IMPERIAL IRWMP

INTEGRATED REGIONAL WATER MANAGEMENT PLAN

Appendix D

Imperial Region Historical and Future Demands

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IMPERIAL
IRWMP
INTEGRATED REGIONAL
WATER MANAGEMENT PLAN

Historical and Future Municipal, Commercial, and Industrial Water Demands

Submitted to
Imperial Water Forum

Date: May 9, 2011
Integrated Regional Water Management Plan





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Abbreviations and Acronyms

20x2020 Water Conservation Plan	CDWR guidelines for forecasting demands and for calculating the 20 percent conservation goal to be achieved by the year 2020
AF	acre-feet
AF/AC	acre-feet per acre
AF/MWh	acre-feet per megawatt-hour
AFCY	acre-feet per capita per year
AFY	acre-feet per year
CDCR	California Department of Corrections and Rehabilitation Facility
CDWR	California Department of Water Resources
Census	United States Census Bureau
Definite Plan	IID Efficiency Conservation Definite Plan, Davids Engineering, et al., May 2007
DOE	United States Department of Energy
DoF	Department of Finances
Draft IID Plan	Draft IID Integrated Water Resources Management Plan (September 2009)
EDP	IID Equitable Distribution Plan (2006)
Gal/AC	gallons per acre
Gal/MWh	gallons per megawatt-hour
GEA	Geothermal Energy Association
GPCD	gallons per capita per day
GPD	gallons per day
IID	Imperial Irrigation District
IRWMP	Integrated Regional Water Management Plan
IVAG	Imperial Valley Association of Governments
MAF	million acre-feet
MCI	municipal, commercial, industrial
MG	million gallon s
MG/AC	million gallons per acre

MGD	million gallons per day
NAF El Centro	Naval Air Facility at El Centro
QSA	Quantification Settlement Agreement
SDI	supply/demand imbalance
SDI Apportionment	IID 2009 SDI Apportionment
UWMP	Urban Water Management Plan

1 Introduction and Summary of Results

1.1 Introduction

A component of the Imperial Integrated Regional Water Management Plan (IRWMP) is to update Imperial Irrigation District's Integrated Water Resources Management Plan's (Draft IID Plan) analysis of current and future municipal, commercial, and industrial (MCI) water demand (September 2009). For purposes of this report, industrial demand includes water used for geothermal processes, environmental uses, and feedlots and dairies.

The purpose of this report is to:

- ✓ Update the demand analysis to include areas outside of the Imperial Irrigation District's (IID) water service area, within the Imperial Region.
- ✓ Update the analysis with data provided by stakeholders (updated from Draft IID Plan), and to reflect comments from stakeholders.
- ✓ Reflect the updated legislative requirements and revised California Department of Water Resources (CDWR) guidelines for forecasting demands, and for calculating the 20 percent conservation goal to be achieved by the year 2020 (20x2020 Water Conservation Plan).
- ✓ Establish the future MCI demands assumption for the Imperial Region.

There are two distinct areas within the Imperial Region; the IID water service area that receives Colorado River water, and the areas outside of the IID water service area that are primarily reliant on groundwater.

This report is separated into two sections: 1) approach and assumptions; and 2) future MCI water demand within and outside the IID water service area. For the purpose of this document, demand refers to the amount of water delivered or pumped.

1.2 Summary of Results

Future water demand within the IID water service area was forecasted for municipal, feedlots and dairies, geothermal/solar thermal, industrial, and environmental uses to the year 2050. Table 1 and Table 2 show the expected future MCI water demand with and without conservation within and outside of the IID water service area for the five water demand categories, in acre-feet per year and million gallons per day, respectively. Figure 1 illustrates with and without conservation future MCI water demands for the Imperial Region. Without conservation, MCI water demand for the year 2050 within the IID water service area is estimated to be 302,251 acre-feet (AF) per year (AFY) or 269.83 million gallons (MG) per day (MGD). With conservation, MCI water demand for the year 2050 within the IID water service area is estimated to be 253,356 AFY or 226.18 MGD, a MCI water use reduction of 48,896 AFY or 43.65 MGD. Outside of the IID water service area within the Imperial Region, MCI water demand without conservation for the year 2050 is estimated to be 1,076 AFY 0.96 MGD. With conservation, water demand outside of the IID water service area within the Imperial Region is estimated to be 955 AFY or 0.85 MGD, a MCI water use reduction of 121 AFY or 0.11 MGD.

Figure 1 Cumulative Future MCI Water Demand with and without Conservation for the Imperial Region

