APPENDIX N

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: Universal Paragon Corporation, California

Project Title: Brisbane Baylands Project

Project No: 134535-001-****

Technical Memorandum No. 1

Subject: Baylands Water Use Projections and Water Balance for Base Land Use Scenario

Date: February 2, 2011

To: Jonathan Scharfman, Land Development Director

From: Tom Birmingham, P.E., Senior Engineer

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1. INTRODUCTION

This Technical Memorandum 1 (Tech Memo 1) includes the water use projections, balance, and savings plan for the Baylands development in Brisbane, California planned by Universal Paragon Corporation (UPC). Also included are the methods and assumptions used to develop the water use projections based on the "base land use scenario".

1.1 Scope of Work

This Tech Memo 1 is intended to fulfill the Task 1 ("Create a Comprehensive Water Balance") scope of work, including the following subtasks:

1.1.1 Task 1 - Water Demand Forecast and Balance

Based on the most recent project development provided by UPC (square footage by type of use), develop a specific, comprehensive water balance for the Brisbane Baylands Project. Forecast water demands for the project based on the current projections of commercial, residential, retail, and office space. We will use our experience with area developments and AWWA standards to determine the water use for each. We will coordinate with Wallace Roberts & Todd, LLC (WRT) to determine the percentage of landscaped area's with high, medium, and low irrigation demands. Brown and Caldwell will engage Natural Systems International, Inc to assist in completing this task.

1.1.2 Task 2 - Water Savings Plan

Brown and Caldwell will create an aggressive but practical water savings plan for the Brisbane Baylands Project. In 2004, URS, the San Francisco Public Utilities Commission (SFPUC), and the Bay Area Water Supply and Conservation Agency (BAWSCA) completed a report detailing a three-tiered water conservation plan. The report used Programs A, B, and C for water conservation, with Program A conforming with the current Uniform Plumbing Code, and Program C using the most aggressive conservation measures. In 2006, BC worked with BAWSCA to update that report. We will use our knowledge of the report to develop water use plans for the Baylands Project. We will also update projections for additional savings possible in Brisbane and Guadalupe Valley Municipal Improvement District (GVMID) if Program C is implemented and an order-of-magnitude estimated cost of that implementation as a possible offset to new water demands from the Baylands. Beyond Program C, evaluate how using recycled water for irrigation will reduce overall water demand. Beyond Program C, evaluate how using recycled water with dual piping will lower the water demands beyond Program C. For this option, in conjunction with Task 3 below, determine if onsite water use would generate sufficient effluent for recycled water needs or whether some raw sewage would need to be diverted from the City/GVMID raw sewage discharge to the San Francisco Southeast Treatment Plant. Brown and Caldwell will engage Natural Systems International, Inc to assist in completing this task.

1.1.3 Task 3 - Draft Technical Memorandum

Brown and Caldwell will prepare a draft technical memorandum (estimated at five pages of text plus supporting tables) summarizing Task 1 and submit five copies to UPC for review and comment. We will address one set of collated comments, and submit 10 copies (PDF format) of a final draft for review by the City. Meeting with City staff once is included to review the draft and receive one set of collated comments and answer questions. We will respond to questions and finalize the tech memo.

2. WATER USE PROJECTIONS AND BALANCE

The water use projections and balance along with methods and assumptions are included in this section.

2.1 Methods

2.1.1 Water Savings Programs

Water use projections were developed for five different scenarios (Table 2-1). To the extent that is economically viable, the maximum water savings will be sought through selection of either one of the water savings programs described in this section or a combination of the programs.

Within Table 2-1, Program A serves as a baseline water demand. The SFPUC Wholesale Customer Water Conservation Potential report (URS 2004) included the evaluation of three potential water conservation programs, each of which contains a unique combination of water conservation measures, for SFPUC's retail agencies (including the City of Brisbane). The water demand evaluation conducted for the Baylands development includes the water savings under each of these three programs (i.e., Programs A, B, and C), assuming that the following water conservation measures are implemented, as appropriate based on end uses for the water, as follows:

Program A

- Public Information

Program B

- Water Budgets
- Public Information
- Landscape Requirements for New Systems
- Require 0.5 gal/flush Urinals in New Commercial, Industrial, Institutional (CII) Buildings
- Commercial water audits

Program C

- All components of Program B
- Water Audits Hotels-Motels
- Multifamily units sub-metering requirement
- Residential multi-family efficient clothes washer rebate
- WAVE Program (US EPA) for Hotels

In addition to the three programs summarized above, more aggressive conservation is incorporated into three additional demand projection scenarios (Programs D, E and F), which are further described below.

Program D

In addition to the packages of water conservation measures evaluated in the SFPUC study, another program (Program D) was developed to incorporate more aggressive water conservation measures in the Baylands development. The measures included in Program D include those mentioned in Program C (above), and additional measures are as follows:

- All components of Program C
- Dedicated Landscape Meters for Outdoor Irrigation Use
- Native Plants
- Subsurface Irrigation for Turf
- Hard-scape (e.g. track and exercise equipment instead of large lawns in parks): Area is covered with materials other than vegetation.
- High Efficiency Toilets (1.28 gpf or less) or Dual-Flush Toilets (0.8 gpf half-flush and 1.6 gpf full-flush)
- Automatic sinks
- Waterless urinals

Program E

Program E includes recycling of all wastewater generated onsite. After wastewater is treated, polished through constructed wetlands, filtered, and disinfected, it would be recycled onsite for irrigation and for flushing toilets and urinals. The water recycling would be achieved through dual plumbing of the water systems throughout the property. The components of Programs C and D are assumed to be implemented in Program E, with the exception that more costly higher efficiency measures would not be implemented if they would be supplied by recycled water in Program E. Such measures include high efficiency and dual-flush toilets and waterless urinals. The components of Program E are as follows:

- All components of Program D (except for high efficiency and dual-flush toilets and waterless urinals)
- Onsite wastewater treatment and recycling
- Dual-plumbing for potable and recycled water

Program F (Offsite Conservation Option, Appendix A)

Another option that was considered includes the implementation of water conservation measures within the City of Brisbane but outside of the Baylands development. The program components considered under this option (Program F – Offsite Conservation Option) include conservation measures that are not cost effective for the City to implement but that would result in water savings. The purpose in implementing such measures would be to pursue a "water credit" from the City by offsetting its current water demand through more intensive water use efficiency.

In 2006, the SFPUC prepared the "Investigation of Regional Water Supply Option No. 4" (RWSO4) technical memorandum to determine the potential for demand reductions related to regional conservation programs. The RWSO4 included the evaluation of three potential regional conservation programs (Programs R1, R2, and R3). All water use efficiency measures evaluated in the RWSO4 and their respective water savings for the City of Brisbane are included in Appendix A.

2.1.2 Calculations

Calculations were performed using a number of assumptions, as further described in Section 2.2. Most calculations were simple conversions of units and occupancy rates.

The most involved of the calculations was the projection for landscape water demand, which was performed by Natural Systems International (NSI). The irrigation requirement was calculated using the Landscape Coefficient Method, as follows:

- **Gross Demand = ETo x KL**

  where: ETo = Reference Evapotranspiration for the Region, inches

  KL = Landscape Coefficient

- **Landscape Coefficient KL = ks x kd x kmc**

  where: ks = Species factor, which takes into account the different water requirements of different species. Adequately green landscapes can be maintained at about 50 percent of reference ET, therefore the average ks value is 0.5. Truly xeric landscapes that require no additional water after establishment have a ks = 0.

  kd = Density factor, accounting for number of plants and total leaf area of a landscape. Sparsely planted areas will have a lower ET rate than densely planted areas.

  kmc = Microclimate factor, accounting for landscape variation in temperature, wind exposure, and humidity. The average kmc is 1.0. Higher values occur in landscapes surrounded by heat-absorbing or reflective surfaces, or where wind exposure is unusually high. Examples of high kmc areas are parking lots, west sides of buildings, west and south slopes, medians, and areas experiencing wind-tunneling. Low kmc areas are shady areas, areas protected from wind, north sides of buildings, courtyards, areas under overhangs, and the north sides of slopes.

- **Net Demand = (Gross Demand / IE) x CE**

  where: IE = Irrigation Efficiency, for the project irrigation type, as shown in the following table.

Table 2-1. Irrigation Efficiency by Type

Irrigation Type	Irrigation Efficiency
Sprinkler	*0.625*
Drip	*0.90*

CE = Controller Efficiency: all major irrigation projects should use a high-efficiency controller, such as an ET-controller. For the purposes of initial estimation of residential landscaping, CE is assumed to be 1.0. For golf courses which will be using an ET-controller or similar controls, CE is assumed to be 0.75, until design is finalized enough to apply direct calculation of likely CE using a daily water balance based on historical rainfall, using daily records or generated daily gamma distributions.

The data and calculations that were used for the landscape water demand are included in Appendix B.

2.1.3 Schedule

It is assumed that the construction of the Baylands development will be phased over approximately 20 years, starting in approximately 2014. The anticipated phased construction will result in a phased water demand for the property. The property buildout in square footage added per year is anticipated to proceed as shown in Figure 2-1.

