,699	4,602	76,699	81,301
2039	45,361	6,744	14,443	10,542	77,091	4,625	77,091	81,716
2040	45,606	6,769	14,493	10,581	77,449	4,647	77,449	82,096
2041	45,845	6,772	14,532	10,597	77,746	4,665	77,746	82,411
2042	46,089	6,784	14,586	10,628	78,088	4,685	78,088	82,773
2043	46,344	6,800	14,647	10,663	78,454	4,707	78,454	83,161
2044	46,574	6,810	14,711	10,696	78,792	4,727	78,792	83,519
2045	46,785	6,837	14,773	10,740	79,135	4,748	79,135	83,883
2046	46,976	6,852	14,813	10,768	79,409	4,765	79,409	84,173
2047	47,148	6,859	14,848	10,787	79,643	4,779	79,643	84,421
2048	47,329	6,874	14,885	10,812	79,900	4,794	79,900	84,694
2049	47,511	6,874	14,920	10,825	80,130	4,808	80,130	84,938
2050	47,685	6,887	14,971	10,856	80,397	4,824	80,397	85,221
2051	47,853	6,903	15,015	10,886	80,658	4,839	80,658	85,497
2052	47,995	6,910	15,050	10,905	80,861	4,852	80,861	85,712
2053	48,127	6,927	15,085	10,930	81,068	4,864	81,068	85,932
2054	48,257	6,932	15,106	10,944	81,239	4,874	81,239	86,113
2055	48,379	6,933	15,132	10,955	81,399	4,884	81,399	86,283
2056	48,510	6,945	15,165	10,977	81,596	4,896	81,596	86,492
2057	48,634	6,947	15,194	10,990	81,765	4,906	81,765	86,671
2058	48,742	6,958	15,227	11,010	81,936	4,916	81,936	86,852
2059	48,846	6,971	15,252	11,029	82,098	4,926	82,098	87,024
2060	48,936	6,971	15,269	11,037	82,213	4,933	82,213	87,146

Table 3.5: Water Demand (acre feet) by Service Type for Basin 88E (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	43	-	-	-	43	3	43	46
2016	44	-	-	-	44	3	44	46
2017	44	-	-	-	44	3	44	46
2018	45	-	-	-	45	3	45	47
2019	45	-	-	-	45	3	45	48
2020	46	-	-	-	46	3	46	49
2021	47	-	-	-	47	3	47	50
2022	48	-	-	-	48	3	48	51
2023	48	-	-	-	48	3	48	51
2024	49	-	-	-	49	3	49	52
2025	50	-	-	-	50	3	50	53
2026	50	-	-	-	50	3	50	53
2027	51	-	-	-	51	3	51	54
2028	51	-	-	-	51	3	51	54
2029	52	-	-	-	52	3	52	55
2030	52	-	-	-	52	3	52	56
2031	53	-	-	-	53	3	53	56
2032	53	-	-	-	53	3	53	56
2033	54	-	-	-	54	3	54	57
2034	54	-	-	-	54	3	54	57
2035	55	-	-	-	55	3	55	58
2036	56	-	-	-	56	3	56	59
2037	56	-	-	-	56	3	56	59
2038	56	-	-	-	56	3	56	60
2039	56	-	-	-	56	3	56	60
2040	57	-	-	-	57	3	57	61
2041	57	-	-	-	57	3	57	61
2042	57	-	-	-	57	3	57	61
2043	57	-	-	-	57	3	57	61
2044	57	-	-	-	57	3	57	61
2045	58	-	-	-	58	3	58	61
2046	58	-	-	-	58	3	58	61
2047	58	-	-	-	58	3	58	61
2048	59	-	-	-	59	4	59	62
2049	59	-	-	-	59	4	59	62
2050	59	-	-	-	59	4	59	62
2051	59	-	-	-	59	4	59	63
2052	59	-	-	-	59	4	59	63
2053	59	-	-	-	59	4	59	63
2054	59	-	-	-	59	4	59	63
2055	60	-	-	-	60	4	60	64
2056	60	-	-	-	60	4	60	64
2057	60	-	-	-	60	4	60	64
2058	60	-	-	-	60	4	60	64
2059	60	-	-	-	60	4	60	64
2060	61	-	-	-	61	4	61	65