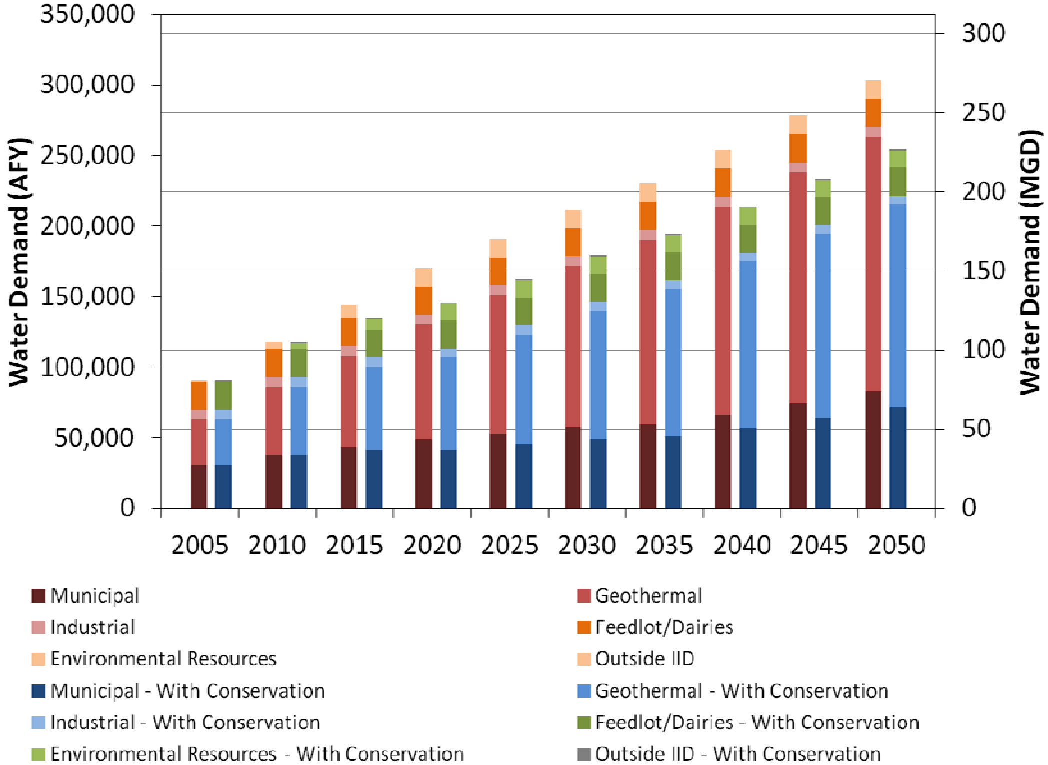

Table 1 Present and Future MCI Water Demand Within and Outside IID Water Service Area, 2005 and 2050, Acre-Feet Per Year

	2005	2050			
		Without Conservation	With Conservation	Use Reduction	% Reduction
Within IID Water Service Area					
Municipal	30,617	83,139	71,272	11,867	3.84
Geothermal/Solar Thermal	31,931	180,000	144,000	36,000	5.56
Industrial	7,092	7,092	6,064	1,028	3.91
Feedlots/Dairies	20,000	20,000	20,000	-	-
Environmental Resources	0	12,020	12,020	-	-
Total	89,640	302,251	253,356	48,896	4.40
Outside IID Water Service Area					
Municipal	130	309	264	44	3.87
Industrial	767	767	690	77	2.63
Total	**897**	**1,076**	**955**	**121**	2.98

Table 2 Present and Future MCI Water Demand Within and Outside IID Water Service Area, 2005 and 2050, Million Gallons Per Day					
	2005	2050			
		Without Conservation	With Conservation	Use Reduction	% Reduction
Within IID Water Service Area					
Municipal	27.33	74.22	63.63	10.59	3.84
Geothermal/Solar Thermal	28.51	160.69	128.56	32.14	5.56
Industrial	6.33	6.33	5.41	0.92	3.91
Feedlots/Dairies	17.85	17.85	17.85	-	-
Environmental Resources	0.00	10.73	10.73	-	-
Total	80.03	269.83	226.18	43.65	4.40
Outside IID Water Service Area					
Municipal	0.12	0.28	0.24	0.04	3.87
Industrial	0.68	0.68	0.62	0.07	2.63
Total	**0.80**	**0.96**	**0.85**	**0.11**	2.98

1.3 Use of the Analysis

The demand forecast is part of the review of the overall Imperial Region water budget. A water budget compares demand and supply conditions. The demand forecast establishes the planning assumptions for water demands under the future No Project Alternative. The No Project Alternative assumes no new supplies are developed and compares the future demands with the currently available water supplies to define the size of the water management problem to be addressed by the Imperial IRWMP. The No Project Alternative provides the basis for evaluating potential impacts to the current water users; current supply and environment; and for comparing a range of alternatives that could include new water supply projects, or other nonstructural strategies to better manage and distribute the current supply of Colorado River water. The demand forecast considered areas both inside and outside the current IID water service area.

1.4 Imperial Region Water Supply and Use

The Imperial Region receives its water supplies from the Colorado River via IID and groundwater. The IID water service area, where imported Colorado River water is the primary supply, encompasses roughly 500,000 acres of irrigated agriculture and the seven major urban areas of the Imperial Region. The East Mesa and West Mesa areas use groundwater that is outside of the IID water service area, but inside the Imperial Region. See Attachment A for maps of the cities and communities of interest in the Imperial Region. These maps present the city boundaries and sphere-of-influence used in the land use based water demand forecast.

1.4.1 IID Water Service Area

Surface water imported from the Colorado River by IID is used to meet all current agricultural and non-agricultural water demands in the IID water service area. Non-agricultural water demands include

MCI water demands. IID is a wholesale water provider that delivers untreated (raw) water to individual user accounts. The cities are retail water purveyors that treat and convey Colorado River water to retail water accounts. The seven major urban areas within the IID water service area are the cities of Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial, and Westmorland. Other urban areas within the IID water service area include the unincorporated communities of Heber, Seeley, Niland, the Naval Air Facility at El Centro (NAF El Centro), and two California Department of Corrections and Rehabilitation Facilities (CDCR). The community of Ocotillo/Nomirage is located within the area of West Mesa, and currently uses groundwater. The total population of these cities and communities are expected to increase significantly through the year 2050, subsequently increasing urban water demand.

