WATER DEMAND FACTOR UPDATE REPORT

Prepared by Water Resources Division, City of Santa Barbara,
in conjunction with the Planning Division, City of Santa Barbara

October 2009

Background

In 1989, the City of Santa Barbara contracted with Interface Planning and Counseling Corporation to prepare the "Water Demand Factor and Conservation Study." Demand factors for various land use categories were developed for use in estimating water use of proposed development as a part of the environmental review process. In support of the ongoing *Plan Santa Barbara* process, staff of the Water Resources Division, in conjunction with the City's Planning Division, have prepared this update of the factors that are of particular interest as a part of *Plan Santa Barbara*.

Water consumption for various land use categories has been analyzed for calendar years 2006 and 2007. These years represent two different weather patterns that influence water use. Precipitation during the calendar year 2006 can be considered average, while 2007 was one of the driest years on record. The data have been reported as overall averages to provide an indication of how different weather patterns contribute to typical long term average water usage. Water use is measured in "Hundred Cubic Feet" (HCF), equal to 748 gallons, "Acre-Feet" (AF) equal to 325,850 gallons, and "Acre-Feet per Year" (AFY).

Methodology

The general methodology for calculating the demand factors involved joining land use data, generated by the Community Development Department, with consumption data from the City's Utility Billing System. The link between the two databases is the Assessor Parcel Number (APN). The land use database contains square footage (for commercial properties) and lot size values used in calculations. Water use through dedicated irrigation meters has been included to the extent the correct APN was identified. Therefore, all demand factors include both indoor and outdoor water use.

Data Sources

- A report from the City of Santa Barbara CIS Utility Billing System titled "Parcel Consumption Data" provided consumption data. The report was written to export account number, customer number, APN, consumption, and read date for 1/1/06 through 12/31/07.
- Land use data came from the Land Use Database established by the Community Development Department. This is a geodatabase that assigns a specific land use category to each parcel within the City limits (e.g., single family or multiple-family residential, service commercial, retail, office, institutional, etc.). This database was developed on a parcel-by-parcel basis and verified by field observation.

Data Analysis

- Specific lists of parcel numbers for a given land use category or lot size for a single family residence were determined using the GIS tool "Select by Attributes". The specific land uses and/or lot areas were selected and only the parcel numbers with those attributes were included in the output. A new layer was created from the output and the table exported to an Access database.
- To link the land use data with water use, the lists of parcel numbers generated in GIS were joined with the "Parcel Consumption Data" report containing water usage data from January 2006 through December 2007. The join was designed to find matching parcel numbers from both lists and exclude parcel numbers that were not common to both lists. Therefore, APN's missing from either the billing system or land use database were excluded from these analyses in order to focus on parcels known to fit the desired category.
- For non-residential uses, building square footage data was included in the water use analysis. Therefore, the joined list of water use and parcels within a certain land use category was merged with the area data from the original land use database. The parcel list was evaluated to ensure that the square footage data did not include parcels that were not joined to water use data.
- Multi-family accounts were analyzed on a bill code basis, as the use of APN can be problematic with this customer class. For example, each condominium is assigned a separate APN, so there is not a consistent one-to-one relationship between the APN for an irrigation account and the corresponding domestic accounts it serves.
- Irrigation accounts for multi-family properties were reviewed based upon service address to ensure the corresponding domestic accounts were also included in the database.

Data Quality Considerations

- Data extremes, likely representing extraordinary water use due to leaks, fire, or water wasting, have not been identified or removed. It is appropriate to include this type of usage, as it contributes to overall demand.
- There are times when meter reading is delayed and one month's reading actually reflects usage values over two months or more. However, this occurrence is not very frequent and does not affect overall annual averages.
- With regard to the land use database, if the land use had changed or the size increased or reduced since the last update, it could also introduce minor inaccuracies.

Presentation of Water Demand Factors

The demand factors presented in Table 1 are intended as indicators of typical water use by various land use categories. A breakout of values for 2006 and 2007 is included in Appendix A. Non-residential water use categories are Retail, Office, Hotel, Institutional, Service Commercial, and Industrial. Residential water use is generally divided between single family and multi-family residential users, with additional analysis of subsets as discussed below.