Table 3.6: Water Demand (acre feet) by Service Type for Basin 88W (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	965	-	3	3	971	58	971	1,030
2016	988	-	3	3	994	60	994	1,054
2017	1,008	-	3	3	1,014	61	1,014	1,075
2018	1,026	-	3	3	1,032	62	1,032	1,094
2019	1,043	-	3	3	1,049	63	1,049	1,112
2020	1,058	-	3	3	1,064	64	1,064	1,128
2021	1,073	-	3	3	1,079	65	1,079	1,143
2022	1,087	-	3	3	1,093	66	1,093	1,159
2023	1,102	-	3	3	1,108	66	1,108	1,174
2024	1,118	-	3	3	1,124	67	1,124	1,191
2025	1,131	-	3	3	1,137	68	1,137	1,205
2026	1,143	-	3	3	1,149	69	1,149	1,218
2027	1,155	-	3	3	1,161	70	1,161	1,230
2028	1,167	-	3	3	1,173	70	1,173	1,243
2029	1,179	-	3	3	1,185	71	1,185	1,256
2030	1,193	-	3	3	1,199	72	1,199	1,271
2031	1,204	-	3	3	1,210	73	1,210	1,282
2032	1,214	-	3	3	1,220	73	1,220	1,293
2033	1,223	-	3	3	1,229	74	1,229	1,303
2034	1,232	-	3	3	1,238	74	1,238	1,312
2035	1,242	-	3	3	1,248	75	1,248	1,323
2036	1,251	-	3	3	1,257	75	1,257	1,333
2037	1,261	-	3	3	1,267	76	1,267	1,343
2038	1,269	-	3	3	1,275	77	1,275	1,352
2039	1,276	-	3	3	1,282	77	1,282	1,359
2040	1,284	-	3	3	1,290	77	1,290	1,367
2041	1,289	-	3	3	1,295	78	1,295	1,373
2042	1,297	-	3	3	1,303	78	1,303	1,381
2043	1,305	-	3	3	1,311	79	1,311	1,389
2044	1,310	-	3	3	1,316	79	1,316	1,395
2045	1,317	-	3	3	1,323	79	1,323	1,402
2046	1,322	-	3	3	1,328	80	1,328	1,408
2047	1,326	-	3	3	1,332	80	1,332	1,412
2048	1,332	-	3	3	1,338	80	1,338	1,418
2049	1,337	-	3	3	1,343	81	1,343	1,423
2050	1,342	-	3	3	1,348	81	1,348	1,429
2051	1,347	-	3	3	1,353	81	1,353	1,434
2052	1,351	-	3	3	1,357	81	1,357	1,438
2053	1,355	-	3	3	1,361	82	1,361	1,442
2054	1,358	-	3	3	1,364	82	1,364	1,446
2055	1,362	-	3	3	1,368	82	1,368	1,450
2056	1,365	-	3	3	1,371	82	1,371	1,453
2057	1,368	-	3	3	1,374	82	1,374	1,457
2058	1,372	-	3	3	1,378	83	1,378	1,460
2059	1,375	-	3	3	1,381	83	1,381	1,464
2060	1,377	-	3	3	1,383	83	1,383	1,466

Table 3.7: Water Demand (acre feet) Service Type for Basin 89 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	126	-	6	0	132	8	132	140
2016	128	-	7	1	136	8	136	144
2017	131	-	7	1	139	8	139	147
2018	134	-	7	1	141	8	141	150
2019	136	-	7	1	143	9	143	152
2020	138	-	7	1	146	9	146	154
2021	139	-	7	1	147	9	147	156
2022	141	-	7	1	149	9	149	158
2023	143	-	7	1	150	9	150	159
2024	145	-	7	1	152	9	152	162
2025	147	-	7	1	155	9	155	164
2026	149	-	7	1	157	9	157	166
2027	149	-	7	1	157	9	157	166
2028	152	-	7	1	159	10	159	169
2029	153	-	7	1	160	10	160	170
2030	155	-	8	1	164	10	164	174
2031	156	-	8	1	165	10	165	175
2032	158	-	8	1	167	10	167	177
2033	160	-	8	1	168	10	168	178
2034	161	-	8	1	169	10	169	180
2035	162	-	8	1	171	10	171	181
2036	162	-	8	1	171	10	171	181
2037	163	-	8	1	172	10	172	182
2038	164	-	8	1	173	10	173	183
2039	165	-	8	1	174	10	174	184
2040	166	-	8	1	175	11	175	186
2041	167	-	8	1	176	11	176	187
2042	169	-	8	1	177	11	177	188
2043	170	-	8	1	179	11	179	189
2044	171	-	8	1	180	11	180	190
2045	171	-	8	1	180	11	180	190
2046	172	-	8	1	181	11	181	192
2047	173	-	8	1	182	11	182	193
2048	173	-	8	1	182	11	182	193
2049	173	-	8	1	182	11	182	193
2050	174	-	8	1	183	11	183	194
2051	174	-	8	1	183	11	183	194
2052	175	-	8	1	184	11	184	195
2053	175	-	8	1	184	11	184	195
2054	177	-	8	1	185	11	185	196
2055	177	-	8	1	185	11	185	196
2056	178	-	8	1	186	11	186	198
2057	178	-	8	1	186	11	186	198
2058	178	-	8	1	186	11	186	198
2059	179	-	8	1	188	11	188	199
2060	179	-	8	1	188	11	188	199