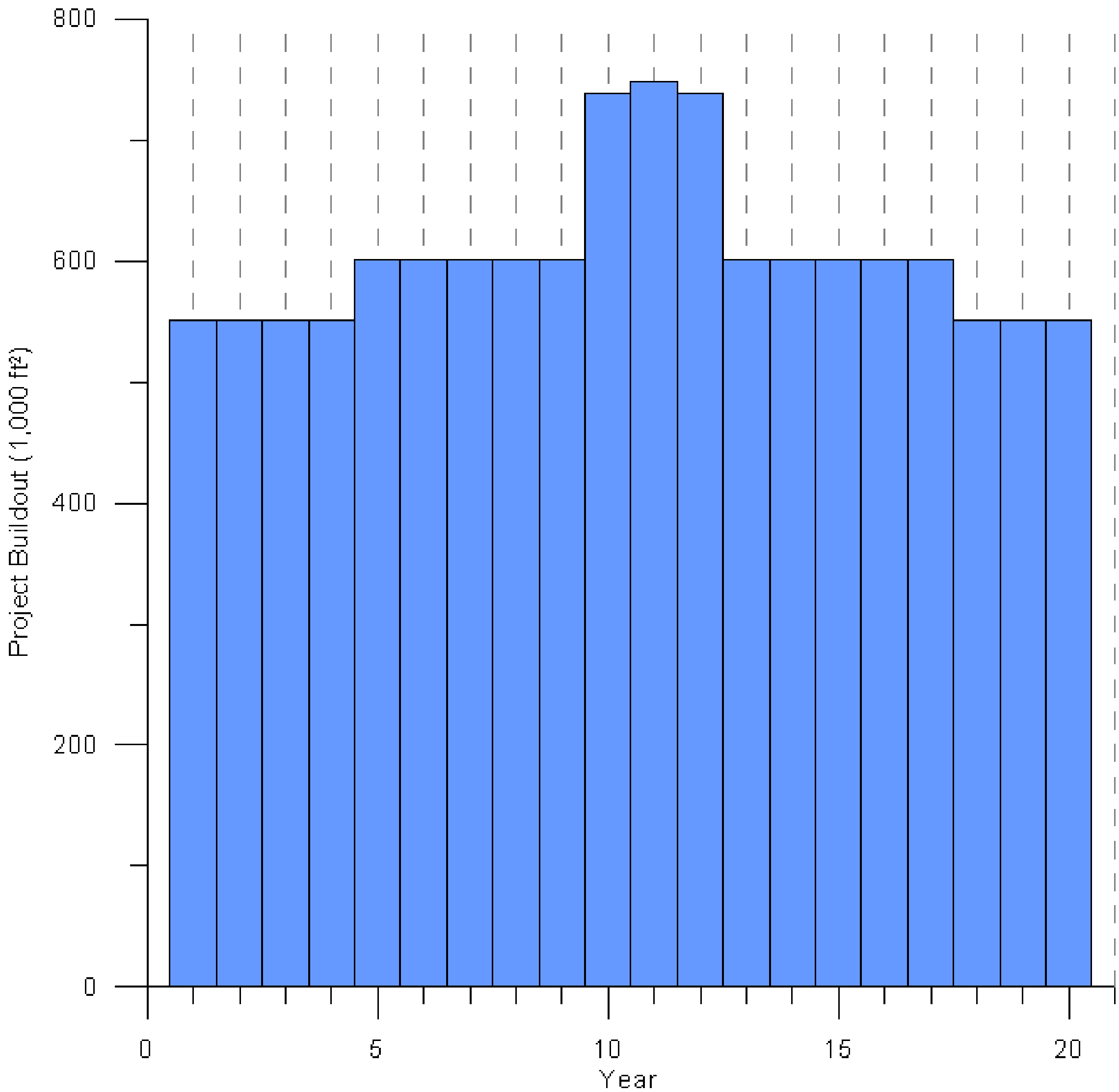

Figure 2-1. Baylands Development Buildout by Year

2.2 Assumptions

A number of assumptions had to be made to estimate water demand for the Baylands property. Assumptions by land use are as follows:

- **Residential** – Residential water use is calculated for one bedroom, two bedroom, and three bedroom flats and townhomes, each assumed to have 85 percent occupancy. One bedroom units are assumed to house 1.5 persons per unit, two bedroom units are assumed to house 3 persons per unit, and three bedroom unites are assumed to house 4.5 persons per unit.. The number of residential flats includes:
  - One bedroom flats: 1,580
  - Two bedroom flats:1,975
  - Three bedroom flats: 395

The number of residential townhomes includes:

- Two bedroom townhomes: 242
- Three bedroom townhomes: 242

Outdoor water demands are not included in the residential use, but are included in the irrigation demand.

- **Office and Institutional** – The office and institutional land uses are assumed to be occupied five days per week (as included in the annual demand). Cooling water demand is estimated as 10 percent of the total water use.
- **Research and Development (R&D)** – It is assumed that there are 1,600 employees. The type of R&D being conducted could potentially drastically change the water demand. For this scenario, we assumed the R&D facility would comprise of 75% office space and 25% R&D. The water demand projection for the R&D portion is based on water use at an existing biotech facility. It is assumed in the annual demand that the R&D facility is operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Retail** – It is assumed in the annual demand that the retail uses are operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Hotel** – It is assumed that there are 185 one bedroom units and 184 two bedroom units. Occupancy rates for the one bedroom and two bedroom units are estimated at 1.5 persons per unit and 3 persons per unit, respectively. It is also assumed that the one bedroom units use 110 gpd and that the two bedroom units use 220 gpd for indoor uses. The hotel restaurant will have a water demand of 35 gpd for each person staying at the hotel, which is embedded within the water demand per hotel room. Using the assumed hotel room occupancy rates of 1.5 persons per unit and 3 persons per unit for one and two bedroom hotel rooms, respectively, the water rates are 162 gpd/room for one bedroom and 325 gpd/room for two bedroom. The hotel is assumed to have an occupancy rate of 75 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Conference Hall** – The conference hall is assumed to have a capacity of 1,400 persons per day with an occupancy rate of 80 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Warehousing and Distribution** – It is assumed in the annual demand that the warehousing and distribution uses are operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Irrigation** – Assumptions related to irrigation include as made by NSI include that the water demand reflects an "average" (50th percentile) year. Density and microclimate coefficients (kd and kmc) of 1.0 were used. For likely ks (species) values, the value of 0.8 was used for turf (adequate maintenance of "green" for cool-season turfs), while the value 0.5 was used for non-turf (average for mixed trees, shrubs, and ground-cover). A default irrigation efficiency of 62.5 percent was used for spray/sprinkler (turf) and 90 percent for drip irrigation (non-turf).

2.3 Results

2.3.1 Water Use Projections

The results of the water demand are included in Tables 2-2 and 2-3. In addition, the amount of water used annually through the phased construction of the Baylands development is included in Table 2-4.

If Program F were considered a viable option for pursuing alternative water supply through funding and supporting the implementation of water use efficiency measures in the City of Brisbane, a water credit of at least 41,000 gpd would be available (Appendix A). It should be noted that water savings information was not available for each of the conservation measures listed in Appendix A; so, the water credit estimation is conservative and could be refined in the future if deemed appropriate.

Figure 2-2 depicts the cumulative water demands under Programs D and E as a function of the phased Baylands development construction. (Note that Program E assumes that no potable water is used for irrigation.)

The irrigation calculations give a peak July demand of 5,393 gpd for turf (including trees planted in turf) and 2,341 gpd for irrigated non-turf. Average annual (April – November) values are less, at 2,821 gpd for turf and 1,225 gpd for non-turf.

Table 2-2. Water Demand Projections under Various Water Savings Programs for the Base Land Use Scenario

Use	Area (sf)	Rate		Units		Program A (gpd)		Program B (gpd)		Program C (gpd)		Program D (gpd)		Program E (gpd)	
						S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]
Residential	5,150,400														
Condos/Apartments	4,351,800														
Residential Flats - 1 BR	-	110	gpd/unit	1,580	units	162,500	162,500	162,500	162,500	162,500	162,500	152,750	152,750	118,630	118,630
Residential Flats - 2 BR	-	220	gpd/unit	1,975	units	406,260	406,260	406,260	406,260	406,260	406,260	381,880	381,880	296,570	296,570
Residential Flats - 3 BR	-	330	gpd/unit	395	units	121,880	121,880	121,880	121,880	121,880	121,880	114,560	114,560	88,970	88,970
Townhomes	798,600														
Residential Townhomes - 2 BR	-	220	gpd/unit	242	units	49,780	49,780	49,780	49,780	49,780	49,780	46,790	46,790	36,340	36,340
Residential Townhomes - 3 BR	-	330	gpd/unit	242	units	74,670	74,670	74,670	74,670	74,670	74,670	70,190	70,190	54,510	54,510
Office and Institutional	2,762,000	75	gpd/1000 sq ft	--	--	216,470	216,470	194,820	194,820	194,820	194,820	146,120	146,120	49,790	49,790
R&D	3,328,300			1,600	employees										
Office	2,496,225	75	gpd/1000 sq ft			195,640	195,640	176,080	176,080	176,080	176,080	132,060	132,060	45,000	45,000
Lab	832,075	10,000	gpd/acre			199,610	199,610	199,610	199,610	199,610	199,610	199,610	199,610	199,610	199,610
Retail	566,300	50	gpd/1000 sq ft	--	--	31,150	31,150	28,030	28,030	28,030	28,030	21,020	21,020	7,160	7,160
Hotel	239,800														
Hotel - 1 BR	-	162	gpd/room	185	rooms	24,730	24,730	24,730	24,730	19,290	19,290	18,130	18,130	18,050	18,050
Hotel - 2 BR	-	325	gpd/room	184	rooms	49,340	49,340	49,340	49,340	38,480	38,480	36,170	36,170	36,010	36,010
Conference Hall	21,300	15	gpd/person	1,400	persons	18,480	18,480	16,630	16,630	16,630	16,630	12,470	12,470	4,250	4,250
Warehousing & Distribution	28,200	600	gpd/acre	--	--	430	430	390	390	390	390	290	290	100	100
Development Subtotal	**12,096,300**					**1,550,940**	**1,550,940**	**1,504,720**	**1,504,720**	**1,488,420**	**1,488,420**	**1,332,040**	**1,332,040**	**954,990**	**954,990**
Irrigation	NA					300,960	0	300,960	0	300,960	0	300,960	0	0	0
Irrigation Subtotal	**NA**					**300,960**	**0**	**300,960**	**0**	**300,960**	**0**	**300,960**	**0**	**0**	**0**
TOTAL	**12,096,300**					**1,851,900**	**1,550,940**	**1,805,680**	**1,504,720**	**1,789,380**	**1,488,420**	**1,633,000**	**1,332,040**	**954,990**	**954,990**

[a]S = Summer/dry season, defined as April through November

[b]W = Winter/wet season, defined as December through March

Table 2-3. Total Water Demand Projections under Various Water Savings Programs for the Base Land Use Scenario (in acre-feet per year)

Program A	Program B	Program C	Program D	Program E
1,893	1,848	1,830	1,670	1,054

Table 2-4. Total Baylands Annual Water Demand with Phased Construction

Year	Area (sf)	Program A (gpd)		Program B (gpd)		Program C (gpd)		Program D (gpd)		Program E (gpd)		Cumulative Demand Based on Program E (gpd)
		S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	
1	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	43,521
2	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	87,041
3	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	130,562
4	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	174,082
5	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	221,550
6	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	269,018
7	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	316,487
8	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	363,955
9	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	411,423
10	738,250	113,023	94,656	110,203	91,835	109,208	90,840	99,664	81,296	58,284	58,284	469,707
11	748,550	114,600	95,976	111,740	93,116	110,731	92,107	101,054	82,430	59,097	59,097	528,804
12	738,250	113,023	94,656	110,203	91,835	109,208	90,840	99,664	81,296	58,284	58,284	587,088
13	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	634,556
14	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	682,024
15	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	729,492
16	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	776,960
17	601,250	92,049	77,090	89,752	74,793	88,942	73,982	81,169	66,209	47,468	47,468	824,428
19	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	867,949
19	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	911,469
20	551,250	84,394	70,679	82,288	68,573	81,545	67,830	74,419	60,703	43,521	43,521	954,990
TOTAL	**12,096,300**											**954,990**