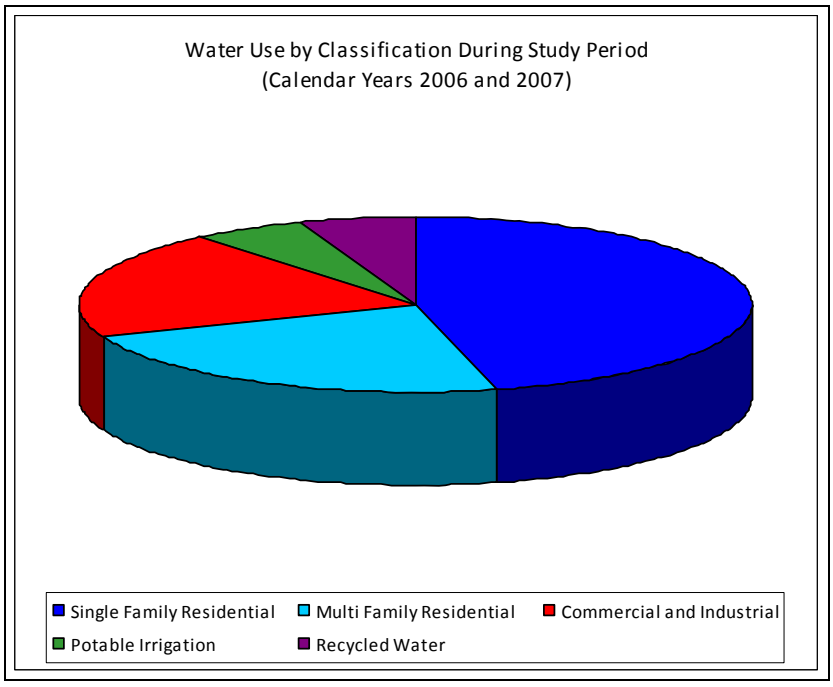

Figure 1. Water Use By Class

The non-residential user groups can be considered general headings for more specific land uses. The Service Commercial category encompasses restaurants, bars, auto service stations, banks, theatres, and

health services. The Institutional category includes educational services, hospitals, government buildings and agencies, public safety, and religious institutions. While schools are considered an Institutional use, water use from schools is not included because the data is based on the number of students and therefore not appropriate to include with data calculated on a square footage basis. Laundromats, shopping malls, grocery stores, and consumer goods fall under the Retail category. The Office category contains general office space. Hotels include hotels, motels and bed & breakfast inns. Manufacturing, warehousing, and construction related business are classified as Industrial land uses. A listing of the specific categories is included in Appendix B.

Table 1. Water Demand Factors 1989 and 2009

(All values include indoor and outdoor usage)

Land Use Category (2009 Study)	1989 Study Values	2009 Study Values	Monthly Units	1989 Study Values	2009 Study Values	Annual Units
Single Family Residential (Aggregate)	18.00	14.40	HCF/month/ dwelling unit	0.50	0.40	AF/ year/ dwelling unit
Single Family - Small Lot size < 7000 ft^2	11.43	9.49	HCF/month/ dwelling unit	0.32	0.26	AF/ year/ dwelling unit
Single Family - Medium Lot size 7000 ft^2 to 1 acre	18.24 – 30.42	15.09	HCF/month/ dwelling unit	0.51 – 0.85	0.42	AF/ year/ dwelling unit
Single Family - Large Lot size > 1 acre	51.57	34.45	HCF/month/ dwelling unit	1.44	0.95	AF/ year/ dwelling unit
Multi-Family Residential (Aggregate)	7.33	5.72	HCF/month/ dwelling unit	0.20	0.16	AF/ year/ dwelling unit
Service Commercial	N/A	6.18	HCF/month/ 1000 ft^2	N/A	0.17	AF/ year/1000 ft^2
Retail Large: > 20,000 ft^2 Small: < 20,000 ft^2	 2.43 3.93	(Retain 1989 values)	 HCF/month/ 1000 ft^2	 0.068 0.11	(Retain 1989 values)	 AF/ year/1000 ft^2
Office	3.57	2.06	HCF/month/ 1000 ft^2	0.10	0.06	AF/ year/1000 ft^2
Industrial	2.49 – 5.37	2.84	HCF/month/ 1000 ft^2	0.07 – 0.15	0.08	AF/ year/1000 ft^2
Institutional	N/A	6.11	HCF/month/ 1000 ft^2	N/A	0.17	AF/ year/1000 ft^2
Hotel/Motel	4.65	4.81	HCF/month/ room	0.13	0.13	AF/ year/room
Hotel/Motel with Restaurant	5.37	7.17	HCF/month/ room	0.15	0.20	AF/ year/room

All values in Table 1 include both indoor and outdoor water usage. Dedicated irrigation meter usage was included to the extent the data were able to be matched to the appropriate domestic service account. Lot size definitions for single family residences were slightly different for the 1989 study. Refer to Appendix B for the specific designations.

Because no aggregate single family residential value was represented in the 1989 study, the 1989 aggregate value is based on metered usage and estimated irrigation usage for calendar year 1989. The same is true for the aggregate multi-family residential value, as there were several sub-categories of multi-family use specified in both the 1989 and 2009 studies, as noted in Appendix A.

1989 values are noted as N/A (Not Applicable) for the Service Commercial and Institutional land uses, as the user group definitions and units of measuring water use were not consistent between the 1989 study and the current update. For example, Restaurant data was previously based on number of seats, Hospital data on number of beds, and School data on number of students. 2009 data for non-residential groups was consistently based on square footage, and therefore not comparable. The exception was hotel data, which was based on number of rooms, as were the 1989 values.