The IID supply of Colorado River water is part of the state of California's fixed apportionment of 4.4 million acre-feet (MAF). IID's supply is based on very senior water rights that are capped at a fixed 3.1 MAF, and the Colorado River supplies are described in a separate technical memorandum,[1] which also includes a description of the supply available in normal, dry, and multiple dry years for purposes of the Imperial IRWMP. The current Colorado River supplies are fully committed to agricultural and MCI demands. Agricultural demands currently use 97 percent of the available supply. All other current MCI demands represent 3 percent. This means that in the absence of any new supplies, any increase in future MCI demands in the IID water service area would be provided through reapportionment of existing supplies from current agricultural uses to the proposed future use. Further, the increase in future MCI demands may represent a decrease in the supply available for agricultural users. This effect is more significant in times when there is a supply and demand imbalance (overrun) since under these conditions MCI demands represent a "hardened" demand that is not easily cut back.[2] Under current IID policies, cut backs are made to the agricultural supply in times of a supply and demand imbalance in order to provide a higher degree of reliability for MCI uses. Review of a proposed project water budget would be needed to quantify this effect.

1.4.2 Areas Outside the IID Water Service Area

The East and West Mesa areas of the Imperial Region are generally outside the IID water service area and rely almost exclusively on groundwater. The majority of uses are for rural residential communities, industrial and limited agricultural production. The source of water outside the IID water service area boundary is groundwater. Groundwater in most areas is limited due to low natural recharge rates. The East Mesa area may have water quality issues that impact the ability to put the water to use, or as in the case in the West Mesa area, is at or in excess of the sustainable yield (overdrafted).

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[1] Draft IID Plan (2009) Appendix C: Technical Memorandum 2.1- Document Existing Colorado River Water Supplies for the Imperial Irrigation District. NRCE, Inc. July, 2009.

[2] The Equitable Distribution Plan defines how the region responds to shortage and grants a higher reliability of supply to MCI users and cut backs in agricultural supplies. http://www.iid.com/index.aspx?page=141

2 Data, Approach, and Assumptions

This section describes the data sources; approach to the analysis of population, land use, and historical unit water requirements; and the assumptions that were then established to forecast future MCI water demands for the major water use sectors.

Recent changes to California State legislation shaped CDWR guidelines and requirements for establishing baseline conditions, forecasting future water demands, and calculating conservation saving goals. This includes:

- CDWR methods for 20x2020 Water Conservation Plan, Water Conservation Act of 2009.[3]
- CDWR Urban Water Management Plan (UWMP) Guidelines.[4]

CDWR has provided updated methodologies to be adhered to in both the 2010 Urban Water Management Plan Guidebook (Final) and in the Methodologies for Calculating Baseline Compliance Urban Per Capita Water Use Requirements Report (Water Conservation Act of 2009). The approach taken to update Technical Memorandum 2.2 closely reflects the recommended approach presented in CDWR's updated standards and guidelines. This analysis was conducted to be consistent with the state requirements. The intent is to support consistency between Imperial IRWMP and UWMPs being prepared by the cities in the Imperial Region.

Two primary activities were conducted to update the forecasted future water demands: evaluate current water demand (baseline conditions) and forecast future water demands for MCI used within the Imperial Region. The approach follows CDWR methods and includes:

- Evaluating current population, land use data, and water supply data.
- Establishing unit water requirements and assumptions (acre-feet per capita per year (AFCY) or gallons per capita per day (GPCD) for population forecast; acre-feet per acre (AF/AC) or gallons per acre (Gal/AC) of water use for land use based forecast.
- Forecasting water use based on population.
- Forecasting water use based on proposed land use plans.
- Evaluating water conservation goals and assumptions.
- Evaluating potential unit water requirements for renewable energy (geothermal and solar thermal) and developing assumptions for this use category.
- Comparing approaches and defining the future demand assumptions for the Imperial IRWMP.

2.1 Data Sources

The sources of data are documented in detail within this report. This demand forecast was prepared at a regional scale using the data readily available or provided by the stakeholders, and based on underlying assumptions as described herein. Presently, it does not include the more detailed city water demand forecasts as required in the 2010 updates if the UWMPs are to be prepared by the cities of Brawley, Calexico, El Centro, and Imperial.

Multiple data sources and analysis methods were reviewed and tested to prepare the demand forecasts, test assumptions, and finalize the future demand forecast to meet Imperial IRWMP needs and CDWR

[3] SB x 7-7 (Steinberg), Water Conservation Act 2009.

[4] California Department of Water Resources, Guidebook to Assist Urban Water Suppliers to Prepare a 2010 Urban Water Management Plan.

standards. Historical data and prior studies were reviewed to develop the Imperial IRWMP assumptions and future demand forecast. Prior studies included the 2005 UWMP, the Imperial Irrigation District Efficiency Conservation Definite Plan (Definite Plan) and the Imperial Irrigation District Equitable Distribution Plan (EDP (2006)). The local data was compared to regional and statewide data in selecting the basis and assumptions or the Imperial Region forecasts.

The planning period is from 2010 to 2050. Factors that could potentially affect future water demands include:

- Changes in cropping patterns or markets.
- Imperial Region economic conditions.
- Population growth.
- Land use changes.
- Renewable energy development policies.
- Climate change.

2.2 Population Projection Calculation Approach

The state requires that population estimates used to forecast future demands be based on data from the state, regional, or local service agency population projections, such as Imperial Valley Association of Governments (IVAG), California Department of Finance (DoF), etc. Population estimates for the Imperial IRWMP demand forecast are presented based on population data from the DoF and IVAG and are presented in five-year increments. The approach taken in presenting population estimates in this report reflects these state-mandated requirements and also mirrors the approach taken in IID's Equitable Distribution Plan (EDP), which utilizes IVAG as its source data. To that effect, when available, IVAG was the primary source for population data and forecasts.

