Summary of Econometric Analysis of Demand and Forecast

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Forecast by Customer Class (MGY)

YEAR	2013	2020	2025	2030	2035
	Actual	Forecast	Forecast	Forecast	Forecast
Single Family	1,233	1,180	1,175	1,172	1,177
Multi Family	705	662	626	625	625
Business	628	579	566	565	567
Industrial	56	57	59	61	62
Municipal	63	47	46	44	43
Irrigation	123	119	133	143	153
Golf	108	58	50	42	40
UC	182	196	234	271	308
TOTAL DEMAND	**3,100**	**2,897**	**2,889**	**2,923**	**2,974**
MISC/LOSS	251	235	234	237	241
TOTAL PRODUCTION	**3,352**	**3,132**	**3,123**	**3,160**	**3,215**
ROUNDED	**3,400**	**3,100**	**3,100**	**3,200**	**3,200**

Comparison with Interim Forecast

YEAR	2020	2025	2030	2035
	Forecast	Forecast	Forecast	Forecast
Unrounded				
Econometric	3,132	3,123	3,160	3,215
Interim	3,236	3,213	3,218	3,169
Rounded				
Econometric	3,100	3,100	3,200	3,200
Interim	3,200	3,200	3,200	3,200

Forecast Components

Forecasted Sales = Forecasted Services x Forecasted Avg Use Per Service

Anchored to
AMBAG 2014 Regional
Growth Forecast

Based on Econometric
Models of
Average Use Per Service

Population & Housing

- Anchored to AMBAG Regional Growth Forecast (adopted 2014)
- Population disaggregated into household, campus, and group quarter populations
- Housing unit forecast = Household population / Avg household size
- Housing units disaggregated into single- and multi-family
- Residential Services forecast anchored to 2014 services count and forecasted growth in housing units

Inside City Population & Housing Units

	2010 [1]	2020	2025	2030	2035
City Total Population [2]	59,946	66,860	70,058	73,375	76,692
UCSC [3]	7,331	8,845	9,602	10,359	11,116
City	52,615	58,015	60,456	63,016	65,576
In households [4]	50,711	55,916	58,268	60,736	63,203
In group qtrs	1,904	2,099	2,188	2,280	2,373
Household size [5]	2.34	2.38	2.41	2.42	2.44
City Housing Units					
Total [6]	22,913	24,854	25,580	26,594	27,429
Occupied [7]	21,657	23,492	24,177	25,136	25,925
Vacancy rate [8]	5.5%	5.5%	5.5%	5.5%	5.5%

Outside City Population & Housing Units

	2010 [1]	**2020**	**2025**	**2030**	**2035**
Population [2]	31,342	32,543	33,562	34,614	35,698
In households [3]	30,678	31,853	32,851	33,880	34,941
In group qtrs.	665	690	712	734	757
Household size [4]	2.39	2.43	2.46	2.46	2.48
Housing Units					
Total [5]	14,323	14,630	14,902	15,329	15,669
Occupied [6]	12,856	13,132	13,376	13,759	14,064
Vacancy rate [7]	10.2%	10.2%	10.2%	10.2%	10.2%

Forecasted Housing Units with Water Services

Inside City

	2014 [1/]	2020	2025	2030	2035	Gain From 2014	% of Gain
Single Family [2/]	12,246	12,534	12,780	13,030	13,246	1,000	24%
Multi Family [3/]	9,583	10,958	11,398	12,106	12,679	3,096	76%
Total	21,829	23,492	24,177	25,136	25,925	4,096	100%

Calibrates exactly to Housing Unit forecast: TRUE

Outside City

	2014 [1/]	2020	2025	2030	2035	Gain From 2014	% of Gain
Single Family [2/]	6,743	6,922	7,074	7,230	7,390	647	52%
Multi Family [3/]	7,901	7,910	8,033	8,310	8,495	594	48%
Total	14,644	14,832	15,107	15,540	15,884	1,240	100%

Calibrates exactly to Housing Unit forecast: FALSE

Business, Municipal, Irrigation Services & Golf Acreage

- Forecast of business services tied to correlation between business water use and residential water use

- No growth in municipal services

- Irrigation services based on historical rate of gain in irrigation services per gain in multi-family and business services

- Golf acreage: 70% reduction in Pasatiempo. No change in DeLaveaga.