A value of 5.37 HCF/month/1,000 ft^2 was calculated for the 2009 Retail category as defined in the Planning Division Land Use Database. However, because this land use category now includes high usage categories such as Grocery Stores and Laundromats, use of this value is not recommended and the 1989 values of 2.43 for Large Retail (>20,000 ft2) and 3.93 for Small Retail (<20,000 ft2)are included in Table 1.

The 2009 value for Hotels/Motels with restaurants (7.17 HCF/month/room) is one of the few that is greater than the 1989 value. Investigation revealed that the highest data point in the new analysis was well above the highest value in the old database, suggesting that perhaps the old sample was not inclusive of such higher use. With the highest data point excluded, the value calculates at 5.65 HCF/month/room, which is similar to 1989 data; however the 7.17 value is considered valid and is retained.

Subset Analysis of Multi-Family Residential Water Demand

Further analysis was completed on subsets of multi-family residential water use to examine usage by neighborhood, by different types of multi-family land uses, and by age of buildings

For neighborhood analysis, the multi-family database was broken into five neighborhoods based on meter reading route books: Riviera, Downtown East, Downtown West, Mesa, and Upper State, as shown in Figure 2.

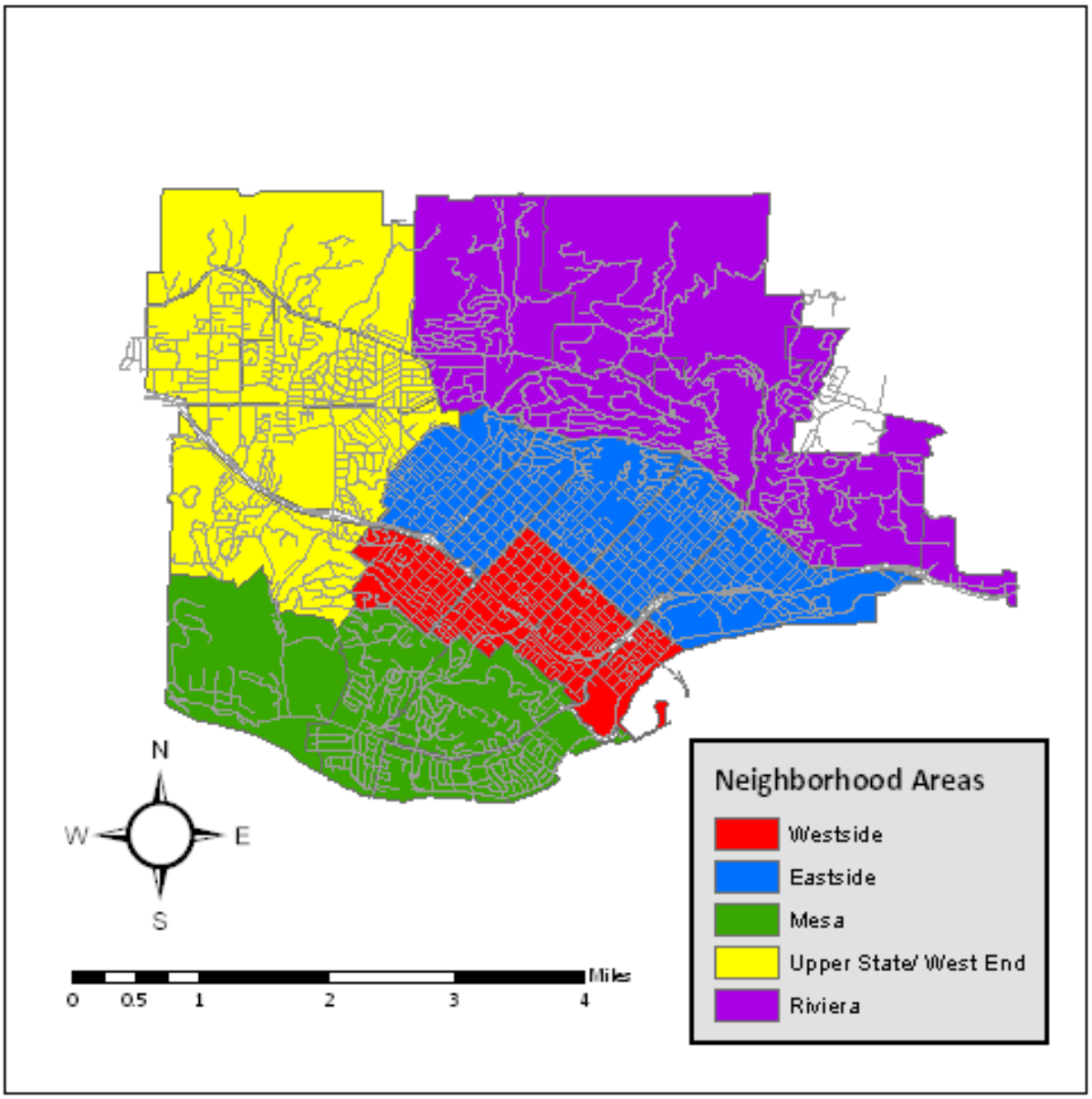

Figure 2. Neighborhood Areas

Results are summarized in Figure 3. While the overall water use patterns are similar among the groups, the Riviera neighborhood showed the greatest use compared to the other neighborhoods. All four of the other neighborhoods exhibit roughly the same range of use, varying from approximately 5 HCF per

month to 7 HCF per month throughout the year. Greater usage in the Riviera neighborhood supports the notion that there are larger lot sizes, and therefore more water used for irrigation, in this area.