Table 3.8: Water Demand (acre feet) by Service Type for Basin 92 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total Retail	System Loss	Total Retail	Total Production
2015	2,898	350	527	365	4,140	248	4,140	4,388
2016	2,965	352	533	370	4,220	253	4,220	4,473
2017	3,027	352	540	373	4,292	258	4,292	4,550
2018	3,080	355	550	378	4,363	262	4,363	4,625
2019	3,129	359	555	381	4,424	265	4,424	4,690
2020	3,175	361	561	386	4,482	269	4,482	4,751
2021	3,218	363	562	386	4,530	272	4,530	4,802
2022	3,262	363	568	388	4,582	275	4,582	4,857
2023	3,308	365	574	391	4,638	278	4,638	4,916
2024	3,354	367	581	396	4,698	282	4,698	4,980
2025	3,394	369	586	399	4,749	285	4,749	5,034
2026	3,430	373	592	401	4,797	288	4,797	5,084
2027	3,465	373	594	404	4,836	290	4,836	5,126
2028	3,501	375	596	404	4,876	293	4,876	5,169
2029	3,540	375	601	407	4,923	295	4,923	5,218
2030	3,578	377	607	409	4,971	298	4,971	5,269
2031	3,613	379	612	414	5,019	301	5,019	5,320
2032	3,645	381	616	417	5,059	304	5,059	5,362
2033	3,673	383	620	417	5,092	306	5,092	5,398
2034	3,700	385	621	420	5,126	308	5,126	5,433
2035	3,728	385	625	422	5,160	310	5,160	5,470
2036	3,756	385	629	422	5,192	312	5,192	5,504
2037	3,784	387	633	425	5,228	314	5,228	5,542
2038	3,809	389	636	427	5,262	316	5,262	5,578
2039	3,831	391	640	430	5,292	318	5,292	5,609
2040	3,852	391	642	430	5,314	319	5,314	5,633
2041	3,872	391	644	430	5,336	320	5,336	5,656
2042	3,893	393	645	433	5,364	322	5,364	5,685
2043	3,914	393	647	433	5,387	323	5,387	5,710
2044	3,934	395	651	435	5,414	325	5,414	5,739
2045	3,951	395	653	438	5,437	326	5,437	5,763
2046	3,968	397	655	438	5,457	327	5,457	5,784
2047	3,982	397	657	438	5,473	328	5,473	5,802
2048	3,997	397	658	440	5,493	330	5,493	5,822
2049	4,013	397	660	440	5,510	331	5,510	5,841
2050	4,027	398	662	443	5,531	332	5,531	5,863
2051	4,042	398	664	443	5,547	333	5,547	5,880
2052	4,054	400	666	446	5,566	334	5,566	5,900
2053	4,065	400	668	446	5,578	335	5,578	5,913
2054	4,076	400	668	446	5,590	335	5,590	5,925
2055	4,086	400	669	446	5,602	336	5,602	5,938
2056	4,097	402	671	448	5,619	337	5,619	5,956
2057	4,108	402	673	448	5,631	338	5,631	5,969
2058	4,117	402	673	448	5,641	338	5,641	5,979
2059	4,126	402	675	448	5,651	339	5,651	5,990
2060	4,133	402	675	448	5,659	340	5,659	5,998