To comply with California's 20x2020 Water Conservation Plan requirement and to calculate conservation targets, CDWR defines a number of methods to calculate baseline urban per capita water use.[5] CDWR Methodology 2: Service Area Population, requires that population data be derived from federal, state, and local population reports. In summary, the approach taken in this report, utilizing IVAG as the source of population data, complies with UWMP and other state requirements.

2.3 Water Supplies and Demand Analysis Approach

The state requires a description of existing and planned water supply sources (groundwater and surface water) and the current and planned quantities available to its supplier. Wholesale and retail water supply sources are to be presented in five-year increments. This report presents available supplies as per the aforementioned requirements.

Future estimates of MCI demands were forecasted consistent with the EDP. The EDP prescribes the amount of water that the IID water users receive during periods of supply/demand imbalance based on past use or the contractual amount. The Imperial IRWMP data is presented in five-year increments to parallel UWMP requirements and to support consistency between plans. This report also presents and compares several methods for calculating anticipated MCI water demands. Method 2: Future Water

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[5] California Department of Water Resources, Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use, February 2011.

Demand Using Per Capita Demand Model, described in Section 3 of this report, was ultimately selected for the Imperial IRWMP to be consistent with methodologies that could be applied in the local UWMPs.

2.4 Water Use Sectors

Showing past, current, and projected water demands by sector is a state requirement. These sectors include: Industrial, Commercial, Agricultural, Institutional and Government, and Residential (which is further subdivided in multi/single family residences). The Imperial IRWMP demand forecast presented here evaluated MCI use categories at a regional scale based on the way the data is categorized at the wholesale level by IID. The data in the Imperial IRWMP report is based on the most recent information available on water sales from IID, or as requested from the cities developing UWMPs. As such, within a city, the MCI are included in a single IID wholesale account number based on water sales to the municipality. Where information was provided by the city, industrial water should be accounted for separately and not included in the per capita water use calculations. This is necessary in order for the per capita water use conservation requirements (with conservation reductions to include 20 percent conservation) to be accurate.

Documented water demands for those cities within the Imperial Region required to complete an UWMP are reflected in this report to the degree the information was available. Within each city, the UWMP will further breakout the water use categories at greater levels of detail (government, residential, large landscape, etc.).

For purposes of the Imperial IRWMP, the industrial use category is primarily based on current or future water demands for the renewable energy industry. This projected water demand for the renewable energy industry is based on the Imperial County General Plan Geothermal/Alternative Energy and Transmission Elements (County of Imperial, 2006), which identifies a geothermal/solar thermal demand of 180,000 AFY (161 MGD) by 2050.

Future agricultural demands are assumed to be the same as those forecasted in the Definite Plan and Systems Conservation Program, and as such, are to be incorporated by reference into the Imperial IRWMP. Future agricultural demands include implementation of all the planned on-farm and systems conservation programs.

2.5 Current Population and Demographic Data

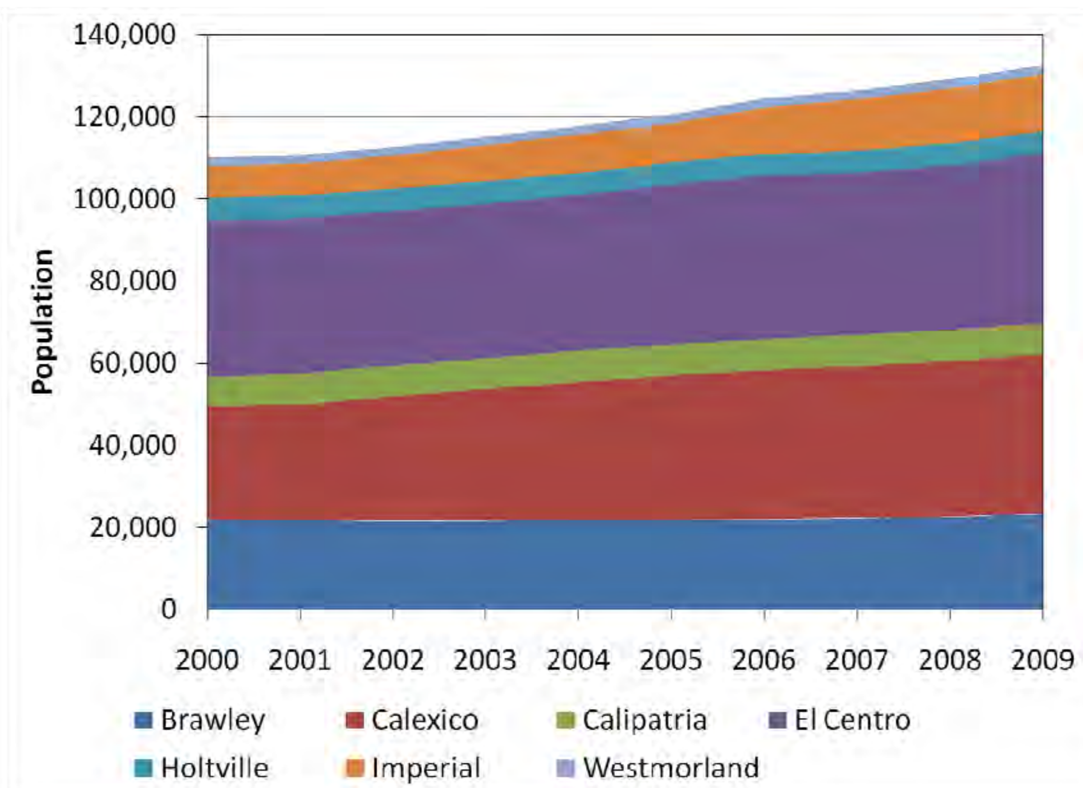
2.5.1 IID Water Service Area

Population in the Imperial Region is concentrated mostly within the IID water service area. Table 3 shows the 2000 through 2009 population for the cities within the IID water service area. Figure 2 shows a chart of the population of the cities within the IID water service area.