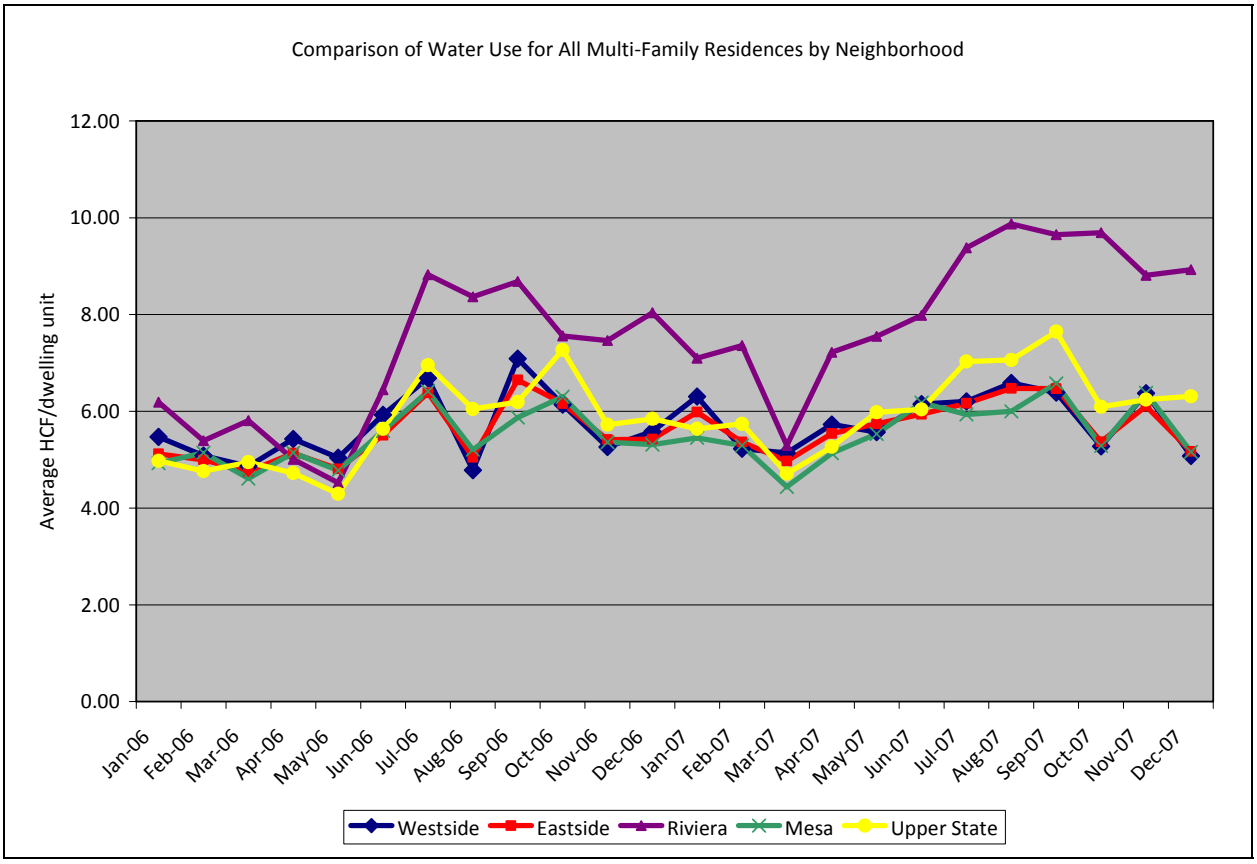

Figure 3. Multi-Family Water Use by Neighborhood

For evaluation of different types of multi-family land uses, the water use database was matched with the County of Santa Barbara Assessor land use database, which designates three different kinds of multi-family use: apartment buildings of 5 or more units, condominiums, and residential income of 2 to 4 units (more commonly referred to as duplexes, tri-plexes, and four-plexes). The County database was matched with the water use data via APN. The data are illustrated in Figure 4.