Non-Residential Services/Acreage Forecasts

	2013 [1]	2020	2025	2030	2035	Gain From 2013
Business [2]	1,889	1,910	1,935	1,980	2,039	150
Municipal [3]	218	218	218	218	218	0
Irrigation	452	624	696	820	931	479

	2013 [1]	2020	2025	2030	2035	Gain From 2013
DeLaveaga	78.9	78.9	78.9	78.9	78.9	0
Pasatiempo [2]	67.5	40	30	20	20	-47.5

Average Use Per Service

Econometric Models of Demand

- Separate models for SFR, MFR, BUS, MUN, IRR, GOLF classes
- Models include seasonal, weather, economic, conservation, and drought response components
- Estimated with monthly billing record data: Jan 2000 to Nov 2014
- Fixed Effects models used so we can pool Inside and Outside City billing data
- Robust regression techniques used to down-weight influence of outlier data on parameter estimates
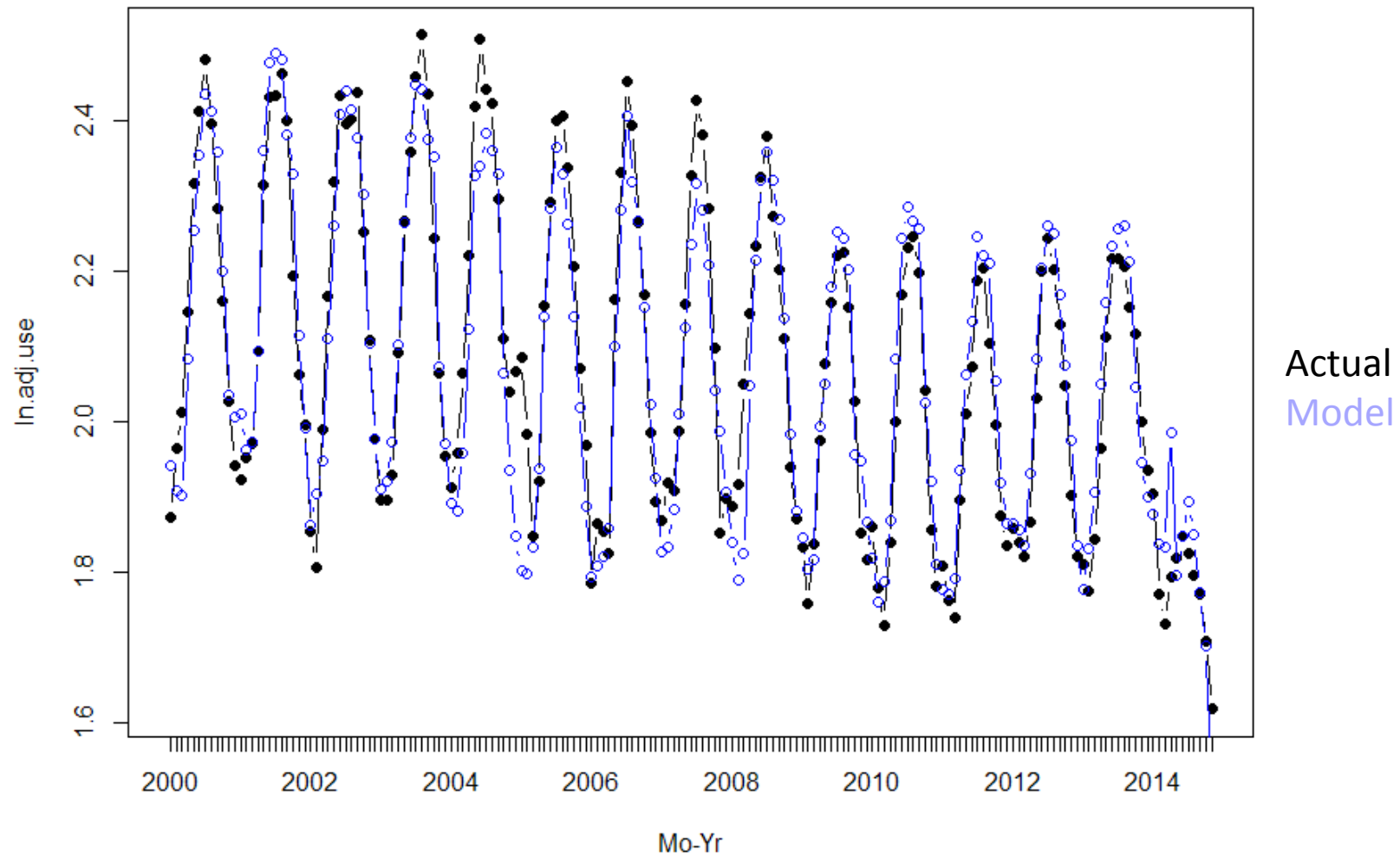
Summary of Model Fit