Table 4. Active Service Counts by Basin (2003 to 2014)

Year	RMWS	RFWS	MMWS	MRFS	MRIS	GMWS	MIS
Basin 83							
2003	35					3	1
2004	37					4	1
2005	37					4	1
2006	38					4	1
2007	42					4	1
2008	42					4	1
2009	42					4	1
2010	42					4	1
2011	42					4	1
2012	42					4	1
2013	42					4	1
2014	42					4	1
Basin 85							
2003	9421	2	254			65	108
2004	11335	2	254			72	113
2005	12812	5	241			80	126
2006	14558	3	413			141	137
2007	14895	1	613			190	149
2008	14711	1	619			233	157
2009	14668	2	885			263	158
2010	14579	1	885			255	163
2011	14627	1	901			257	164
2012	14733	1	901			259	165
2013	14956	1	901			262	167
2014	15298	1	909			263	164
Basin 86							
2003	321	318	124	16		10	6
2004	392	249	124	16		9	6
2005	442	187	124	16		8	6
2006	480	135	124	16		8	7
2007	489	103	124	16		8	7
2008	504	97	124	16		10	8
2009	524	80	124	16		10	8
2010	531	59	140	16		10	8
2011	533	47	140			10	8
2012	543	40	140			10	8
2013	548	34	140			10	8
2014	550	28	140			10	8
Basin 87							
2003	37358	30277	13688	3772	2061	5273	1929
2004	47676	25080	16719	3773	2236	5431	2078
2005	54916	18655	17425	2626	2172	5638	2262
2006	59618	14169	17753	2433	2193	5764	2347
2007	61772	11860	18024	2428	2189	5866	2414
2008	63500	10685	19044	2422	2207	5927	2476
2009	65630	9750	21453	2416	2106	5964	2525
2010	67373	7640	25313	1954	1883	5994	2552
2011	68489	6431	26006	1720	1810	6041	2582
2012	69539	5601	24989	1685	1664	6038	2596
2013	70796	4969	25875	1685	1642	6045	2607
2014	72194	4544	26425	1913	1589	6108	2614

Table 4 cont. Active Service Counts by Basin (2003 to 2014)

Year	RMWS	RFWS	MMWS	MRFS	MRIS	GMWS	MIS
Basin 88E							
2003	30						
2004	33						
2005	35						
2006	37						
2007	38						
2008	38						
2009	38						
2010	40						
2011	42						
2012	44						
2013	45						
2014	50						
Basin 88W							
2003	628					8	5
2004	754					9	5
2005	846					9	6
2006	977					10	5
2007	1027					10	5
2008	1050					10	4
2009	1067					11	4
2010	1101					11	4
2011	1112					11	4
2012	1134					11	4
2013	1178					11	3
2014	1213					11	3
Basin 89							
2003	76					3	1
2004	86					4	1
2005	93					4	1
2006	98					4	
2007	102					5	
2008	103					6	2
2009	104					6	2
2010	105					5	2
2011	105					5	2
2012	106					5	2
2013	107					5	2
2014	110					5	2
Basin 92							
2003	5307	1474	1201	70	6	226	109
2004	6132	1196	1368	70	12	233	123
2005	6648	1014	1368	70	14	237	132
2006	7234	914	1368	70	12	247	143
2007	7527	879	1368	70	11	256	150
2008	7599	852	1384	70	9	260	153
2009	7911	723	1384	70	7	265	155
2010	7863	437	1384	70	6	265	154
2011	7916	389	1383	70	7	278	155
2012	7950	355	1383	70	7	277	156
2013	7993	323	1383	70	8	287	164
2014	8043	302	1570	70	6	285	165

Table 5: Ratio of Active Services by Year

Year	Average Number of Multi-Family Units	Ratio of Active Single Family Units (RMWS)	Ratio of Active Multi-Family Units (MMWS)	Ratio of Active Commercial Units (GMWS)
2009	10.123	0.853	1.104	0.725
2010	10.269	0.865	1.144	0.726
2011	10.260	0.873	1.121	0.731
2012	10.235	0.879	1.085	0.729
2013	10.225	0.886	1.086	0.727
2014	10.207	0.894	1.086	0.732
2015	10.201	0.964	1.125	0.738