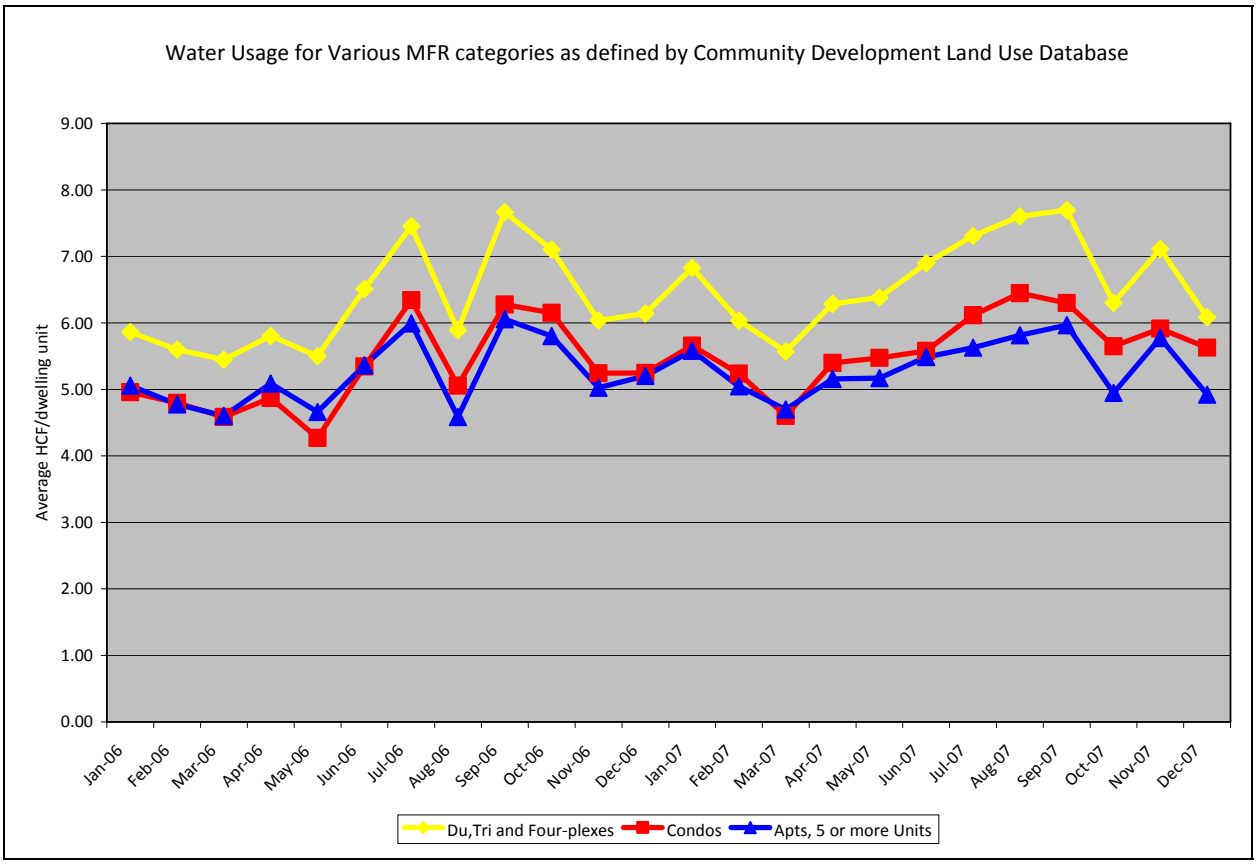

Figure 4. Water Usage by Various Multi-Family Categories

While general patterns of use are similar among the groups, use in the duplex, triplex and fourplex category data reflects consistently higher use than for condos or apartment buildings. This is consistent with the idea that lower density multi-family units have larger lot sizes with more landscaping and irrigation.

Analysis by age of structure was of interest because technology has advanced, water conservation messages have improved, block rate billing has been implemented, and stricter water use standards have been adopted. Because account numbers in the water billing system have been assigned sequentially, it was possible to designate cut-off points to distinguish between buildings built and occupied before and after 1990, the approximate effective date of current water efficiency standards. Comparing pre-1990 data to newer buildings reflects less water use overall for newer buildings, as shown in Figure 5, supporting the notion that water conservation actions have been working to reduce water use. Because the water use data analyzed was from 2006 through 2007, more recently built structures were not available for examination.