Customer Class	Number of Observations	Adjusted R-Square
Single Family	358	0.917
Multi Family	351	0.900
Business	353	0.942
Municipal	177	0.951
Irrigation	358	0.916
Golf	352	0.957

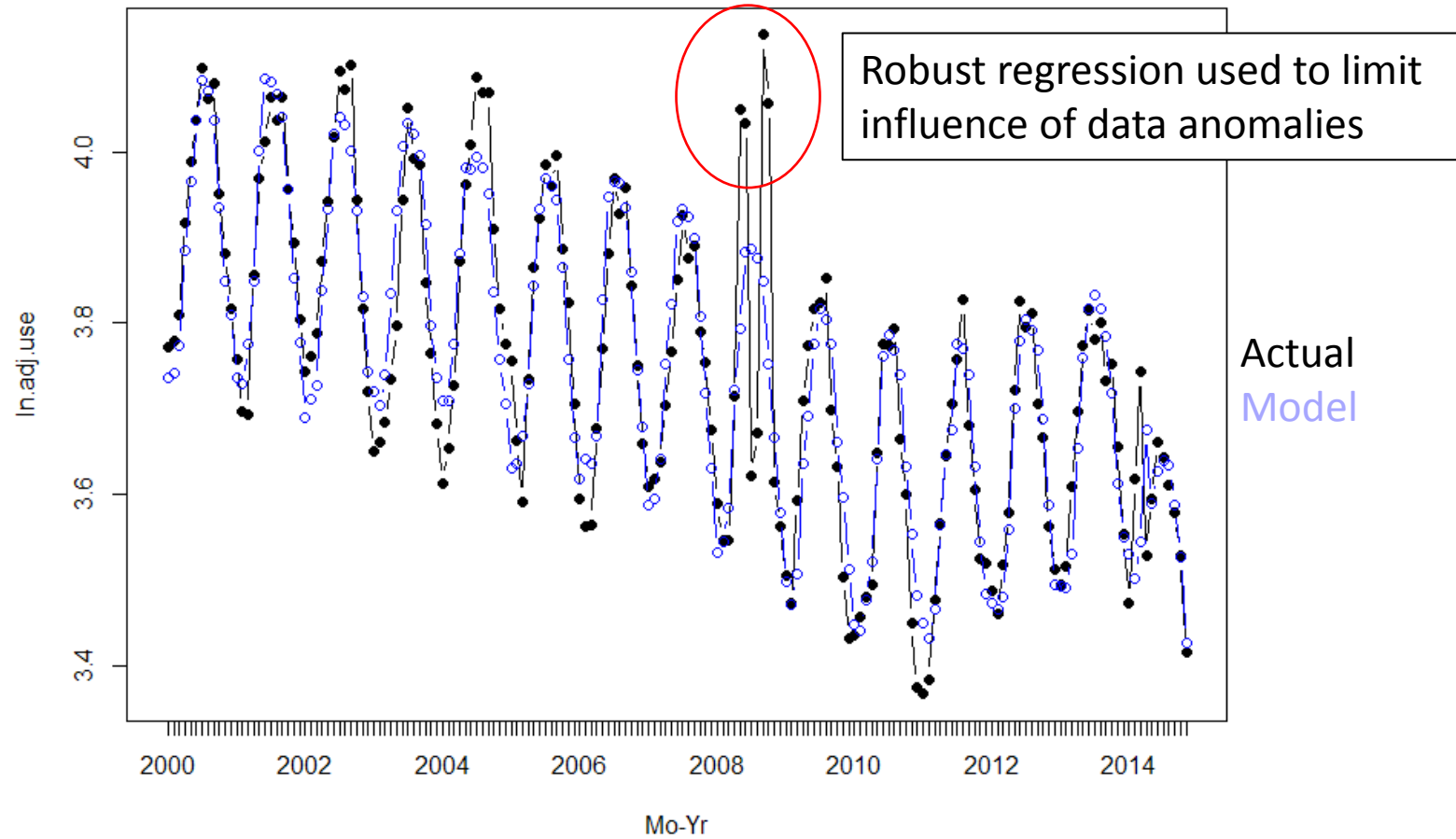Models "explain" 90-96% of observed variation in average monthly water use