[a]S = Summer/dry season, defined as April through November

[b]W = Winter/wet season, defined as December through March

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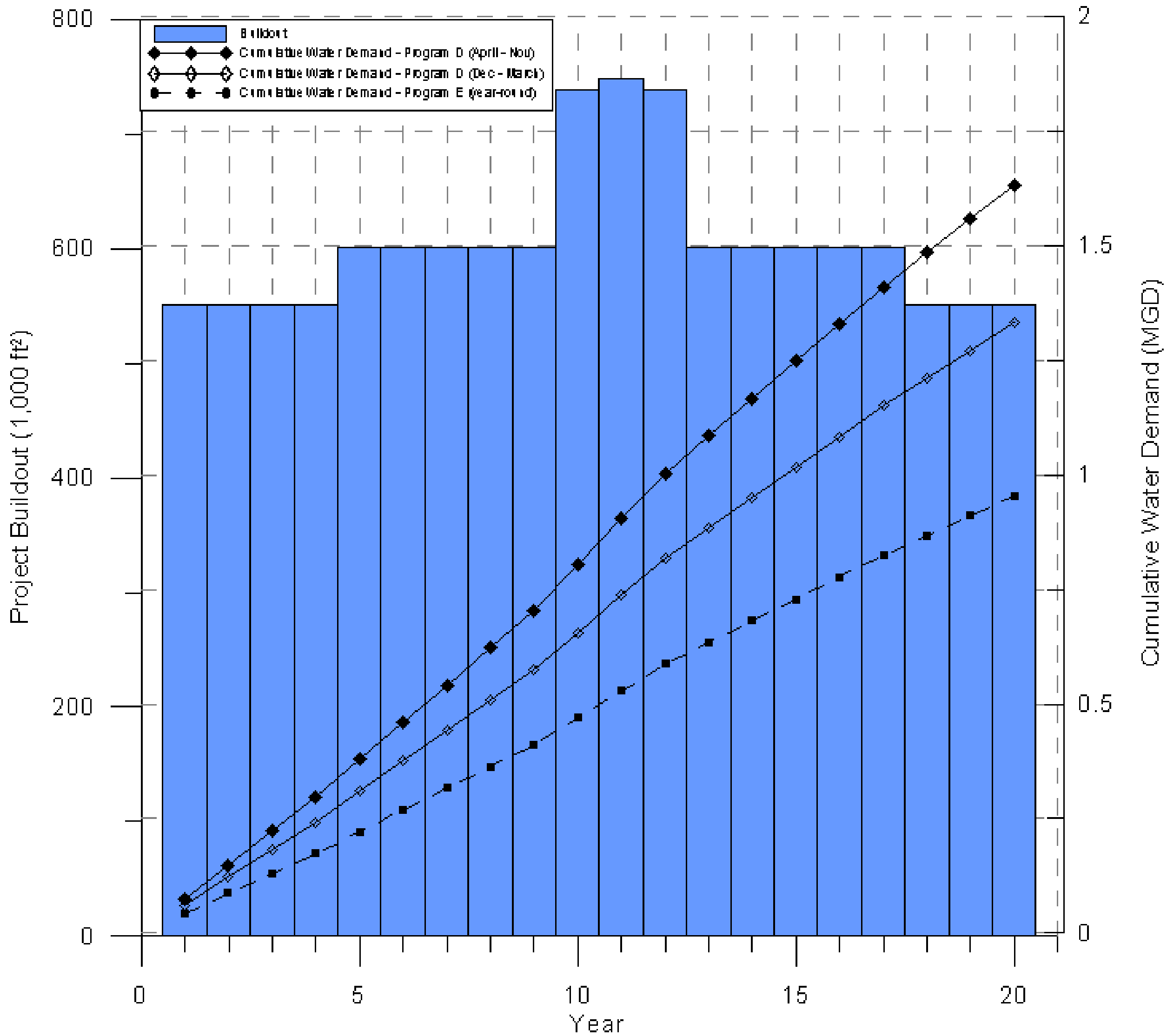

Figure 2-2. Baylands Cumulative Water Demand (under Programs D and E) as a Function of Buildout Schedule

Notes: (1) Program E assumes no potable water would be used for irrigation; (2) MGD is million gallons per day.

APPENDIX A – PROGRAM F (OFFSITE CONSERVATION OPTION) WATER USE EFFICIENCY MEASURES

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	1	Residential Water Surveys	0.001		
Measure	2	Residential Retrofit			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	3	Large Landscape Conservation	0.002		
Measure	4	Water Budgets		0.017	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	5	Clothes Washer Rebate	0.001		
Measure	6	Public Information Program		0.002	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	7	Commercial Water Audits	0.004		
Measure	8	Commercial ULF Toilet and Urinal Rebates	0.000		
Measure	9	Residential ULF Toilet Rebate	0.004		
Measure	10	Require 1.6 gpf toilets to be installed at the time of sale of existing buildings	0.005		
Measure	11	Home Leak Detection and Repair	0.000		
Measure	12	Rebates for 6/3 dual flush or 4 liter toilets	0.004		
Measure	13	ET Controller Rebates	0.002		
Measure	14	Xeriscape education and staff training at retail garden/irrigation supply houses			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	15	Homeowner irrigation classes	0.001		
Measure	16	Promote water efficient plantings at new homes	0.000		
Measure	17	Offer incentives for replacement of clothes washers in coin-operated laundries	0.001		
Measure	18	Incentives for retrofitting sub-metering	0.000		
Measure	19	Require sub-metering multifamily units	0.001		
Measure	20	Rebate efficient clothes washers	0.000		
Measure	21	Enforce landscape requirements for new landscaping systems (turf limitations/regulations)		0.006	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	22	Restaurant low flow spray rinse nozzles	0.001		
Measure	23	Focused water audits for hotels/motels	0.002		
Measure	24	WAVE Program (USEPA) for hotels	0.000		
Measure	25	Hotel retrofit (w/ financial assistance)	0.001		
Measure	26	Award program for water savings by business			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	27	Replace inefficient water using equipment	0.000		

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	28	Require 0.5 gpf urinals in new buildings		0.002	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004).Assumed to be included in the City of Brisbane's water conservation program.
Measure	29	Financial incentives for complying with water use budget	0.010		
Measure	30	Financial incentives for irrigation upgrades	0.001		
Measure	31	Require dedicated irrigation meters for new accounts			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	32	Water Utility/City Department water reduction goals			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM1	Direct Install of HETs			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM2	Educational and Training Programs			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM3	Rain Sensor Rebate			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM4	Replacement of Urinals			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	RM7	Commercial Water Audits (revised)			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	RM25	Hotel-Motel Retrofit (revised)			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
TOTAL			**0.041**	**0.027**	

NOTE: All average potential City of Brisbane water savings shown in this table are based on URS, 2006 (Investigation of Regional Water Supply Option No. 4 Technical Memorandum. Prepared for the San Francisco Public Utilities Commission)

APPENDIX B – LANDSCAPE WATER DEMAND DATA AND CALCULATIONS

Climate and Soil Summary

Project: Baylands Project

Locale: Brisbane, CA

Sources:

1) Temperature Data from: *NOAA Climatology of the U.S. #20: 30-year Station Normals. Stations:San Francisco Downtown, Int'l AP, & Oceanside (3 Stn Avg).*

2) Precipitation Data from: *ibid. (average of 3 stations).*

3) Pan Evaporation Data: *Oregon Climate Service (Western Regional Climate Center); Station: San Francisco Int'l Airport (calculated via Mod Penman eq'n)*

4) Evapotranspiration Data: *WUCOLS III (CIMIS 1999): Avg ET_0 Zones 1&2 (Coast. Fog Areas)* (Verified w/ CIMIS Estimates for July for San Fran: 4.6" - 4.9")

5) Design Storm Data from: *NOAA ATLAS 2 vol.11, Northern California (San Francisco).*

Mean Air Temperature[1]

January:	50.8 °F =	**10.4 °C**	(min)
July:	60.5 °F =	**15.8 °C**	(max)

Mean Pan Evap & Precipitation (inches)[2,3,4]

	PanEv[3]	ET_o[4]	Precip[2]	PE[3] %	ET_0[4] %	P[2] %
Jan	1.7	1.09	4.44	3.1%	3.0%	21.4%
Feb	2.4	1.54	3.97	4.4%	4.3%	19.1%
Mar	3.8	2.79	3.30	7.0%	7.8%	15.9%
Apr	5.3	3.60	1.20	9.7%	10.0%	5.8%
May	6.4	4.34	0.48	11.8%	12.1%	2.3%
Jun	7.1	4.80	0.11	13.1%	13.3%	0.5%
Jul	6.7	4.81	0.03	12.3%	13.4%	0.2%
Aug	6.6	4.34	0.08	12.1%	12.1%	0.4%
Sep	5.9	3.60	0.22	10.8%	10.0%	1.0%
Oct	4.4	2.64	1.09	8.1%	7.3%	5.2%
Nov	2.4	1.50	2.80	4.4%	4.2%	13.5%
Dec	1.7	0.93	3.01	3.1%	2.6%	14.5%
Annual	**54.4**	**35.97**	**20.72**	100.0%	100.0%	100.0%

Design Storm Events (inches)[5]

Frequency	2-y	5-y	10-y	50-y	**100-y**	year
Duration	24	24	24	24	**24**	hours
P (inch)	2.40	3.00	3.30	4.30	**4.50**	inches
i (in/h)	0.10	0.13	0.14	0.18	0.19	inch/hour

Water Balance:
Climate Data Summary

Project: Baylands Project
Phase: Preliminary Study Review
File Date: 1/25/08

1. Rainfall Probabilities

Table 1. Means from 1971-2000 Monthly Normals.

Month	Days per Month	Mean (inches)	Mean Distribution Curve (%)
Jan	31	4.44	21.4%
Feb	28	3.97	19.1%
Mar	31	3.30	15.9%
Apr	30	1.20	5.8%
May	31	0.48	2.3%
Jun	30	0.11	0.5%
Jul	31	0.03	0.2%
Aug	31	0.08	0.4%
Sep	30	0.22	1.0%
Oct	31	1.09	5.2%
Nov	30	2.80	13.5%
Dec	31	3.01	14.5%
Ann	365	20.72	100.0%

Table 2. Incomplete Gamma Distribution: based on 1971-2000 monthly normals. (Average of 3 Stations)

Annual Precipitation Probabilites (NOAA)			
percentile	10%	50%	90%
inches	11.75	19.78	30.87

It should be noted that rainfall probabilities do not follow a normal distribution; rather, rainfall is best modeled by the gamma or partial-gamma distribution (Table 3, above). The water balance is thus calculated for 3 possibilities: the 50th percentile, 90th percentile (wettest year in 10), & 10th percentile (driest year in 10). Note that the 50th percentile annual rainfall is not equal to the mean. This is an expected difference, and is the result of statistical modeling methods. For this water balance, the annual rainfall depth will be used, distributed according to the mean distribution curve (see Table 1).