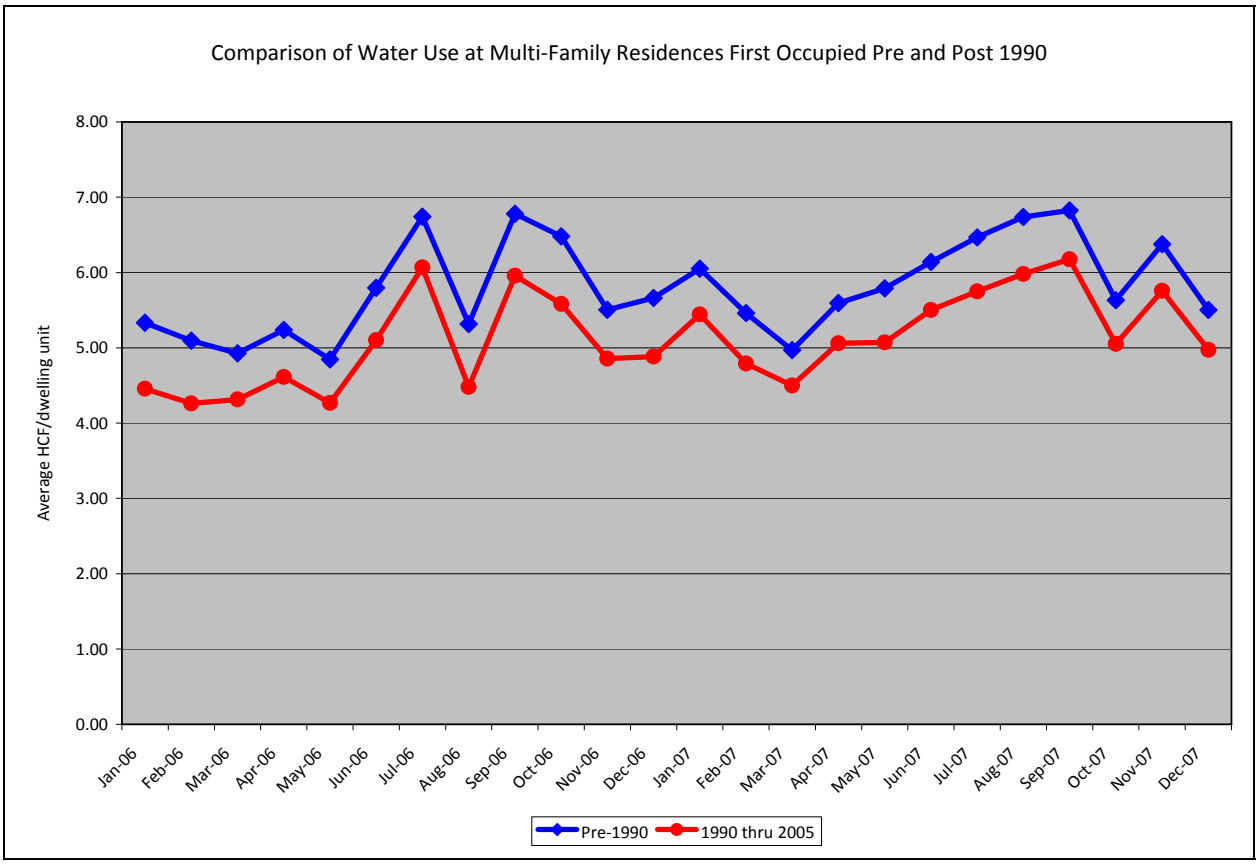

Figure 5. Multi-Family Water Usage Pre and Post 1990

Results of the subset analysis of multi-family usage as described above are summarized in Table 2.

Table 2. Subset Analysis of Multi-Family Water Usage

(All values include indoor and outdoor usage)

Multi-Family Analysis	2006 Values	2007 Values	Average	2006 Values	2007 Values	Average
	Monthly Usage (HCF/dwelling unit/month)			Annual Water Usage (AFY/dwelling unit)		
Multi-Family Residential (Aggregate)	5.56	5.88	5.72	0.15	0.16	0.16
Multi-Family – Neighborhoods (Aggregate)	5.58	5.93	5.76	0.15	0.16	0.16
Multi-Family – West Side Neighborhood	5.61	5.83	5.72	0.15	0.16	0.16
Multi-Family – East Side Neighborhood	5.45	5.77	5.61	0.15	0.16	0.15
Multi-Family – Mesa Neighborhood	5.39	5.61	5.50	0.15	0.15	0.15
Multi-Family – Upper State/West End Neighborhood	5.61	6.15	5.88	0.15	0.17	0.16
Multi-Family – Riviera Neighborhood	6.86	8.23	7.55	0.19	0.23	0.21
Multi-Family – Land use Categories (Aggregate)	5.51	5.79	5.65	0.15	0.16	0.16
Multi-Family – Du, Tri & Four-plex Category	6.25	6.68	6.46	0.17	0.18	0.18
Multi-Family – Condo Category	5.26	5.67	5.46	0.14	0.16	0.15
Multi-Family – 5+ Apt Building Category	5.18	5.35	5.27	0.14	0.15	0.15
Multi-Family – Age of Building (Aggregate)	5.59	5.92	5.75	0.15	0.16	0.16
Multi-Family – Occupied Pre-1990	5.64	5.96	5.80	0.16	0.16	0.16
Multi-Family – Occupied Between 1990 – 2005	4.90	5.34	5.12	0.13	0.15	0.14

Summary

The current water demand factor study reflects decreased water use as a whole from 1989 to the present. Figure 6 presents a summary of historical usage by customer classification. The majority of the water usage is for residential purposes, which is expected considering residential users comprise roughly 85% of the customer base. Usage rates tend to increase as the property size increases, accounting for increased landscaping area and irrigation.