Table 6: Ratio of Active Services within Hydrographic Basin

Hydrobasin	RMWS	MMWS	GMWS
083	0.752		0.252
085	0.955	1.074	1.033
086	0.154	0.748	0.101
087	0.954	1.102	0.721
088E	0.895		
088W	0.959		2.571
089	0.914		0.418
092	1.040	1.408	0.966

Table 7: Regression Results for Predicting Active MIS

Restricted Model 1 - GMWS only		Restricted Model 2 -Multi-Family only		Unrestricted Model	
VARIABLES	MIS		MIS		MIS
GMWS	0.435***	MMWS/MRFS	0.956***	GMWS	0.289***
	(0.00545)		(0.0201)		(0.0339)
				MMWS/MRFS	0.323***
					(0.0746)
Observations	13		13		13
R-squared	0.998		0.995		0.999

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Water Use Coefficient per Hydrographic Basin (2015 to 2060)

RMWS	MMWS	GMWS	MIS	Average*	HydroBasin
				149.57	083
161.96	359.94	326.90	1140.28		085
98.80	191.03	171.50	735.50		086
144.49	421.01	632.30	895.30		087
254.78					088E
262.59		301.55	1036.00		088W
368.75		375.80	118.00		089
110.45	636.46	600.94	849.24		092

* Average used for basins with very small service counts.

Table 9: Total Service Projections for Truckee Meadows Service Area 2015 to 2060

Year	RMWS	MMWS	GMWS	MIS	Total
2015	101156	4955	6696	3534	116341
2016	103519	4977	6774	3565	118835
2017	105682	4991	6873	3598	121144
2018	107528	5049	6993	3653	123223
2019	109235	5102	7072	3692	125101
2020	110827	5135	7124	3719	126805
2021	112342	5154	7164	3735	128395
2022	113888	5154	7218	3752	130012
2023	115484	5175	7299	3781	131739
2024	117088	5211	7386	3819	133504
2025	118491	5242	7460	3850	135043
2026	119736	5283	7517	3879	136415
2027	120969	5304	7554	3897	137724
2028	122228	5312	7594	3910	139044
2029	123581	5332	7650	3934	140497
2030	124922	5351	7716	3958	141947
2031	126136	5381	7786	3988	143291
2032	127234	5417	7841	4016	144508
2033	128203	5435	7880	4033	145551
2034	129144	5453	7913	4048	146558
2035	130144	5463	7946	4061	147614
2036	131135	5469	7991	4076	148671
2037	132106	5495	8043	4099	149743
2038	132990	5515	8089	4119	150713
2039	133742	5533	8128	4137	151540
2040	134466	5553	8156	4151	152326
2041	135169	5555	8178	4158	153060
2042	135891	5566	8209	4170	153836
2043	136642	5578	8242	4184	154646
2044	137319	5587	8279	4197	155382
2045	137942	5609	8314	4215	156080
2046	138506	5621	8337	4225	156689
2047	139012	5627	8356	4232	157227
2048	139548	5638	8377	4243	157806
2049	140081	5638	8397	4248	158364
2050	140594	5649	8424	4260	158927
2051	141091	5663	8449	4271	159474
2052	141511	5669	8470	4280	159930
2053	141898	5682	8489	4289	160358
2054	142283	5686	8500	4293	160762
2055	142645	5687	8516	4298	161146
2056	143030	5697	8533	4307	161567
2057	143393	5699	8550	4312	161954
2058	143712	5707	8569	4320	162308
2059	144020	5718	8582	4326	162646
2060	144286	5718	8592	4330	162926

Table 10.1: Service Projections for Basin 83 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	46	0	5	1	52
2016	47	0	5	1	53
2017	47	0	6	2	55
2018	48	0	6	2	56
2019	49	0	6	2	57
2020	50	0	6	2	58
2021	50	0	6	2	58
2022	51	0	6	2	59
2023	52	0	6	2	60
2024	53	0	6	2	61
2025	53	0	6	2	61
2026	54	0	6	2	62
2027	55	0	6	2	63
2028	55	0	6	2	63
2029	56	0	6	2	64
2030	56	0	6	2	64
2031	57	0	6	2	65
2032	57	0	6	2	65
2033	58	0	6	2	66
2034	58	0	6	2	66
2035	59	0	6	2	67
2036	59	0	6	2	67
2037	59	0	6	2	67
2038	60	0	7	2	69
2039	60	0	7	2	69
2040	61	0	7	2	70
2041	61	0	7	2	70
2042	61	0	7	2	70
2043	62	0	7	2	71
2044	62	0	7	2	71
2045	62	0	7	2	71
2046	62	0	7	2	71
2047	62	0	7	2	71
2048	63	0	7	2	72
2049	63	0	7	2	72
2050	63	0	7	2	72
2051	64	0	7	2	73
2052	64	0	7	2	73
2053	64	0	7	2	73
2054	64	0	7	2	73
2055	65	0	7	2	74
2056	65	0	7	2	74
2057	65	0	7	2	74
2058	65	0	7	2	74
2059	65	0	7	2	74
2060	65	0	7	2	74