Table 3 City Population within IID Water Service Area, 2000 – 2009										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Brawley	21,980	21,760	21,531	21,609	21,852	21,934	22,037	22,314	22,593	23,342
Calexico	27,340	28,274	30,423	32,093	33,630	35,113	36,230	37,095	37,978	38,827
Calipatria	7,314	7,514	7,538	7,552	7,606	7,636	7,601	7,595	7,566	7,685
El Centro	38,126	37,773	37,661	37,664	37,876	38,966	39,797	39,476	40,081	41,241
Holtville	5,597	5,545	5,490	5,462	5,411	5,356	5,283	5,359	5,396	5,487
Imperial	7,714	7,855	8,033	8,784	9,423	9,470	11,406	12,580	13,444	13,878
Westmorland	2,114	2,093	2,071	2,060	2,043	2,203	2,170	2,168	2,185	2,221
Total	**110,185**	**110,814**	**112,747**	**115,224**	**117,841**	**120,678**	**124,524**	**126,587**	**129,243**	**132,684**

Source: United States Census, *Population Estimates, Incorporated Places and Minor Civil Divisions, All Place: 2000 to 2009, California.*

Figure 2 City Population within IID Water Service Area, 2000 – 2009



The total population for incorporated cities within the IID water service area increased from 110,185 in 2000 to 132,684 in 2009, about 20 percent over the 10-year period. The city of Imperial had the largest population growth between 2000 and 2009 with an increase of 6,164.

Table 4 shows the 2000 Census data for population, housing units, average household size, land area, population, and household density for the individual cities within IID.

Table 4 Demographic Data for Cities within IID Water Service Area, 2000						
	Population[1]	Housing Units	Average Household Size	Land Area[2,*]	Population per Acre	Housing Unit per Acre
Brawley	21,980	7,038	3.1	9,890	2.2	0.7
Calexico	27,340	6,983	3.9	8,300	3.3	0.8
Calipatria	7,314	961	7.6	4,285	1.7	0.2
El Centro	38,126	12,263	3.1	14,300	2.7	0.9
Holtville	5,597	1,617	3.5	4,080	1.4	0.4
Imperial	7,714	2,385	3.2	8,480	0.9	0.3
Westmorland	2,114	677	3.1	880	2.4	0.8
Total	**110,185**	**31,924**		**50,215**		
Weighted Average			**3.5**		**2.2**	**0.6**

1 – Population *Estimates, Incorporated Places and Minor Civil Divisions, All Place: 2000 to 2009, California.*
2 – County of Imperial – Imperial County General Plan, 2006
** Units: Acres*

Unincorporated communities make up about 12 percent of the population within the IID water service area. Population estimates for unincorporated communities within the IID water service area are available for 2006 (Table 5).

Table 5 Unincorporated Communities Population within IID Water Service Area, 2006	
	2006
Heber	2,988
Seeley	1,624
Niland	1,143
Calipatira – CDCR	4,180
Centinela – CDCR	5,110
Total	**15,045**

Source: *2009 SDI Apportionment*, Imperial Irrigation District

IID also provides water for the NAF El Centro. Population varies seasonally; in 2010 the population ranged from 1581 to 1803.

2.5.2 Outside IID Water Service Area

There is one community located within the Imperial Region that does not receive water from IID. The community of Ocotillo/Nomirage is located in West Mesa. According to the 2000 Census, Ocotillo had a population of 296.

2.6 Future Population

Based on IVAG historical data, the average annual growth rate for the *incorporated* municipal areas within the IID water service area for 2010 to 2035 is 2.4 percent. Using this rate, and the recent historical population data presented in Table 3, the population forecast was extended to 2050.

Based on SCAG household forecasts, the average annual growth rate of the *unincorporated* areas within the Imperial Region for 2010 to 2035 was 3.8 percent. This growth rate was used to extend the unincorporated 2006 populations in Table 5 to the year 2050.