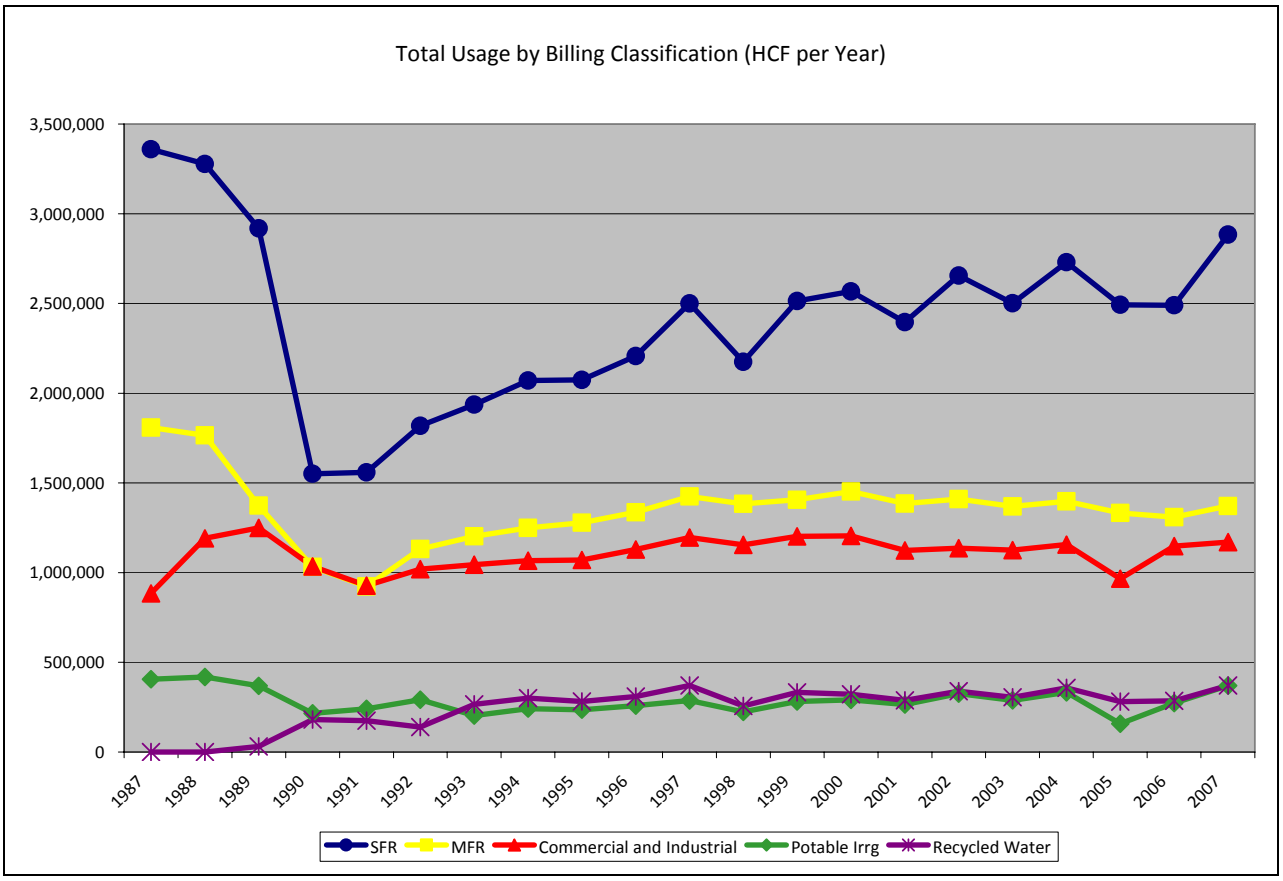

Figure 6. Historical Water Usage By Class

As a check on the updated non-residential demand factors, and as an indicator of overall water use in the non-residential sector, a comparison was made between the parcel specific data described above and aggregate water use for all non-residential accounts in the water billing system. Average 2006 & 2007 non-residential usage for all Commercial, Industrial, and non-residential Irrigation accounts was 2,752 AF. When divided by the 21.3 million square feet of currently existing non-residential floor area identified by the *Plan Santa Barbara* process, the result is .13 AFY per 1,000 sq. ft. For comparison, this same value is achieved by calculating a weighted average value (by floor area) for the data sample used in developing the demand factors in the various non-residential categories. Various analyses among multi-family users also yielded similar results on an aggregate basis, as shown in Table 2.