Table 10.2: Service Projections for Basin 85 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	15511	87	273	107	15978
2016	15873	88	276	108	16345
2017	16205	88	280	109	16682
2018	16488	89	285	111	16973
2019	16749	90	288	112	17239
2020	16994	90	290	113	17487
2021	17226	91	291	113	17721
2022	17463	91	293	114	17961
2023	17708	91	297	115	18211
2024	17954	92	301	117	18464
2025	18168	92	304	118	18682
2026	18359	93	306	118	18876
2027	18549	93	308	119	19069
2028	18741	93	309	119	19262
2029	18950	94	312	121	19477
2030	19155	94	314	121	19684
2031	19341	95	317	122	19875
2032	19509	95	319	123	20046
2033	19658	96	321	124	20199
2034	19802	96	322	124	20344
2035	19955	96	323	124	20498
2036	20108	96	325	125	20654
2037	20257	97	327	126	20807
2038	20392	97	329	126	20944
2039	20507	97	330	127	21061
2040	20618	98	332	128	21176
2041	20726	98	333	128	21285
2042	20837	98	335	128	21398
2043	20952	98	336	129	21515
2044	21056	98	337	129	21620
2045	21151	99	339	130	21719
2046	21238	99	340	130	21807
2047	21315	99	340	130	21884
2048	21397	99	341	131	21968
2049	21479	99	342	131	22051
2050	21558	99	343	131	22131
2051	21634	100	344	132	22210
2052	21698	100	345	132	22275
2053	21758	100	346	132	22336
2054	21817	100	346	132	22395
2055	21872	100	347	133	22452
2056	21931	100	347	133	22511
2057	21987	100	348	133	22568
2058	22036	100	349	133	22618
2059	22083	101	349	133	22666
2060	22124	101	350	134	22709

Table 10.3: Service Projections for Basin 86 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	600	14	10	7	631
2016	614	14	10	7	645
2017	627	14	10	7	658
2018	638	14	11	8	671
2019	648	14	11	8	681
2020	657	14	11	8	690
2021	666	14	11	8	699
2022	675	14	11	8	708
2023	685	15	11	8	719
2024	694	15	11	8	728
2025	703	15	11	8	737
2026	710	15	11	8	744
2027	717	15	11	8	751
2028	725	15	12	8	760
2029	733	15	12	8	768
2030	741	15	12	8	776
2031	748	15	12	8	783
2032	755	15	12	8	790
2033	760	15	12	8	795
2034	766	15	12	8	801
2035	772	15	12	8	807
2036	778	15	12	8	813
2037	783	15	12	8	818
2038	789	16	12	9	826
2039	793	16	12	9	830
2040	797	16	12	9	834
2041	802	16	12	9	839
2042	806	16	12	9	843
2043	810	16	12	9	847
2044	814	16	13	9	852
2045	818	16	13	9	856
2046	821	16	13	9	859
2047	824	16	13	9	862
2048	828	16	13	9	866
2049	831	16	13	9	869
2050	834	16	13	9	872
2051	837	16	13	9	875
2052	839	16	13	9	877
2053	842	16	13	9	880
2054	844	16	13	9	882
2055	846	16	13	9	884
2056	848	16	13	9	886
2057	850	16	13	9	888
2058	852	16	13	9	890
2059	854	16	13	9	892
2060	856	16	13	9	894