Table 3. Precipitation based on Annual Depth x Mean Distribution Curve (inch)

Month	10th Percentile	50th Percentile	90th Percentile
Jan	2.52	4.24	6.61
Feb	2.25	3.79	5.91
Mar	1.87	3.15	4.91
Apr	0.68	1.15	1.79
May	0.27	0.46	0.71
Jun	0.06	0.11	0.16
Jul	0.02	0.03	0.05
Aug	0.05	0.08	0.12
Sep	0.12	0.21	0.32
Oct	0.62	1.04	1.62
Nov	1.59	2.68	4.18
Dec	1.71	2.88	4.49
Annual	11.75	19.78	30.87

2. Planting Mix Landscape Coefficients & Irrigation Coefficients

Table 6. Crop & Irrigation Coefficients

Landscape Type	Species Factor (K_s)	Density Factor (K_d)	Micro Climate (K_{mc})	Landscape Coefficient (K_L)	Irrigation Type	Irrigation Efficiency (IE)	Controller Reduction (CR)
Turf	0.8	1.0	1.0	**0.80**	spray	0.625	1.0
Non-Turf	0.5	1.0	1.0	**0.50**	drip	0.9	1.0

Source: Metcalf & Eddy, "Water Reuse", McGraw-Hill, 2007 & WUCOLS III (U. Cal. 1999).

3. Evapotranspiration (ET_0) Data

Table 7. Pan and Reference ET (inches)

Month	Mean Pan Evap	ET_o (green cvr)	Percent ET Distribution
Jan	1.70		0.0%
Feb	2.40		0.0%
Mar	3.80		0.0%
Apr	5.30	3.60	12.1%
May	6.40	4.34	14.6%
Jun	7.10	4.80	16.2%
Jul	6.70	4.81	16.2%
Aug	6.60	4.34	14.6%
Sep	5.90	3.60	12.1%
Oct	4.40	2.64	8.9%
Nov	2.40	1.50	5.1%
Dec	1.70		0.0%
Annual	**54.40**	**29.63**	**100.0%**

PE from: *Oregon Climate Service (Western Reg. Clim. Ctr.); Stn: San Francisco Int'l Airport.*
ET_o from: *WUCOLS III (U.Cal. 1999 - CIMIS Data): Average ET_0 Zones 1&2 (Coast. Fog Areas).*

4. Net Demand = (ET_0 x K_L x CE) / IE

Adjust Demand for Rainfall? **no** (no if ET_0 takes into account rainfall already)

Effective Rainfall Use by Plants: **0%** (typ. 40%-60%, unless ET_0 takes into account rainfall)

Design Rainfall Use by Plants: **0%**

Table 8A. Average-Year Demand (inches)

Month	Demand **Turf**	Demand **Non-Turf**	Demand
Jan	0.00	0.00	
Feb	0.00	0.00	
Mar	0.00	0.00	
Apr	4.61	2.00	
May	5.56	2.41	
Jun	6.14	2.67	
Jul	6.16	2.67	
Aug	5.56	2.41	
Sep	4.61	2.00	
Oct	3.38	1.47	
Nov	1.92	0.83	
Dec	0.00	0.00	
Annual	**37.93**	**16.46**	

Table 8B. Rainfall Adj. Avg Demand (in)

Month	Demand **Turf**	Demand **Non-Turf**	Demand
Jan	0.00	0.00	
Feb	0.00	0.00	
Mar	0.00	0.00	
Apr	4.61	2.00	
May	5.56	2.41	
Jun	6.14	2.67	
Jul	6.16	2.67	
Aug	5.56	2.41	
Sep	4.61	2.00	
Oct	3.38	1.47	
Nov	1.92	0.83	
Dec	0.00	0.00	
Annual	**37.93**	**16.46**	

Table 8C. Average Demand (gpd/acre)

Month	Demand **Turf**	Demand **Non-Turf**	Demand
Jan	0	0	
Feb	0	0	
Mar	0	0	
Apr	4,171	1,810	
May	4,866	2,112	
Jun	5,561	2,414	
Jul	5,393	2,341	
Aug	4,866	2,112	
Sep	4,171	1,810	
Oct	2,960	1,285	
Nov	1,738	754	
Dec	0	0	
Annual	**2,821**	**1,225**	

5. Landscaping Mix By Locale

Table 11. Landscaping Mix by Category

Landscaping Area	Planted Acres	% Planted **Turf**	% Planted **Non-Turf**	% Planted	
Parking Lot Turf Landscape	7.78	100.00%	0%		100%
Right-of-Way Turf Landscape	18.26	100.00%	0%		100%
Open Space Landscape	25.1	76.49%	23.51%		100%
Open Area Landscape	29.9	34.78%	65.22%		100%
Total Acres:	**81.04**	69%	31%	0%	100%

6. Annual Water Demand

Table 12. Summary of Demand

Landscaping Area	Avg Yearly Demand (acre-feet)
Parking Lot Turf Landscape	**24.6**
Right-of-Way Turf Landscape	**57.7**
Open Space Landscape	**68.8**
Open Area Landscape	**59.6**
	-
	-
	-
	-
	-
Total Demand (acre-feet per year)	**210.7**
Total Demand (million gallons/yr)	**68.65**

Table 13. Summary of Landscaping

	Acres of Parking Landscape (10% of (footprint)	Acres of Right-of-Way Landscape (9 sf/tree)	Acres of Open "Space"	Acres of Open "Area"	Total Acres of Landscape Type
total acres	7.78	18.26	25.1	29.9	81.04
Turf acres:	7.78	18.26	19.2	10.4	55.64
%:	100.00%	100.00%	76.49%	34.78%	68.66%
H_2O AFY:	24.59	57.71	60.68	32.87	175.85
Non-turf ac	0	0	5.9	19.5	25.4
%:	0.00%	0.00%	23.51%	65.22%	31.34%
H_2O AFY:	0.00	0.00	8.09	26.75	34.84

Table 14. Summary of Tree Assumptions

	# Trees in Parking Landscape (1 tree per 6 spaces)	# Trees in Right-of-Way (25 ft tree spacing)	# Trees in Open Space Turf	# Trees in Open Area Turf	Total Acres of Landscape Type
# Trees:	2,446	4,096	0	0	6,542
Water Use:	included above for turf & non plantings	included above for turf & non plantings	0 but would be incl'd in above est.	0 but would be incl'd in above est.	included above for turf & non plantings

Table 15. Summary of ET_0/K_L Method Landscape Demand

	Landscape Demand (acre-ft/yr) (Apr - Nov)	Landscape Demand (mil.gal/yr) (Apr - Nov)	Peak (July) gpd/acre turf	Annual (Apr - Nov) gpd/acre turf	Peak (July) gpd/acre non-turf	Annual (Apr - Nov) gpd/acre non-turf
ET_0/K_L Method	**210.7**	68.65	5,393	2,821	2,341	1,225

7. Landscape Coefficient Method Explanation

ET_o represents the estimated water demand for a reference crop, typically green groundcover. Landscaping demand is estimated using the widely accepted Landscape Coefficient Method, which is outlined in Metcalf & Eddy, "Water Reuse", McGraw-Hill, 2007, "A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California", and the USGBC LEED NC-2.2 Reference Manual.

Gross Demand = ET_o x K_L

where: ET_o = Reference Evapotranspiration for the Region, inches

K_L = Landscape Coefficient

Landscape Coefficient K_L = k_s x k_d x k_{mc}

k_s = Species factor, which takes into account the different water requirements of different species. Adequately green landscapes can be maintained at about 50% of reference ET, therefore the average ks value is 0.5. Truly xeric landscapes that require no additional water after establishment have a k_s = 0.

k_d = Density factor, accounting for number of plants and total leaf area of a landscape. Sparsely planted areas will have a lower ET rate than densely planted areas.

k_{mc} = Microclimate factor, accounting for landscape variation in temperature, wind exposure, and humidity. The average k_{mc} is 1.0. Higher values occur in landscapes surrounded by heat-absorbing or reflective surfaces, or where wind exposure is unusually high. Examples of high k_{mc} areas are parking lots, west sides of buildings, west and south slopes, medians, and areas experiencing wind-tunneling. Low k_{mc} areas are shady areas, areas protected from wind, north sides of buildings, courtyards, areas under overhangs, and the north sides of slopes.

Typical Landscape Coefficient Factors

Vegetation Type	Species Factor k_s low	average	high
Trees	0.2	0.5	0.9
Shrubs	0.2	0.5	0.7
Groundcovers	0.2	0.5	0.7
Tree, Shrub, Groundcover: Mixed	0.2	0.5	0.9
Turfgrass	0.6	0.7	0.8

Vegetation Type	Density Factor k_d low	average	high
Trees	0.5	1.0	1.3
Shrubs	0.5	1.0	1.1
Groundcovers	0.5	1.0	1.1
Tree, Shrub, Groundcover: Mixed	0.6	1.1	1.3
Turfgrass	0.6	1.0	1.0

Vegetation Type	Microclimate Factor k_{mc} low	average	high
Trees	0.5	1.0	1.4
Shrubs	0.5	1.0	1.3
Groundcovers	0.5	1.0	1.2
Tree, Shrub, Groundcover: Mixed	0.5	1.0	1.4
Turfgrass	0.8	1.0	1.2

Net Demand = (Gross Demand / IE) x CE

where: IE = Irrigation Efficiency for the project irrigation, as shown in the next table.
CR = Controller Reduction: all major irrigation projects should use a high-efficiency controller, such as an ET-controller.
For the purposes of initial estimation of residential landscaping, CE is assumed to be 1.0. For golf courses which will be using an ET-controller or similar controls, CE could be assumed to be 0.75.

Typical Irrigation Efficiencies

Irrigation Type	Irrigation Efficiency
Sprinkler	0.625
Drip	0.90

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: Universal Paragon Corporation, California

Project Title: Brisbane Baylands Project

Project No: 134535-001-****

Technical Memorandum No. 1

Subject: Baylands Water Use Projections and Water Balance for Entertainment Land Use Scenario

Date: February 2, 2011

To: Jonathan Scharfman, Land Development Director

From: Tom Birmingham, P.E., Senior Engineer

Copy to: Jeff Burnham, E.I.T., LEED AP

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Reviewed by: ______________________________

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Limitations:

This document was prepared solely for Universal Paragon Corporation (UPC) in accordance with professional standards at the time the services were performed and in accordance with the contract between UPC and Brown and Caldwell dated January 8, 2008 This document is governed by the specific scope of work authorized by UPC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by UPC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

1. INTRODUCTION

This Technical Memorandum 1 (Tech Memo 1) includes the water use projections, balance, and savings plan for the Baylands development in Brisbane, California planned by Universal Paragon Corporation (UPC). Also included are the methods and assumptions used to develop the water use projections based on the "entertainment land use scenario".