Single Family Class Model Fit in Log Scale

Model 1: Inside City Actual v. Fitted

Actual
Model

Business Class Model Fit in Log Scale

Model 1: Outside City Actual v. Fitted

Robust regression used to limit influence of data anomalies

Actual
Model

Estimated Price & Income Elasticities

Price	Point Estimate	95% CI	Interim Assumption
Single Family			
Winter	-0.08	-0.06 to -0.10	-0.15
Summer	-0.14	-0.11 to -0.17	-0.30
Multi Family	-0.12	-0.06 to -0.18	-0.12
Business	-0.10	-0. 07 to -0.13	-0.10
Municipal	-0.24	-0.12 to -0.36	NA
Irrigation	-0.54	-0.40 to -0.68	NA
Golf (DeLaveaga)	-0.34	-0.13 to -0.55	NA

Income	Point Estimate	95% CI	Interim Assumption
Single Family	0.23	0.08 to 0.38	0.25

Forecast of Average Use (CCF/Year)

YEAR	Per	2013 Actual	2020 Forecast	2025 Forecast	2030 Forecast	2035 Forecast
Single Family	Housing Unit	89	81	79	77	76
Multi Family	Housing Unit	54	47	43	41	39
Business	Service	445	405	391	382	372
Municipal	Service	323	289	282	272	263
Irrigation	Service	339	255	255	233	219
Golf	Acre	740	654	615	565	537

1. Given normal weather, employment, and vacancy conditions
2. Adjusted for Plumbing Code and Program A water savings
3. Price & income growth forecast same as interim forecast

Peak Season Savings Due to Price Response

Peak (May-Oct) Demand Without Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	TOTAL
2020	750	386	372	39	123	58	**1,728**
2025	763	375	373	39	138	52	**1,739**
2030	778	383	381	39	162	46	**1,790**
2035	798	393	393	39	184	46	**1,854**

Peak (May-Oct) Demand With Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	TOTAL
2020	705	364	348	35	93	52	**1,598**
2025	703	347	342	35	104	45	**1,575**
2030	702	347	341	34	111	37	**1,572**
2035	703	347	342	33	119	35	**1,580**

Peak (May-Oct) Savings from Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	TOTAL	% Savings
2020	46	22	23	4	30	5	**131**	**8%**
2025	60	28	31	5	34	7	**164**	**9%**
2030	76	36	40	6	51	9	**218**	**12%**
2035	95	46	51	7	65	11	**274**	**15%**

UC & Industrial Sales Forecast

- UC same as interim
- Industrial based on forecast of Santa Cruz County mfg employment