Table 10.4: Service Projections for Basin 87 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	77368	4675	6132	3282	91457
2016	79176	4695	6203	3309	93383
2017	80832	4709	6293	3340	95174
2018	82245	4764	6402	3389	96800
2019	83549	4814	6476	3426	98265
2020	84767	4846	6523	3450	99586
2021	85926	4863	6561	3467	100817
2022	87109	4863	6610	3481	102063
2023	88330	4882	6684	3509	103405
2024	89556	4916	6764	3543	104779
2025	90629	4946	6832	3572	105979
2026	91580	4984	6884	3599	107047
2027	92523	5005	6918	3616	108062
2028	93487	5012	6955	3629	109083
2029	94522	5031	7005	3649	110207
2030	95547	5049	7065	3673	111334
2031	96476	5077	7129	3700	112382
2032	97317	5112	7180	3726	113335
2033	98057	5128	7216	3742	114143
2034	98777	5145	7247	3756	114925
2035	99541	5155	7277	3768	115741
2036	100300	5161	7318	3782	116561
2037	101044	5185	7366	3804	117399
2038	101718	5203	7407	3821	118149
2039	102295	5220	7443	3837	118795
2040	102847	5239	7469	3851	119406
2041	103386	5241	7489	3857	119973
2042	103937	5251	7517	3868	120573
2043	104511	5263	7548	3881	121203
2044	105031	5271	7581	3893	121776
2045	105506	5292	7613	3909	122320
2046	105937	5303	7634	3919	122793
2047	106325	5309	7652	3926	123212
2048	106734	5320	7671	3935	123660
2049	107143	5320	7689	3940	124092
2050	107535	5330	7715	3951	124531
2051	107915	5343	7738	3962	124958
2052	108236	5348	7756	3969	125309
2053	108532	5361	7774	3978	125645
2054	108826	5365	7785	3983	125959
2055	109102	5366	7798	3987	126253
2056	109397	5375	7815	3995	126582
2057	109676	5377	7830	4000	126883
2058	109919	5385	7847	4007	127158
2059	110155	5395	7860	4014	127424
2060	110357	5395	7869	4017	127638

Table 10.5: Service Projections for Basin 88E (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	55	0	0	0	55
2016	56	0	0	0	56
2017	56	0	0	0	56
2018	57	0	0	0	57
2019	58	0	0	0	58
2020	59	0	0	0	59
2021	60	0	0	0	60
2022	61	0	0	0	61
2023	62	0	0	0	62
2024	63	0	0	0	63
2025	64	0	0	0	64
2026	64	0	0	0	64
2027	65	0	0	0	65
2028	65	0	0	0	65
2029	66	0	0	0	66
2030	67	0	0	0	67
2031	68	0	0	0	68
2032	68	0	0	0	68
2033	69	0	0	0	69
2034	69	0	0	0	69
2035	70	0	0	0	70
2036	71	0	0	0	71
2037	71	0	0	0	71
2038	72	0	0	0	72
2039	72	0	0	0	72
2040	73	0	0	0	73
2041	73	0	0	0	73
2042	73	0	0	0	73
2043	73	0	0	0	73
2044	73	0	0	0	73
2045	74	0	0	0	74
2046	74	0	0	0	74
2047	74	0	0	0	74
2048	75	0	0	0	75
2049	75	0	0	0	75
2050	75	0	0	0	75
2051	76	0	0	0	76
2052	76	0	0	0	76
2053	76	0	0	0	76
2054	76	0	0	0	76
2055	77	0	0	0	77
2056	77	0	0	0	77
2057	77	0	0	0	77
2058	77	0	0	0	77
2059	77	0	0	0	77
2060	78	0	0	0	78