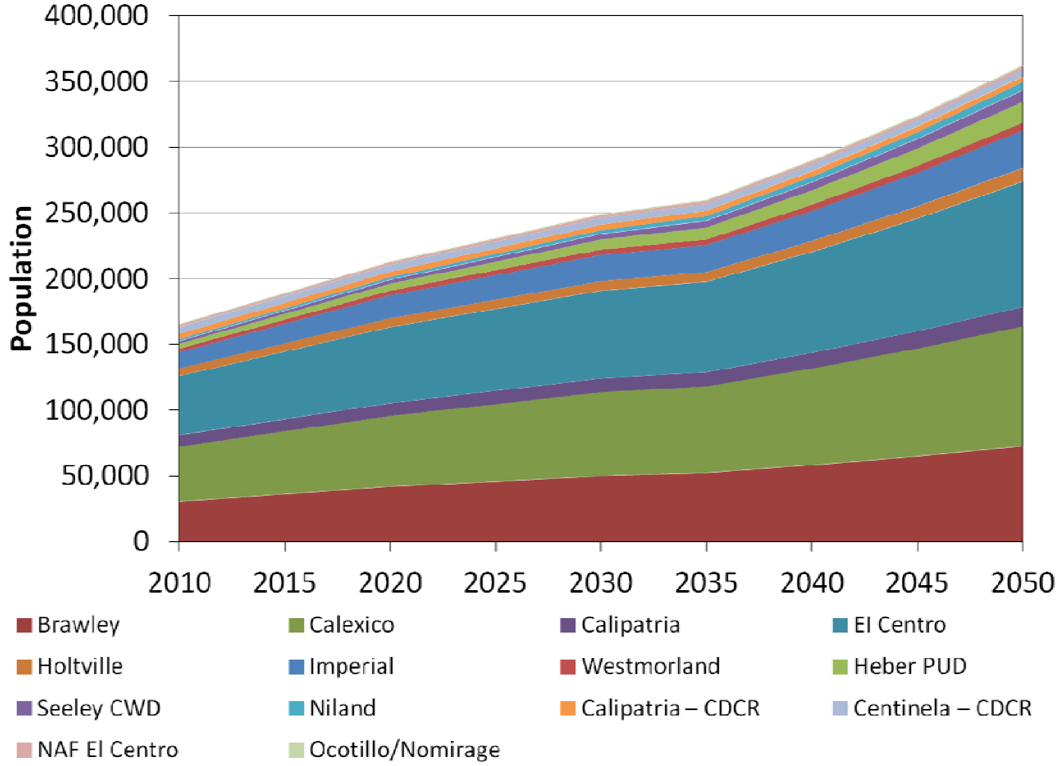
Table 6 and Figure 3 present 2010 and forecasted population data for the Imperial Region. From Figure 3, the urban communities within the IID water service area will contribute to the majority of the Imperial Region's population through the year 2050. These population values are used to estimate future residential water demand.

Table 6 Imperial Planning Region Population, Current and Forecasted, 2010 – 2050

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Within IID Water Service Area									
Brawley	30,705	36,206	41,707	45,852	49,996	52,266	58,274	64,972	72,441
Calexico	41,653	47,764	53,874	58,751	63,628	65,905	73,481	81,927	91,344
Calipatria1	4,381	4,992	5,602	5,997	6,392	6,515	7,264	8,099	9,030
El Centro	45,003	51,406	57,808	62,257	66,705	68,836	76,749	85,571	95,407
Holtville	5,939	6,305	6,671	6,937	7,202	7,309	8,149	9,086	10,130
Imperial	12,321	14,956	17,591	18,783	19,974	20,543	22,904	25,537	28,473
Westmorland	2,846	3,245	3,644	3,934	4,223	4,367	4,869	5,429	6,053
Heber Public Utilities District	3,601	4,339	5,228	6,300	7,591	9,147	11,023	13,282	16,005
Seeley County Water District	1,957	2,358	2,841	3,424	4,126	4,972	5,991	7,219	8,699
Niland	1,377	1,660	2,000	2,410	2,904	3,499	4,217	5,081	6,122
Calipatria – CDCR[2]	4,180	4,180	4,180	4,180	4,180	4,180	4,180	4,180	4,180
Centinela – CDCR[2]	5,110	5,110	5,110	5,110	5,110	5,110	5,110	5,110	5,110
NAF El Centro[3]	1,692	1,787	1,888	1,994	2,106	2,224	2,349	2,481	2,621
Specific Plan Area[4]	876	1,753	2,629	3,505	4,382	5,258	6,134	7,011	7,887
Total	**160,765**	**184,307**	**208,144**	**225,929**	**244,137**	**254,873**	**284,559**	**317,974**	**355,614**
Outside IID Water Service Area									
West Mesa									
- Ocotillo/Nomirage[4]	607	651	698	748	802	859	921	987	1,059
-Specific Plan Area[5]	24	47	71	95	118	142	166	189	213
East Mesa	-	-	-	-	-	-	-	-	-
Imperial Planning Region Total	**161,372**	**184,958**	**208,842**	**226,677**	**244,939**	**255,732**	**285,480**	**318,961**	**356,673**

Source: *2009 SDI Apportionment*, IID – EDP Class data Muni IVAG_CA Dof CHG v31.xls.
1 – Reported IVAG population minus Calipatria CDCR population.
2 –California Department of Corrections and Rehabilitation. No growth is assumed for these institutions.
3 –Average seasonal population values, interpolated at 11% increase over 10 years. Information provided by William Kagele, Water Program Manager, NAF El Centro.
4 – Population estimates extrapolated from Ocotillo/Coyote Wells Hydrology and Groundwater Modeling Study, Table 4-3.
5 – Unless specifically given, population estimates based on Specific Plan land use changes and demographic values in Table 4. Assumes linear growth between 2005 and 2050.

Figure 3 Imperial Region Population Forecast



2.7 Per Capita Water Demand

Table 7 lists the daily per capita municipal demand in gallons per day (GPD) and acre-feet per year for the urban areas within the IID water service area. The values in Table 7 were calculated using total water demand values given in the 2005 UWMPs for Brawley, Calexico, and Imperial; the 2010 UWMP for El Centro; and the 2005 population estimates provided by IVAG. The population weighted averages of the per capita water demands were calculated. These values included the aggregated industrial water demand as well as residential and commercial water demands. When the 2010 UWMP updates are published, values can be updated to separate industrial, residential, and commercial water demands.

Table 7 Per Capita Municipal Demand for Cities within the IID Water Service Area		
	AFY	*GPD*
Brawley	0.34	301
Calexico	0.17	154
El Centro	0.22	194
Holtville	0.22	196
Imperial	0.25	220
Westmorland	0.26	236
Heber	0.19	171
Calipatria/Niland	0.28	251
Seeley	0.15	133
Population Weighted Average	0.23	205

The EDP prescribes that future municipal water use should be estimated as the water demand in 2006 plus 0.26 AFCY (250 GPCD) for the population difference between 2006 and some future year.