APPENDIX A – Factor Values: 2006, 2007, and Averages

Land Use Category (2009 Study)	2006 Values	2007 Values	Average	Monthly Units	2006 Values	2007 Values	Average	Annual Units
Single Family Residential (Aggregate)	13.43	15.37	14.40	HCF/month/ dwelling unit	0.37	0.42	0.40	AF/ year/ DU
Single Family - Small Lot size < 7000 ft^2	9.20	9.79	9.49	HCF/month/ dwelling unit	0.25	0.27	0.26	AF/ year/ DU
Single Family - Medium Lot size 7000 ft^2 to 1 acre	14.03	16.15	15.09	HCF/month/ dwelling unit	0.39	0.44	0.42	AF/year/ DU
Single Family - Large Lot size > 1 acre	33.73	38.17	34.45	HCF/month/ dwelling unit	0.93	1.05	0.95	AF/year/ DU
Multi-Family Residential (Aggregate)	5.56	5.88	5.72	HCF/month/ dwelling unit	0.15	0.16	0.16	AF/year/ DU
Multi-Family - 1-4 dwelling units	5.83	6.26	6.05	HCF/month/ dwelling unit	0.16	0.17	0.17	AF/year/ DU
Multi-Family - 5+ dwelling units	4.80	4.94	4.87	HCF/month/ dwelling unit	0.13	0.14	0.13	AF/year/ DU
Service Commercial	5.93	6.30	6.11	HCF/month/ 1000 ft^2	0.16	0.17	0.17	AF/year/ 1000 ft^2
Retail	5.35	5.38	5.37	HCF/month/ 1000 ft^2	0.15	0.15	0.15	AF/year/ 1000 ft^2
Office	1.98	2.14	2.06	HCF/month/ 1000 ft^2	0.05	0.06	0.06	AF/year/ 1000 ft^2
Industrial	2.79	2.89	2.84	HCF/month/ 1000 ft^2	0.08	0.08	0.08	AF/year/ 1000 ft^2
Institutional	5.85	6.37	6.11	HCF/month/ 1000 ft^2	0.16	0.18	0.17	AF/year/ 1000 ft^2
Hotel/Motel	4.81	4.82	4.81	HCF/month/ room	0.13	0.13	0.13	AF/year/ room
Hotel/Motel with Restaurant	7.17	7.16	7.17	HCF/month/ room	0.20	0.20	0.20	AF/year/ room

NOTES:

1. The 1989 Study Values are from Table 1, Water Demand Factors of the "Water Demand Factor and Conservation Study," Interface, August 1989.
2. 2009 Study values reflect the averages of usages for Calendar Years 2006 (average rainfall) and 2007 (extremely low rainfall, 43% of average), based on analysis of City Water Billing data and Planning Division Land Use Database.
3. All values represent estimated usage by category including indoor usage and outdoor usage.
4. Total SFR accounts for 2009 analysis (including 144 separately metered irrigation accounts, assumed split evenly between "medium" and "large".)
   SFR small = 5,198
   SFR medium = 9,176
   SFR large = 995
5. Number of hotels included in 2009 analysis:
   With restaurants attached = 7 hotels (20 accounts)
   Without restaurants attached = 28 hotels (36 accounts)

APPENDIX B - Land Use Category Details

2009 study categories	1989 study categories
Service Commercial	
'C - Bank, Credit Union'	Auto repair and auto body shop
'C - Bar or Drinking Place'	Bank
'C - Car Dealer'	Gas station
'C - Car Service & Repair'	Gas station/mini market
'C - Car Wash'	Health club
'C - Clubs (including gyms, health & fitness clubs, and private clubs)'	Restaurant, 24 hr
'C - Fast-Food Restaurant'	Restaurant, fast food
'C - Fast-Food Restaurant with Drive-Thru'	Restaurant, sit down
'C - Food sales (not grocery/supermarket)'	Theater
'C - Full Service Restaurant'	
'C - Gasoline Service'	
'C - Medical Related Uses'	
'C - Theater (Live or Movie)'	
'C & I - Communication & Information (TV, Newspaper, Radio, Etc.)'	
'C - Veterinary Services'	
Industrial	
'M - Manufacturing and Wholesale Trade'	Industrial assembly and manufacturing
'M - Other Industrial or Manufacturing'	Industrial R&D
'M - Warehousing and Storage'	Warehouse/industrial storage
'M - Construction Related Businesses'	
Retail	
'C - Grocery Store, Supermarket'	Grocery store
'C - Retail - Consumer Goods & Services'	Retail large
‘C - Shopping Center'	Retail small
Hotel	
'C - Lodging'	Hotel/motel
	Hotel/motel with restaurant
Institutional	
'I - Educational Services (day cares/schools)'	Church
'I - Hospital'	Church w/ school
'I - Memorial Services (funeral homes, cemeteries)'	Medical office
'I - Nursing Home/ Convalescent Hospital/ Rest Home'	Mixed medical/dental
'I - Other Government (Military, DMV, Post Office)'	School - elementary
'I - Other Institutional'	School - junior high
'I - Public Administration'	
'I - Public Safety (Police and Fire Stations)'	
'I - Religious Institutions (Churches, etc.)'	
'I - Special Purpose Institutions (Museum, Zoo, Library)'	
Office	
'C - Office (non-Institutional) - Business, Professional, Research'	General office
Multi-family	
‘R - Condo'	Condominium
'R - Mobile Home'	Multi-family apt
'R - Nursing Home/ Convalescent Hospital/ Rest Home'	Senior apt
'R - Multi-Family Residence'	
Single-family	
'R - Single Family Residence'	Single family, Small (up to 9999 sq ft lot)
	Single family, Medium (10000-22000 sq ft lot)
	Single family, Large (22001 sq ft - 1 acre lot)
	Single family, (over 1 acre lot)