Table 10.6: Service Projections for Basin 88W (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	1198	0	3	1	1202
2016	1226	0	3	1	1230
2017	1251	0	3	1	1255
2018	1273	0	3	1	1277
2019	1294	0	3	1	1298
2020	1313	0	3	1	1317
2021	1331	0	3	1	1335
2022	1349	0	3	1	1353
2023	1367	0	3	1	1371
2024	1387	0	3	1	1391
2025	1403	0	3	1	1407
2026	1418	0	3	1	1422
2027	1433	0	3	1	1437
2028	1448	0	3	1	1452
2029	1463	0	3	1	1467
2030	1480	0	3	1	1484
2031	1494	0	3	1	1498
2032	1506	0	3	1	1510
2033	1518	0	3	1	1522
2034	1529	0	3	1	1533
2035	1541	0	3	1	1545
2036	1553	0	3	1	1557
2037	1565	0	3	1	1569
2038	1575	0	3	1	1579
2039	1584	0	3	1	1588
2040	1593	0	3	1	1597
2041	1600	0	3	1	1604
2042	1609	0	3	1	1613
2043	1619	0	3	1	1623
2044	1626	0	3	1	1630
2045	1634	0	3	1	1638
2046	1641	0	3	1	1645
2047	1646	0	3	1	1650
2048	1653	0	3	1	1657
2049	1659	0	3	1	1663
2050	1665	0	3	1	1669
2051	1671	0	3	1	1675
2052	1676	0	3	1	1680
2053	1681	0	3	1	1685
2054	1685	0	3	1	1689
2055	1690	0	3	1	1694
2056	1694	0	3	1	1698
2057	1698	0	3	1	1702
2058	1702	0	3	1	1706
2059	1706	0	3	1	1710
2060	1709	0	3	1	1713

Table 10.7: Service Projections for Basin 89 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	111	0	5	1	117
2016	113	0	6	2	121
2017	116	0	6	2	124
2018	118	0	6	2	126
2019	120	0	6	2	128
2020	122	0	6	2	130
2021	123	0	6	2	131
2022	125	0	6	2	133
2023	126	0	6	2	134
2024	128	0	6	2	136
2025	130	0	6	2	138
2026	132	0	6	2	140
2027	132	0	6	2	140
2028	134	0	6	2	142
2029	135	0	6	2	143
2030	137	0	7	2	146
2031	138	0	7	2	147
2032	140	0	7	2	149
2033	141	0	7	2	150
2034	142	0	7	2	151
2035	143	0	7	2	152
2036	143	0	7	2	152
2037	144	0	7	2	153
2038	145	0	7	2	154
2039	146	0	7	2	155
2040	147	0	7	2	156
2041	148	0	7	2	157
2042	149	0	7	2	158
2043	150	0	7	2	159
2044	151	0	7	2	160
2045	151	0	7	2	160
2046	152	0	7	2	161
2047	153	0	7	2	162
2048	153	0	7	2	162
2049	153	0	7	2	162
2050	154	0	7	2	163
2051	154	0	7	2	163
2052	155	0	7	2	164
2053	155	0	7	2	164
2054	156	0	7	2	165
2055	156	0	7	2	165
2056	157	0	7	2	166
2057	157	0	7	2	166
2058	157	0	7	2	166
2059	158	0	7	2	167
2060	158	0	7	2	167

Table 10.8: Service Projections for Basin 92 (2015 to 2060)

Year	RMWS	MMWS	GMWS	MIS	Total
2015	8549	179	286	140	9154
2016	8749	180	289	142	9360
2017	8932	180	293	143	9548
2018	9087	182	298	145	9712
2019	9232	184	301	146	9863
2020	9366	185	304	148	10003
2021	9495	186	305	148	10134
2022	9625	186	308	149	10268
2023	9760	187	311	150	10408
2024	9895	188	315	152	10550
2025	10014	189	318	153	10674
2026	10120	191	321	154	10786
2027	10224	191	322	155	10892
2028	10330	192	323	155	11000
2029	10444	192	326	156	11118
2030	10557	193	329	157	11236
2031	10660	194	332	159	11345
2032	10753	195	334	160	11442
2033	10835	196	336	160	11527
2034	10915	197	337	161	11610
2035	10999	197	339	162	11697
2036	11082	197	341	162	11782
2037	11164	198	343	163	11868
2038	11239	199	345	164	11947
2039	11303	200	347	165	12015
2040	11364	200	348	165	12077
2041	11423	200	349	165	12137
2042	11485	201	350	166	12202
2043	11548	201	351	166	12266
2044	11605	202	353	167	12327
2045	11658	202	354	168	12382
2046	11706	203	355	168	12432
2047	11749	203	356	168	12476
2048	11793	203	357	169	12522
2049	11839	203	358	169	12569
2050	11882	204	359	170	12615
2051	11924	204	360	170	12658
2052	11960	205	361	171	12697
2053	11992	205	362	171	12730
2054	12025	205	362	171	12763
2055	12055	205	363	171	12794
2056	12088	206	364	172	12830
2057	12119	206	365	172	12862
2058	12146	206	365	172	12889
2059	12172	206	366	172	12916
2060	12194	206	366	172	12938