Baseline and target conservation water use levels for the Colorado River hydrologic region are established in California's 20x2020 Water Conservation Plan. The Imperial Region is in the Colorado River hydrologic region. According to the 20x2020 Water Conservation Plan, per capita water demand for the Colorado Hydrologic Region should be reduced to the values listed in Table 8 by the year 2020. This should coincide with a 20 percent reduction in water use. However, the target for a hydrologic region may not be the appropriate target for a particular supplier within that region, and the targets were developed for planning at the statewide and regional level. There is significant variation in urban water use within both the Colorado Hydrologic Region and the Imperial Region due to climatic, demographic, or economic factors, as well as differing levels of conservation implementation. This variation demonstrates the need for flexibility in the design of conservation programs for the Imperial Region.

Table 8 Regional Urban Per Capita Water Use Patterns for the Colorado Hydrologic Region		
Sector Water Use	**AFY**	**GPD**
Residential (Single- and Multi-Family)	0.29	255
Commercial and Institutional	0.04	38
Industrial	0.00	3
Un-Reported Water	0.06	50
Total, Weighted Average, 1995-2005	0.39	346

Source: California 20x2020 Water Conservation Plan

2.8 Future Land Use Changes

2.8.1 IID Water Service Area

According to the Imperial County General Plan, the Imperial Region can expect changes in land use designations both within and outside the IID water service area. Currently, the majority of lands not designated open space is used for agriculture. It is anticipated that development around the major cities and communities will likely result in the transitioning of agricultural lands to urban land uses; significantly altering the characteristics of water demand for the Imperial Region. Attachment A provides maps for current and expected land use. These were produced using data in the applicable city's General Plan or the county's General Plan, community plans, or specific plans. When land use changes are not specifically identified in a prevailing land use plan, it is assumed that the current use would continue (i.e., agriculture, open space).

The Imperial County Planning Department provided AutoCAD drawings and GIS data files showing the current limits of municipal boundaries, as well as AutoCAD drawings showing the spheres-of-influence of these municipalities as recognized by the Imperial County Local Area Formation Commission. For Calexico, the city limit and sphere-of-influence data were provided by the city. The city of Imperial provided city limit and sphere-of-influence data. The future development build-out date within the spheres-of-influence was not provided with the drawings, so for purposes of the Imperial IRWMP demand forecast, it was assumed that the build-out of the spheres-of-influence is 2050.

In addition, NAF El Centro encompasses 2,686 acres, 1585.5 acres of which are used for agriculture. The remaining lands are used for housing, airfields, supply, and other military buildings. There are currently no published land use plans for NAF El Centro that document proposed land use changes.

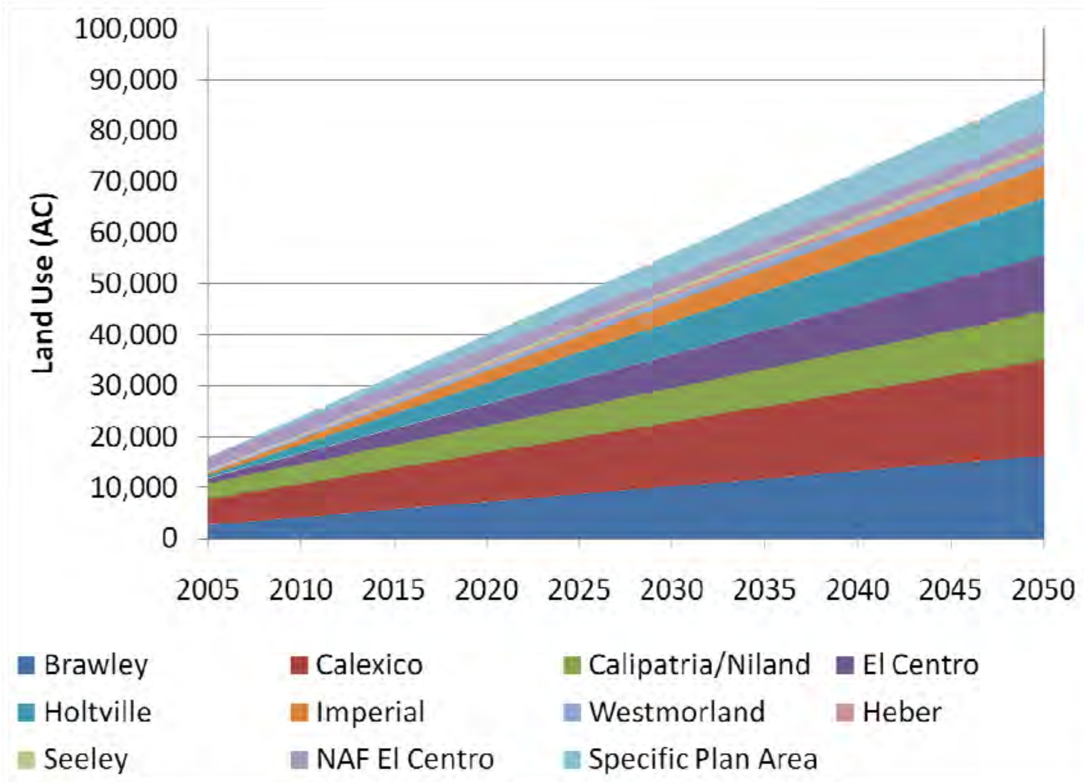
Land use data for Specific Plan areas were collected from those Specific Plans that are within the Imperial Region and have received Conditional Use Permits at the time of this report. There are seven Specific Plans within the IID water service area: Imperial Center, Gateway of Americas, Mesquite Lake, Rio Bend, Imperial Lakes, McCabe Ranch, and McCabe Ranch II. According to these Specific Plans, current land use in these areas is predominantly agriculture. It is assumed that the lands will be converted from agricultural to municipal uses. Build-out dates were not available for every Specific Plan, due to the uncertainty of market conditions, coordination of multiple construction phases, and permitting and administration processes. Therefore, full build-out of the Specific Plans is assumed to be the year 2050.