1.1 Scope of Work

This Tech Memo 1 is intended to fulfill the Task 1 ("Create a Comprehensive Water Balance") scope of work, including the following subtasks:

1.1.1 Task 1 - Water Demand Forecast and Balance

Based on the most recent project development provided by UPC (square footage by type of use), develop a specific, comprehensive water balance for the Brisbane Baylands Project. Forecast water demands for the project based on the current projections of commercial, residential, retail, and office space. We will use our experience with area developments and AWWA standards to determine the water use for each. We will coordinate with Wallace Roberts & Todd, LLC (WRT) to determine the percentage of landscaped area's with high, medium, and low irrigation demands. Brown and Caldwell will engage Natural Systems International, Inc to assist in completing this task.

1.1.2 Task 2 - Water Savings Plan

Brown and Caldwell will create an aggressive but practical water savings plan for the Brisbane Baylands Project. In 2004, URS, the San Francisco Public Utilities Commission (SFPUC), and the Bay Area Water Supply and Conservation Agency (BAWSCA) completed a report detailing a three-tiered water conservation plan. The report used Programs A, B, and C for water conservation, with Program A conforming with the current Uniform Plumbing Code, and Program C using the most aggressive conservation measures. In 2006, BC worked with BAWSCA to update that report. We will use our knowledge of the report to develop water use plans for the Baylands Project. We will also update projections for additional savings possible in Brisbane and Guadalupe Valley Municipal Improvement District (GVMID) if Program C is implemented and an order-of-magnitude estimated cost of that implementation as a possible offset to new water demands from the Baylands. Beyond Program C, evaluate how using recycled water for irrigation will reduce overall water demand. Beyond Program C, evaluate how using recycled water with dual piping will lower the water demands beyond Program C. For this option, in conjunction with Task 3 below, determine if onsite water use would generate sufficient effluent for recycled water needs or whether some raw sewage would need to be diverted from the City/GVMID raw sewage discharge to the San Francisco Southeast Treatment Plant. Brown and Caldwell will engage Natural Systems International, Inc to assist in completing this task.

1.1.3 Task 3 - Draft Technical Memorandum

Brown and Caldwell will prepare a draft technical memorandum (estimated at five pages of text plus supporting tables) summarizing Task 1 and submit five copies to UPC for review and comment. We will address one set of collated comments, and submit 10 copies (PDF format) of a final draft for review by the City. Meeting with City staff once is included to review the draft and receive one set of collated comments and answer questions. We will respond to questions and finalize the tech memo.

2. WATER USE PROJECTIONS AND BALANCE

The water use projections and balance along with methods and assumptions are included in this section.

2.1 Methods

2.1.1 Water Savings Programs

Water use projections were developed for five different scenarios (Table 2-1). To the extent that is economically viable, the maximum water savings will be sought through selection of either one of the water savings programs described in this section or a combination of the programs.

Within Table 2-1, Program A serves as a baseline water demand. The SFPUC Wholesale Customer Water Conservation Potential report (URS 2004) included the evaluation of three potential water conservation programs, each of which contains a unique combination of water conservation measures, for SFPUC's retail agencies (including the City of Brisbane). The water demand evaluation conducted for the Baylands development includes the water savings under each of these three programs (i.e., Programs A, B, and C), assuming that the following water conservation measures are implemented, as appropriate based on end uses for the water, as follows:

Program A

- Public Information

Program B

- Water Budgets
- Public Information
- Landscape Requirements for New Systems
- Require 0.5 gal/flush Urinals in New Commercial, Industrial, Institutional (CII) Buildings
- Commercial water audits

Program C

- All components of Program B
- Water Audits Hotels-Motels
- Multifamily units sub-metering requirement
- Residential multi-family efficient clothes washer rebate
- WAVE Program (US EPA) for Hotels

In addition to the three programs summarized above, more aggressive conservation is incorporated into three additional demand projection scenarios (Programs D, E and F), which are further described below.

Program C

In addition to the packages of water conservation measures evaluated in the SFPUC study, another program (Program D) was developed to incorporate more aggressive water conservation measures in the Baylands development. The measures included in Program D include those mentioned in Program C (above), and additional measures are as follows:

- All components of Program C
- Dedicated Landscape Meters for Outdoor Irrigation Use
- Native Plants
- Subsurface Irrigation for Turf
- Hard-scape (e.g. track and exercise equipment instead of large lawns in parks): Area is covered with materials other than vegetation.
- High Efficiency Toilets (1.28 gpf or less) or Dual-Flush Toilets (0.8 gpf half-flush and 1.6 gpf full-flush)
- Automatic sinks
- Waterless urinals

Program D

Program E includes recycling of all wastewater generated onsite. After wastewater is treated, polished through constructed wetlands, filtered, and disinfected, it would be recycled onsite for irrigation and for flushing toilets and urinals. The water recycling would be achieved through dual plumbing of the water systems throughout the property. The components of Programs C and D are assumed to be implemented in Program E, with the exception that more costly higher efficiency measures would not be implemented if they would be supplied by recycled water in Program E. Such measures include high efficiency and dual-flush toilets and waterless urinals. The components of Program E are as follows:

- All components of Program D (except for high efficiency and dual-flush toilets and waterless urinals)
- Onsite wastewater treatment and recycling
- Dual-plumbing for potable and recycled water

Program F(Offsite Conservation Option, Appendix A)

Another option that was considered includes the implementation of water conservation measures within the City of Brisbane but outside of the Baylands development. The program components considered under this option (Program F – Offsite Conservation Option) include conservation measures that are not cost effective for the City to implement but that would result in water savings. The purpose in implementing such measures would be to pursue a "water credit" from the City by offsetting its current water demand through more intensive water use efficiency.

In 2006, the SFPUC prepared the "Investigation of Regional Water Supply Option No. 4" (RWSO4) technical memorandum to determine the potential for demand reductions related to regional conservation programs. The RWSO4 included the evaluation of three potential regional conservation programs (Programs R1, R2, and R3). All water use efficiency measures evaluated in the RWSO4 and their respective water savings for the City of Brisbane are included in Appendix A.

2.1.2 Calculations

Calculations were performed using a number of assumptions, as further described in Section 2.2. Most calculations were simple conversions of units and occupancy rates.

The most involved of the calculations was the projection for landscape water demand, which was performed by Natural Systems International (NSI). The irrigation requirement was calculated using the Landscape Coefficient Method, as follows:

- **Gross Demand = ETo x KL**

  where: ETo = Reference Evapotranspiration for the Region, inches

  KL = Landscape Coefficient

- **Landscape Coefficient KL = ks x kd x kmc**

  where: ks = Species factor, which takes into account the different water requirements of different species. Adequately green landscapes can be maintained at about 50 percent of reference ET, therefore the average ks value is 0.5. Truly xeric landscapes that require no additional water after establishment have a ks = 0.

  kd = Density factor, accounting for number of plants and total leaf area of a landscape. Sparsely planted areas will have a lower ET rate than densely planted areas.

  kmc = Microclimate factor, accounting for landscape variation in temperature, wind exposure, and humidity. The average kmc is 1.0. Higher values occur in landscapes surrounded by heat-absorbing or reflective surfaces, or where wind exposure is unusually high. Examples of high kmc areas are parking lots, west sides of buildings, west and south slopes, medians, and areas experiencing wind-tunneling. Low kmc areas are shady areas, areas protected from wind, north sides of buildings, courtyards, areas under overhangs, and the north sides of slopes.

- **Net Demand = (Gross Demand / IE) x CE**

  where: IE = Irrigation Efficiency, for the project irrigation type, as shown in the following table.

Table 2-1. Irrigation Efficiency by Type

Irrigation Type	Irrigation Efficiency
Sprinkler	*0.625*
Drip	*0.90*

CE = Controller Efficiency: all major irrigation projects should use a high-efficiency controller, such as an ET-controller. For the purposes of initial estimation of residential landscaping, CE is assumed to be 1.0. For golf courses which will be using an ET-controller or similar controls, CE is assumed to be 0.75, until design is finalized enough to apply direct calculation of likely CE using a daily water balance based on historical rainfall, using daily records or generated daily gamma distributions.

The data and calculations that were used for the landscape water demand are included in Appendix B.

2.1.3 Schedule

It is assumed that the construction of the Baylands development will be phased over approximately 20 years, starting in approximately 2014. The anticipated phased construction will result in a phased water demand for the property. The property buildout in square footage added per year is anticipated to proceed as shown in Figure 2-1.

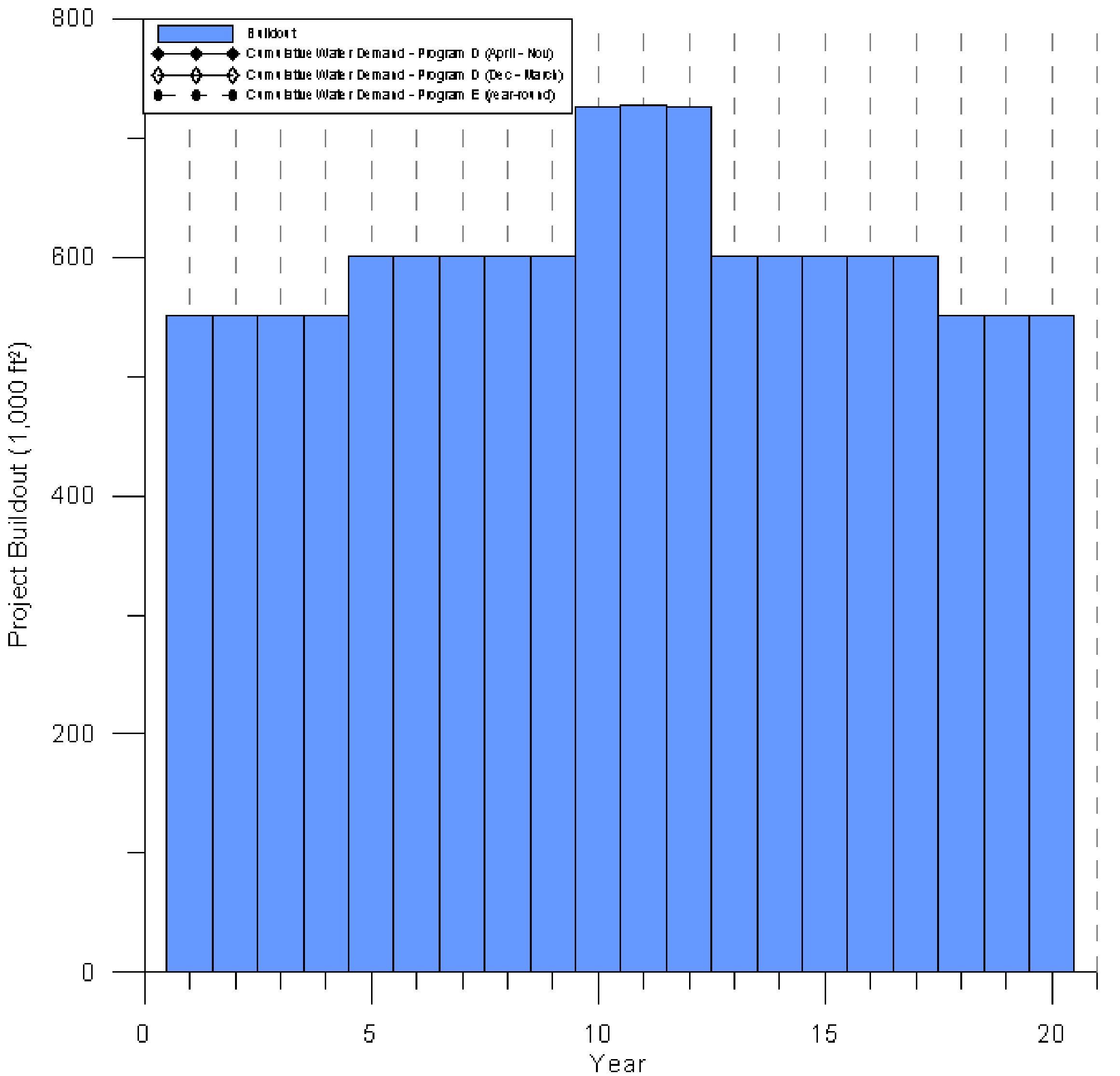

Figure 2-1. Baylands Development Buildout by Year

2.2 Assumptions

A number of assumptions had to be made to estimate water demand for the Baylands property. Assumptions by land use are as follows:

- **Cinema** – The cinema is assumed to have 2,300 seats with an occupancy rate of 75 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Arena** – The arena is assumed to contain 19,000 seats with an occupancy rate of 80 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Residential** – Residential water use is calculated for one bedroom, two bedroom, and three bedroom flats and townhomes, each assumed to have 85 percent occupancy. One bedroom units are assumed to house 1.5 persons per unit, two bedroom units are assumed to house 3 persons per unit, and three bedroom unites are assumed to house 4.5 persons per unit.. The number of residential flats includes:

- One bedroom flats: 1,580
- Two bedroom flats:1,975
- Three bedroom flats: 395

The number of residential townhomes includes:

- Two bedroom townhomes: 242
- Three bedroom townhomes: 242

Outdoor water demands are not included in the residential use, but are included in the irrigation demand.

- **Office and Institutional** – The office and institutional land uses are assumed to be occupied five days per week (as included in the annual demand). Cooling water demand is estimated as 10 percent of the total water use.
- **Research and Development (R&D)** – It is assumed that there are 1,600 employees. The type of R&D being conducted could potentially drastically change the water demand. For this scenario, we assumed the R&D facility would comprise of 75% office space and 25% R&D. The water demand projection for the R&D portion is based on water use at an existing biotech facility. It is assumed in the annual demand that the R&D facility is operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Retail** – It is assumed in the annual demand that the retail uses are operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Entertainment Theater** – The entertainment theater is assumed to have 9,700 seats with an 80 percent occupancy rate. Cooling water demand is estimated as 10 percent of the total water use.
- **Hotel** – It is assumed that there are 360 one bedroom units and 359 two bedroom units. Occupancy rates for the one bedroom and two bedroom units are estimated at 1.5 persons per unit and 3 persons per unit, respectively. It is also assumed that the one bedroom units use 110 gpd and that the two bedroom units use 220 gpd for indoor uses. The hotel restaurant will have a water demand of 35 gpd for each person staying at the hotel, which is embedded within the water demand per hotel room. Using the assumed hotel room occupancy rates of 1.5 persons per unit and 3 persons per unit for one and two bedroom hotel rooms, respectively, the water rates are 162 gpd/room for one bedroom and 325 gpd/room for two bedroom. The hotel is assumed to have an occupancy rate of 75 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Conference Hall** – The conference hall is assumed to have a capacity of 5,000 persons per day with an occupancy rate of 80 percent. Cooling water demand is estimated as 10 percent of the total water use.
- **Warehousing and Distribution** – It is assumed in the annual demand that the warehousing and distribution uses are operational 365 days a year (i.e., an occupancy rate of 100 percent). Cooling water demand is estimated as 10 percent of the total water use.
- **Irrigation** – Assumptions related to irrigation include as made by NSI include that the water demand reflects an "average" (50th percentile) year. Density and microclimate coefficients (kd and kmc) of 1.0 were used. For likely ks (species) values, the value of 0.8 was used for turf (adequate maintenance of "green" for cool-season turfs), while the value 0.5 was used for non-turf (average for mixed trees, shrubs, and ground-cover). A default irrigation efficiency of 62.5 percent was used for spray/sprinkler (turf) and 90 percent for drip irrigation (non-turf).

2.3 Results

2.3.1 Water Use Projections

The results of the water demand are included in Tables 2-2 and 2-3. In addition, the amount of water used annually through the phased construction of the Baylands development is included in Table 2-4.

If Program F were considered a viable option for pursuing alternative water supply through funding and supporting the implementation of water use efficiency measures in the City of Brisbane, a water credit of at least 41,000 gpd would be available (Appendix A). It should be noted that water savings information was not available for each of the conservation measures listed in Appendix A; so, the water credit estimation is conservative and could be refined in the future if deemed appropriate.

Figure 2-2 depicts the cumulative water demands under Programs D and E as a function of the phased Baylands development construction. (Note that Program E assumes that no potable water is used for irrigation.)

The irrigation calculations give a peak July demand of 5,393 gpd for turf (including trees planted in turf) and 2,341 gpd for irrigated non-turf. Average annual (April – November) values are less, at 2,821 gpd for turf and 1,225 gpd for non-turf.

Table 2-2. Water Demand Projections under Various Water Savings Programs for the Base Land Use Scenario

Use	Area (sf)	Rate		Units		Program A (gpd)		Program B (gpd)		Program C (gpd)		Program D (gpd)		Program E (gpd)	
						S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]
Cinema (Multiplex)	71,000	3	gpd/seat	2,300	seats	5,690	5,690	5,120	5,120	5,120	5,120	3,590	3,590	1,310	1,310
Arena	630,100	5	gpd/seat	19,000	seats	50,160	50,160	45,140	45,140	45,140	45,140	31,600	31,600	11,540	11,540
Residential	5,150,400														
	4,351,800														
Residential Flats - 1 BR	-	110	gpd/unit	1,580	units	162,500	162,500	162,500	162,500	162,500	162,500	152,750	152,750	118,630	118,630
Residential Flats - 2 BR	-	220	gpd/unit	1,975	units	406,260	406,260	406,260	406,260	406,260	406,260	381,880	381,880	296,570	296,570
Residential Flats - 3 BR	-	330	gpd/unit	395	units	121,880	121,880	121,880	121,880	121,880	121,880	114,560	114,560	88,970	88,970
	798,600														
Residential Townhomes - 2 BR	-	220	gpd/unit	242	units	49,780	49,780	49,780	49,780	49,780	49,780	46,790	46,790	36,340	36,340
Residential Townhomes - 3 BR	-	330	gpd/unit	242	units	74,670	74,670	74,670	74,670	74,670	74,670	70,190	70,190	54,510	54,510
Office and Institutional	2,363,100	75	gpd/1000 sq ft	--	--	185,210	185,210	166,690	166,690	166,690	166,690	125,020	125,020	42,600	42,600
R&D	2,599,200			1,600	employees										
Office	1,949,400	75	gpd/1000 sq ft			152,780	152,780	137,510	137,510	137,510	137,510	103,130	103,130	35,140	35,140
Lab	649,800	10,000	gpd/acre			155,890	155,890	155,890	155,890	155,890	155,890	155,890	155,890	155,890	155,890
Retail	283,400	50	gpd/1000 sq ft	--	--	15,590	15,590	14,030	14,030	14,030	14,030	10,520	10,520	3,590	3,590
Theater	337,200	3	gpd/seat	9,700	seats	25,610	25,610	23,050	23,050	23,050	23,050	17,290	17,290	5,890	5,890
Hotel	513,300														
Hotel - 1 BR	-	162	gpd/room	360	rooms	48,110	48,110	48,110	48,110	37,530	37,530	35,280	35,280	35,120	35,120
Hotel - 2 BR	-	325	gpd/room	359	rooms	96,260	96,260	96,260	96,260	75,080	75,080	70,580	70,580	70,270	70,270
Conference Hall	73,500	15	gpd/person	5,000	persons	66,000	66,000	59,400	59,400	59,400	59,400	44,550	44,550	15,180	15,180
Warehousing & Distribution	28,200	600	gpd/acre	--	--	430	430	390	390	390	390	290	290	100	100
Development Subtotal	**12,049,400**					1,616,820	1,616,820	1,566,680	1,566,680	1,534,920	1,534,920	1,363,910	1,363,910	971,650	971,650
Irrigation	NA					300,960	0	300,960	0	300,960	0	300,960	0	0	0
Irrigation Subtotal	**NA**					**300,960**	**0**	**300,960**	**0**	**300,960**	**0**	**300,960**	**0**	**0**	**0**
TOTAL	**12,049,400**					1,917,780	1,616,820	1,867,640	1,566,680	1,835,880	1,534,920	1,664,870	1,363,910	971,650	971,650

[a]S = Summer/dry season, defined as April through November

[b]W = Winter/wet season, defined as December through March

Table 2-3. Total Water Demand Projections under Various Water Savings Programs for the Base Land Use Scenario (in acre-feet per year)

Program A	Program B	Program C	Program D	Program E
1,977	1,926	1,891	1,713	1,075

Table 2-4. Total Baylands Annual Water Demand with Phased Construction

Year	Area (sf)	Program A (gpd)		Program B (gpd)		Program C (gpd)		Program D (gpd)		Program E (gpd)		Cumulative Demand Based on Program E (gpd)
		S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	S[a]	W[b]	
1	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	44,446
2	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	88,893
3	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	133,339
4	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	177,786
5	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	226,264
6	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	274,743
7	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	323,221
8	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	371,700
9	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	420,178
10	726,150	115,575	97,436	112,550	94,416	110,639	92,500	100,334	82,195	58,559	58,559	478,737
11	727,550	115,798	97,623	112,767	94,598	110,853	92,678	100,528	82,353	58,672	58,672	537,409
12	726,150	115,575	97,436	112,550	94,416	110,639	92,500	100,334	82,195	58,559	58,559	595,968
13	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	644,447
14	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	692,925
15	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	741,404
16	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	789,882
17	601,150	95,680	80,663	93,175	78,163	91,594	76,577	83,063	68,046	48,479	48,479	838,361
19	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	882,807
19	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	927,254
20	551,150	87,722	73,954	85,426	71,662	83,976	70,208	76,154	62,386	44,446	44,446	971,700
TOTAL	**12,049,400**											**971,700**