Industrial Demand vs County Mfg Employment

$y = 38.298x - 145732$
$R^2 = 0.9303$

$y = 11.863x - 29081$
$R^2 = 0.9361$

CCF Industrial Demand

County Mfg Employment

- Pre Recession   - Post Recession
...... Linear (Pre Recession) ...... Linear (Post Recession)
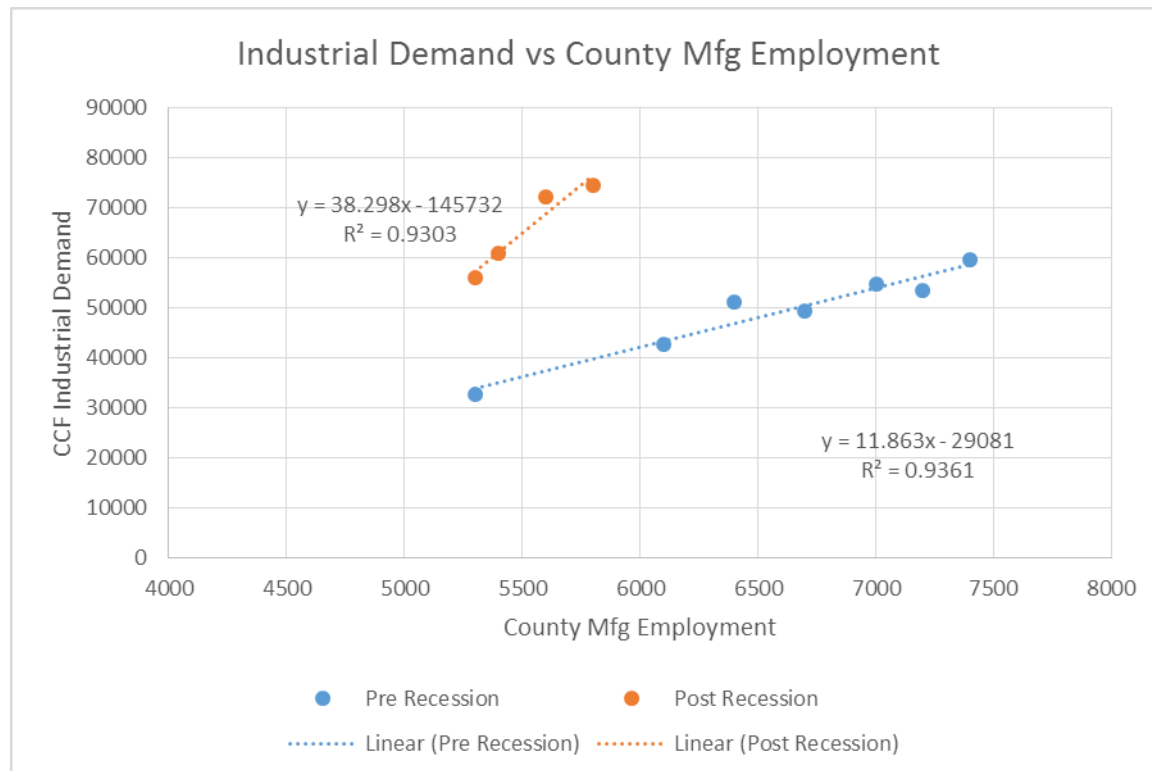
Industrial Sales Forecast

	2013 [1]	2020	2022	2025	2030	2035
Mfg Employment Forecast						
EDD	5,800		6,000			
Cal Trans		5,900		6,200	6,400	6,500
Industrial Water Demand						
CCF [2]	74,451	75,641		79,211	81,591	82,781
MG	56	57		59	61	62

City of Santa Cruz Water Department
Water Demand Forecast

YEAR		2020	2025	2030	2035
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,910	1,935	1,980	2,039
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	624	696	820	931
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	81.1	79.1	77.3	76.2
MFR	CCF	46.9	43.1	40.9	39.5
BUS	CCF	405.3	391.4	381.6	371.6
IND	NA	NA	NA	NA	NA
MUN	CCF	288.7	282.5	272.5	262.8
IRR	CCF	254.9	255.1	232.5	219.2
GOLF	CCF	654.0	614.9	565.3	536.9
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,180	1,175	1,172	1,177
MFR	MG	662	626	625	625
BUS	MG	579	566	565	567
IND	MG	57	59	61	62
MUN	MG	47	46	44	43
IRR	MG	119	133	143	153
GOLF	MG	58	50	42	40
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Total Demand	**MG**	**2,897**	**2,889**	**2,923**	**2,974**
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Total Production	**MG**	**3,132**	**3,123**	**3,160**	**3,215**
Rounded	**MG**	**3,100**	**3,100**	**3,200**	**3,200**