[a]S = Summer/dry season, defined as April through November

[b]W = Winter/wet season, defined as December through March

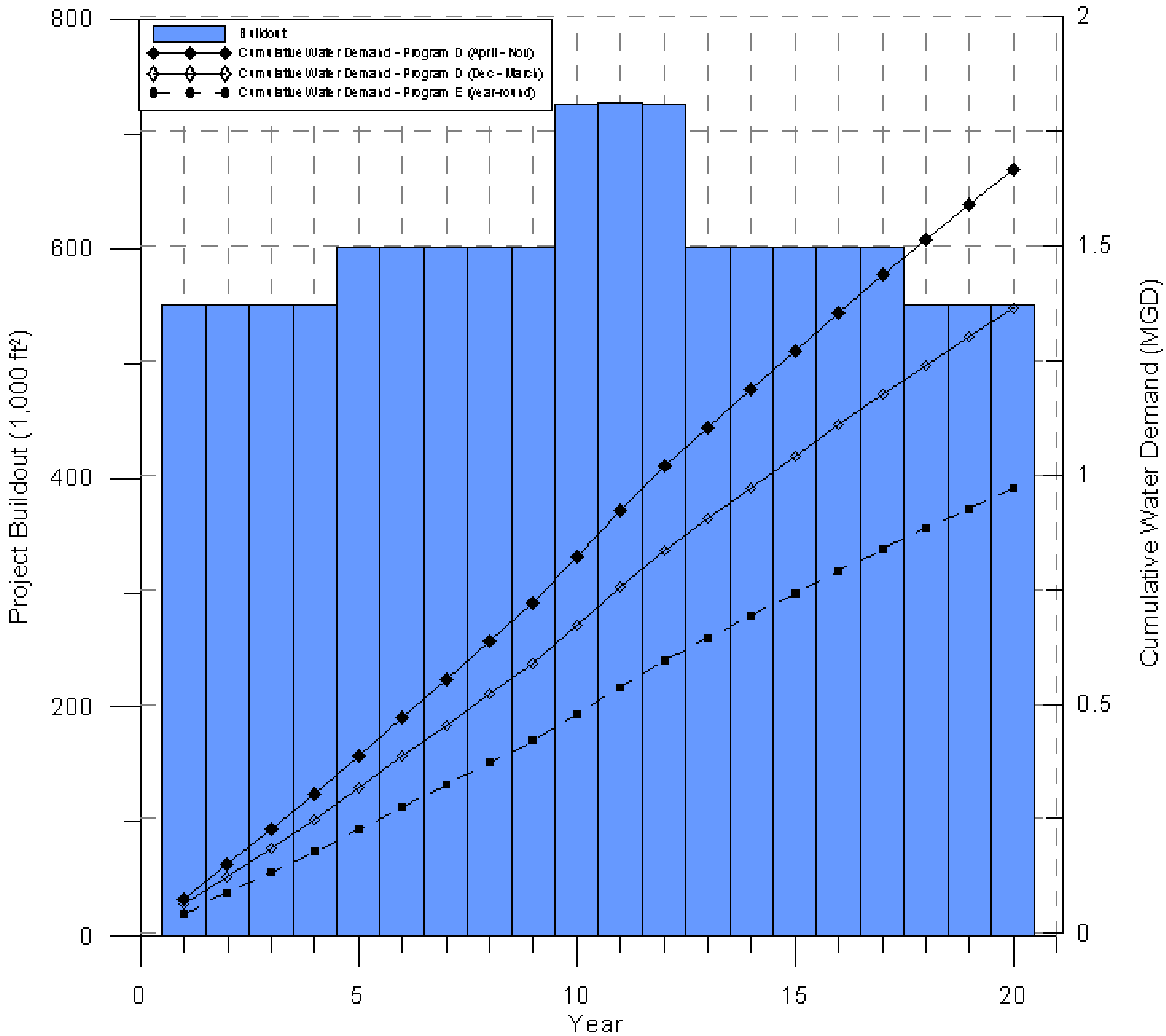

Figure 2-2. Baylands Cumulative Water Demand (under Programs D and E) as a Function of Buildout Schedule

Notes: (1) Program E assumes no potable water would be used for irrigation; (2) MGD is million gallons per day.

REFERENCES

Nanos, Brian P., 2007. Oro Valley Car Wash Uses Recycled Water. Explorer Newspaper. 31 January 2007.

URS, 2006. Investigation of Regional Water Supply Option No. 4 Technical Memorandum. Prepared for the San Francisco Public Utilities Commission. 6 March 2006.

URS, 2004. SFPUC Wholesale Customer Water Conservation Potential. Prepared for the San Francisco Public Utilities Commission.

APPENDIX A – PROGRAM F (OFFSITE CONSERVATION OPTION) WATER USE EFFICIENCY MEASURES

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	1	Residential Water Surveys	0.001		
Measure	2	Residential Retrofit			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	3	Large Landscape Conservation	0.002		
Measure	4	Water Budgets		0.017	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	5	Clothes Washer Rebate	0.001		
Measure	6	Public Information Program		0.002	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	7	Commercial Water Audits	0.004		
Measure	8	Commercial ULF Toilet and Urinal Rebates	0.000		
Measure	9	Residential ULF Toilet Rebate	0.004		
Measure	10	Require 1.6 gpf toilets to be installed at the time of sale of existing buildings	0.005		
Measure	11	Home Leak Detection and Repair	0.000		
Measure	12	Rebates for 6/3 dual flush or 4 liter toilets	0.004		
Measure	13	ET Controller Rebates	0.002		
Measure	14	Xeriscape education and staff training at retail garden/irrigation supply houses			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	15	Homeowner irrigation classes	0.001		
Measure	16	Promote water efficient plantings at new homes	0.000		
Measure	17	Offer incentives for replacement of clothes washers in coin-operated laundries	0.001		
Measure	18	Incentives for retrofitting sub-metering	0.000		
Measure	19	Require sub-metering multifamily units	0.001		
Measure	20	Rebate efficient clothes washers	0.000		
Measure	21	Enforce landscape requirements for new landscaping systems (turf limitations/regulations)		0.006	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004). Assumed to be included in the City of Brisbane's water conservation program.
Measure	22	Restaurant low flow spray rinse nozzles	0.001		
Measure	23	Focused water audits for hotels/motels	0.002		
Measure	24	WAVE Program (USEPA) for hotels	0.000		
Measure	25	Hotel retrofit (w/ financial assistance)	0.001		
Measure	26	Award program for water savings by business			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	27	Replace inefficient water using equipment	0.000		

Conservation Program Measure		Measure Description	Avg. Potential City of Brisbane Water Savings (MGD)		Notes
			Included in Program F	Not Included in Program F	
Measure	28	Require 0.5 gpf urinals in new buildings		0.002	Included in Program B from the SFPUC Wholesale Customer Water Conservation Potential tech memo (URS, 2004).Assumed to be included in the City of Brisbane's water conservation program.
Measure	29	Financial incentives for complying with water use budget	0.010		
Measure	30	Financial incentives for irrigation upgrades	0.001		
Measure	31	Require dedicated irrigation meters for new accounts			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	32	Water Utility/City Department water reduction goals			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM1	Direct Install of HETs			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM2	Educational and Training Programs			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM3	Rain Sensor Rebate			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	NM4	Replacement of Urinals			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	RM7	Commercial Water Audits (revised)			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
Measure	RM25	Hotel-Motel Retrofit (revised)			Savings for this measure were not quantified in the SFPUC RWSO4 tech memo.
TOTAL			**0.041**	**0.027**	

NOTE: All average potential City of Brisbane water savings shown in this table are based on URS, 2006 (Investigation of Regional Water Supply Option No. 4 Technical Memorandum. Prepared for the San Francisco Public Utilities Commission)

APPENDIX B – LANDSCAPE WATER DEMAND DATA AND CALCULATIONS

Climate and Soil Summary

Project: **Baylands Project**

Locale: **Brisbane, CA**

Sources:

1) Temperature Data from:	*NOAA Climatology of the U.S. #20: 30-year Station Normals.*
	Stations:San Francisco Downtown, Int'l AP, & Oceanside (3 Stn Avg).
2) Precipitation Data from:	*ibid. (average of 3 stations).*
3) Pan Evaporation Data:	*Oregon Climate Service (Western Regional Climate Center);*
	Station: San Francisco Int'l Airport (calculated via Mod Penman eq'n)
4) Evapotranspiration Data:	*WUCOLS III (CIMIS 1999): Avg* ET_0 *Zones 1&2 (Coast. Fog Areas)*
	(Verified w/ CIMIS Estimates for July for San Fran: 4.6" - 4.9")
5) Design Storm Data from:	*NOAA ATLAS 2 vol.11, Northern California (San Francisco).*

Mean Air Temperature[1]

January:	50.8	°F =	**10.4 °C**	(min)
July:	60.5	°F =	**15.8 °C**	(max)

Mean Pan Evap & Precipitation (inches)[2,3,4]

	PanEv[3]	ET_o[4]	Precip[2]	PE[3] %	ET_0[4] %	P[2] %
Jan	1.7	1.09	4.44	3.1%	3.0%	21.4%
Feb	2.4	1.54	3.97	4.4%	4.3%	19.1%
Mar	3.8	2.79	3.30	7.0%	7.8%	15.9%
Apr	5.3	3.60	1.20	9.7%	10.0%	5.8%
May	6.4	4.34	0.48	11.8%	12.1%	2.3%
Jun	7.1	4.80	0.11	13.1%	13.3%	0.5%
Jul	6.7	4.81	0.03	12.3%	13.4%	0.2%
Aug	6.6	4.34	0.08	12.1%	12.1%	0.4%
Sep	5.9	3.60	0.22	10.8%	10.0%	1.0%
Oct	4.4	2.64	1.09	8.1%	7.3%	5.2%
Nov	2.4	1.50	2.80	4.4%	4.2%	13.5%
Dec	1.7	0.93	3.01	3.1%	2.6%	14.5%
Annual	**54.4**	**35.97**	**20.72**	100.0%	100.0%	100.0%

Design Storm Events (inches)[5]

Frequency	2-y	5-y	10-y	50-y	**100-y**	year
Duration	24	24	24	24	**24**	hours
P (inch)	2.40	3.00	3.30	4.30	**4.50**	inches
i (in/h)	0.10	0.13	0.14	0.18	0.19	inch/hour

Water Balance:
Climate Data Summary

Project: Baylands Project
Phase: Preliminary Study Review
File Date: 1/25/08

1. Rainfall Probabilities

Table 1. Means from 1971-2000 Monthly Normals.

Month	Days per Month	Mean (inches)	Mean Distribution Curve (%)
Jan	31	4.44	21.4%
Feb	28	3.97	19.1%
Mar	31	3.30	15.9%
Apr	30	1.20	5.8%
May	31	0.48	2.3%
Jun	30	0.11	0.5%
Jul	31	0.03	0.2%
Aug	31	0.08	0.4%
Sep	30	0.22	1.0%
Oct	31	1.09	5.2%
Nov	30	2.80	13.5%
Dec	31	3.01	14.5%
Ann	365	20.72	100.0%

Table 2. Incomplete Gamma Distribution: based on 1971-2000 monthly normals.
(Average of 3 Stations)

Annual Precipitation Probabilites (NOAA)			
percentile	10%	50%	90%
inches	11.75	19.78	30.87

It should be noted that rainfall probabilities do not follow a normal distribution; rather, rainfall is best modeled by the gamma or partial-gamma distribution (Table 3, above). The water balance is thus calculated for 3 possibilities: the 50th percentile, 90th percentile (wettest year in 10), & 10th percentile (driest year in 10). Note that the 50th percentile annual rainfall is not equal to the mean. This is an expected difference, and is the result of statistical modeling methods. For this water balance, the annual rainfall depth will be used, distributed according to the mean distribution curve (see Table 1).

Table 3. Precipitation based on Annual Depth x Mean Distribution Curve (inch)

Month	10th Percentile	50th Percentile	90th Percentile
Jan	2.52	4.24	6.61
Feb	2.25	3.79	5.91
Mar	1.87	3.15	4.91
Apr	0.68	1.15	1.79
May	0.27	0.46	0.71
Jun	0.06	0.11	0.16
Jul	0.02	0.03	0.05
Aug	0.05	0.08	0.12
Sep	0.12	0.21	0.32
Oct	0.62	1.04	1.62
Nov	1.59	2.68	4.18
Dec	1.71	2.88	4.49
Annual	11.75	19.78	30.87

2. Planting Mix Landscape Coefficients & Irrigation Coefficients

Table 6. Crop & Irrigation Coefficients

Landscape Type	Species Factor (K_s)	Density Factor (K_d)	Micro Climate (K_{mc})	Landscape Coefficient (K_L)	Irrigation Type	Irrigation Efficiency (IE)	Controller Reduction (CR)
Turf	0.8	1.0	1.0	**0.80**	spray	0.625	1.0
Non-Turf	0.5	1.0	1.0	**0.50**	drip	0.9	1.0

Source: Metcalf & Eddy, "Water Reuse", McGraw-Hill, 2007 & WUCOLS III (U. Cal. 1999).

3. Evapotranspiration (ET_0) Data

Table 7. Pan and Reference ET (inches)

Month	Mean Pan Evap	ET_o (green cvr)	Percent ET Distribution
Jan	1.70		0.0%
Feb	2.40		0.0%
Mar	3.80		0.0%
Apr	5.30	3.60	12.1%
May	6.40	4.34	14.6%
Jun	7.10	4.80	16.2%
Jul	6.70	4.81	16.2%
Aug	6.60	4.34	14.6%
Sep	5.90	3.60	12.1%
Oct	4.40	2.64	8.9%
Nov	2.40	1.50	5.1%
Dec	1.70		0.0%
Annual	**54.40**	**29.63**	**100.0%**

PE from: *Oregon Climate Service (Western Reg. Clim. Ctr.); Stn: San Francisco Int'l Airport.*
ET_o from: *WUCOLS III (U.Cal. 1999 - CIMIS Data): Average ET_0 Zones 1&2 (Coast. Fog Areas).*

4. Net Demand = (ET_0 x K_L x CE) / IE

Adjust Demand for Rainfall? **no** (no if ET_0 takes into account rainfall already)

Effective Rainfall Use by Plants: **0%** (typ. 40%-60%, unless ET_0 takes into account rainfall)

Design Rainfall Use by Plants: **0%**

Table 8A. Average-Year Demand (inches)

Month	Demand Turf	Demand Non-Turf	Demand
Jan	0.00	0.00	
Feb	0.00	0.00	
Mar	0.00	0.00	
Apr	4.61	2.00	
May	5.56	2.41	
Jun	6.14	2.67	
Jul	6.16	2.67	
Aug	5.56	2.41	
Sep	4.61	2.00	
Oct	3.38	1.47	
Nov	1.92	0.83	
Dec	0.00	0.00	
Annual	**37.93**	**16.46**	

Table 8B. Rainfall Adj. Avg Demand (in)

Month	Demand Turf	Demand Non-Turf	Demand
Jan	0.00	0.00	
Feb	0.00	0.00	
Mar	0.00	0.00	
Apr	4.61	2.00	
May	5.56	2.41	
Jun	6.14	2.67	
Jul	6.16	2.67	
Aug	5.56	2.41	
Sep	4.61	2.00	
Oct	3.38	1.47	
Nov	1.92	0.83	
Dec	0.00	0.00	
Annual	**37.93**	**16.46**	

Table 8C. Average Demand (gpd/acre)

Month	Demand Turf	Demand Non-Turf	Demand
Jan	0	0	
Feb	0	0	
Mar	0	0	
Apr	4,171	1,810	
May	4,866	2,112	
Jun	5,561	2,414	
Jul	5,393	2,341	
Aug	4,866	2,112	
Sep	4,171	1,810	
Oct	2,960	1,285	
Nov	1,738	754	
Dec	0	0	
Annual	**2,821**	**1,225**	

5. Landscaping Mix By Locale

Table 11. Landscaping Mix by Category

Landscaping Area	Planted Acres	% Planted **Turf**	% Planted **Non-Turf**	% Planted	
Parking Lot Turf Landscape	7.78	100.00%	0%		100%
Right-of-Way Turf Landscape	18.26	100.00%	0%		100%
Open Space Landscape	25.1	76.49%	23.51%		100%
Open Area Landscape	29.9	34.78%	65.22%		100%
Total Acres:	**81.04**	69%	31%	0%	100%

6. Annual Water Demand

Table 12. Summary of Demand

Landscaping Area	Avg Yearly Demand (acre-feet)
Parking Lot Turf Landscape	**24.6**
Right-of-Way Turf Landscape	**57.7**
Open Space Landscape	**68.8**
Open Area Landscape	**59.6**
	-
	-
	-
	-
	-
Total Demand (acre-feet per year)	**210.7**
Total Demand (million gallons/yr)	**68.65**

Table 13. Summary of Landscaping

	Acres of Parking Landscape (10% of (footprint)	Acres of Right-of-Way Landscape (9 sf/tree)	Acres of Open "Space"	Acres of Open "Area"	Total Acres of Landscape Type
total acres	7.78	18.26	25.1	29.9	81.04
Turf acres:	7.78	18.26	19.2	10.4	55.64
%:	100.00%	100.00%	76.49%	34.78%	68.66%
H_2O AFY:	24.59	57.71	60.68	32.87	175.85
Non-turf ac	0	0	5.9	19.5	25.4
%:	0.00%	0.00%	23.51%	65.22%	31.34%
H_2O AFY:	0.00	0.00	8.09	26.75	34.84

Table 14. Summary of Tree Assumptions

	# Trees in Parking Landscape (1 tree per 6 spaces)	# Trees in Right-of-Way (25 ft tree spacing)	# Trees in Open Space Turf	# Trees in Open Area Turf	Total Acres of Landscape Type
# Trees:	2,446	4,096	0	0	6,542
Water Use:	included above for turf & non plantings	included above for turf & non plantings	0 but would be incl'd in above est.	0 but would be incl'd in above est.	included above for turf & non plantings

Table 15. Summary of ET_0/K_L Method Landscape Demand

	Landscape Demand (acre-ft/yr) (Apr - Nov)	Landscape Demand (mil.gal/yr) (Apr - Nov)	Peak (July) gpd/acre turf	Annual (Apr - Nov) gpd/acre turf	Peak (July) gpd/acre non-turf	Annual (Apr - Nov) gpd/acre non-turf
ET_0/K_L Method	**210.7**	68.65	5,393	2,821	2,341	1,225

7. Landscape Coefficient Method Explanation

ET_o represents the estimated water demand for a reference crop, typically green groundcover. Landscaping demand is estimated using the widely accepted Landscape Coefficient Method, which is outlined in Metcalf & Eddy, "Water Reuse", McGraw-Hill, 2007, "A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California", and the USGBC LEED NC-2.2 Reference Manual.

Gross Demand = $ET_o \times K_L$

where: ET_o = Reference Evapotranspiration for the Region, inches

K_L = Landscape Coefficient

Landscape Coefficient $K_L = k_s \times k_d \times k_{mc}$

k_s = Species factor, which takes into account the different water requirements of different species. Adequately green landscapes can be maintained at about 50% of reference ET, therefore the average ks value is 0.5. Truly xeric landscapes that require no additional water after establishment have a $k_s = 0$.

k_d = Density factor, accounting for number of plants and total leaf area of a landscape. Sparsely planted areas will have a lower ET rate than densely planted areas.

k_{mc} = Microclimate factor, accounting for landscape variation in temperature, wind exposure, and humidity. The average k_{mc} is 1.0. Higher values occur in landscapes surrounded by heat-absorbing or reflective surfaces, or where wind exposure is unusually high. Examples of high k_{mc} areas are parking lots, west sides of buildings, west and south slopes, medians, and areas experiencing wind-tunneling. Low k_{mc} areas are shady areas, areas protected from wind, north sides of buildings, courtyards, areas under overhangs, and the north sides of slopes.

Typical Landscape Coefficient Factors

Vegetation Type	***Species Factor k_s*** low	average	high
Trees	*0.2*	*0.5*	*0.9*
Shrubs	*0.2*	*0.5*	*0.7*
Groundcovers	*0.2*	*0.5*	*0.7*
Tree, Shrub, Groundcover: Mixed	*0.2*	*0.5*	*0.9*
Turfgrass	*0.6*	*0.7*	*0.8*

Vegetation Type	***Density Factor k_d*** low	average	high
Trees	*0.5*	*1.0*	*1.3*
Shrubs	*0.5*	*1.0*	*1.1*
Groundcovers	*0.5*	*1.0*	*1.1*
Tree, Shrub, Groundcover: Mixed	*0.6*	*1.1*	*1.3*
Turfgrass	*0.6*	*1.0*	*1.0*

Vegetation Type	***Microclimate Factor k_{mc}*** low	average	high
Trees	*0.5*	*1.0*	*1.4*
Shrubs	*0.5*	*1.0*	*1.3*
Groundcovers	*0.5*	*1.0*	*1.2*
Tree, Shrub, Groundcover: Mixed	*0.5*	*1.0*	*1.4*
Turfgrass	*0.8*	*1.0*	*1.2*

Net Demand = (Gross Demand / IE) x CE

where: IE = Irrigation Efficiency for the project irrigation, as shown in the next table.
CR = Controller Reduction: all major irrigation projects should use a high-efficiency controller, such as an ET-controller.
For the purposes of initial estimation of residential landscaping, CE is assumed to be 1.0. For golf courses which will be using an ET-controller or similar controls, CE could be assumed to be 0.75.

Typical Irrigation Efficiencies

Irrigation Type	*Irrigation Efficiency*
Sprinkler	*0.625*
Drip	*0.90*