Table 9 summarizes the municipal land use within the IID water service area. Figure 4 shows the expected land use growth for the IID water service area.

Table 9 Forecasted Developed Land Use Area within IID Water Service Area, Present – 2050										
	Developed Municipal Area									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Brawley	2,686	4,193	5,699	7,207	8,714	10,218	11,725	13,231	14,738	16,244
El Centro	5,050	6,576	8,105	9,631	11,158	12,685	14,213	15,739	17,267	18,794
Calexico	3,188	3,893	4,599	5,303	6,008	6,714	7,419	8,124	8,829	9,534
Imperial	964	2,084	3,206	4,326	5,445	6,565	7,685	8,805	9,925	11,045
Calipatria	467	1,651	2,837	4,021	5,206	6,389	7,574	8,758	9,943	11,127
Holtville	525	1,160	1,794	2,428	3,063	3,698	4,333	4,967	5,602	6,236
Westmorland	189	416	646	873	1,101	1,329	1,557	1,785	2,013	2,241
Heber	91	201	312	421	531	641	751	861	971	1,081
Seeley	92	202	313	424	534	645	756	866	977	1,088
NAF El Centro	2,734	2,734	2,734	2,734	2,734	2,734	2,734	2,734	2,734	2,734
Specific Plan Areas	0	862	1,724	2,586	3,448	4,311	5,173	6,035	6,897	7,759
Total	**15,986**	**23,972**	**31,969**	**39,954**	**47,942**	**55,929**	**63,920**	**71,905**	**79,896**	**87,883**

Units: Acres
Source: Data extracted from AutoCAD files provided by Imperial County Planning Department, LAFCO and City of Calexico. Heber and Seeley area estimated.

Figure 4 Projected Urban Land Use within IID Water Service Area



As can be seen from Table 9 and Figure 4, build-out of the spheres-of-influence would result in a nearly 450 percent increase in municipal land use by the year 2050.

2.8.2 Outside IID Water Service Area

The community of Ocotillo/Nomirage is located in West Mesa and uses only groundwater. Data for land use outside the IID water service area within the Imperial Region, including for the Ocotillo/Nomirage community area, were obtained from Imperial County. The land use data from Imperial County agreed with data from aerial photographs (land use type per parcel). Table 10 lists the area per land use type outside the IID water service area within the Imperial Region boundary.

Table 10 Land Use Outside the IID Water Service Area, Present	
Land Use	**Area**
Agriculture	376
Commercial	743
Government/Special Public	1,826
Industrial	3,765
Open Space/Recreation	976,830
Residential	307
Vacant/Unidentified Use	2,902
Total	**986,749**
Units: Acres	

Outside of the IID water service area there is one Specific Plan that has received a Conditional Permit: Coyote Wells/Wind Zero Specific Plan. The Coyote Wells/Wind Zero Specific Plan area is located in West Mesa within the Ocotillo/Nomirage community area. Currently, this area is zoned for low-density residential or desert residential, which is about equivalent to one housing unit per 40 acres. Future water demand for the Coyote Wells/Wind Zero Specific Plan is expected to be 65 AFY (0.06 MGD) of well water by build-out. Table 11 shows the planned changes in land use and zoning designations for the Coyote Wells/Wind Zero Specific Plan Area, assuming a build-out year of 2050.

Table 11 Planned Coyote Wells/Wind Zero Specific Plan Land Use, 2050	
Land Use	**Area**
Agriculture	0
Commercial	24
Government/Special Public	242
Industrial	39
Open Space/Recreation	585
Residential	53
Total	**943**
Units: Acres	

2.9 Renewable Energy Land Use Changes

The planned land use changes for renewable energy projects (geothermal/solar thermal) would occur on land designated as open space (either agricultural land and/or natural habitat) based on the land use policies of Imperial County and the United States Bureau of Land Management, which oversee the majority of land in federal ownership in the Imperial Region. Use of water for cooling purposes at geothermal/solar thermal plants is potentially the largest future demand. Where and when such growth is to occur is subject to market forces and proposals from private renewable energy project development interests.

The Imperial County General Plan Renewable Energy Element promotes development of renewable energy facilities for economic growth in the community. The IID, as the owner and manager of the power distribution grid and wholesale water provider, is consulted by both the county and private project proponents. Geothermal or solar thermal projects could substantially increase water use with the increase in use related to cooling. Depending on the type of facility, renewable energy could intensify water use on lands that are currently cultivated, or on lands in open space which have no history of water use. Facilities may be located within IID water service area or in outside areas.

Most of the land in East and West Mesa is owned and managed by the United States Bureau of Land Management. There is the potential for geothermal, solar, and wind renewable resource projects to be developed on these lands and to obtain water from IID. Only geothermal and solar thermal projects would substantially increase water use. Solar facilities based on photovoltaic technology require limited water primarily for washing, domestic, and some dust control uses.

2.10 Current MCI Water Demands and Use

MCI water demand accounts for approximately 3 percent of IID's delivered Colorado River water. However, it is expected that MCI water demand will increase with population growth.

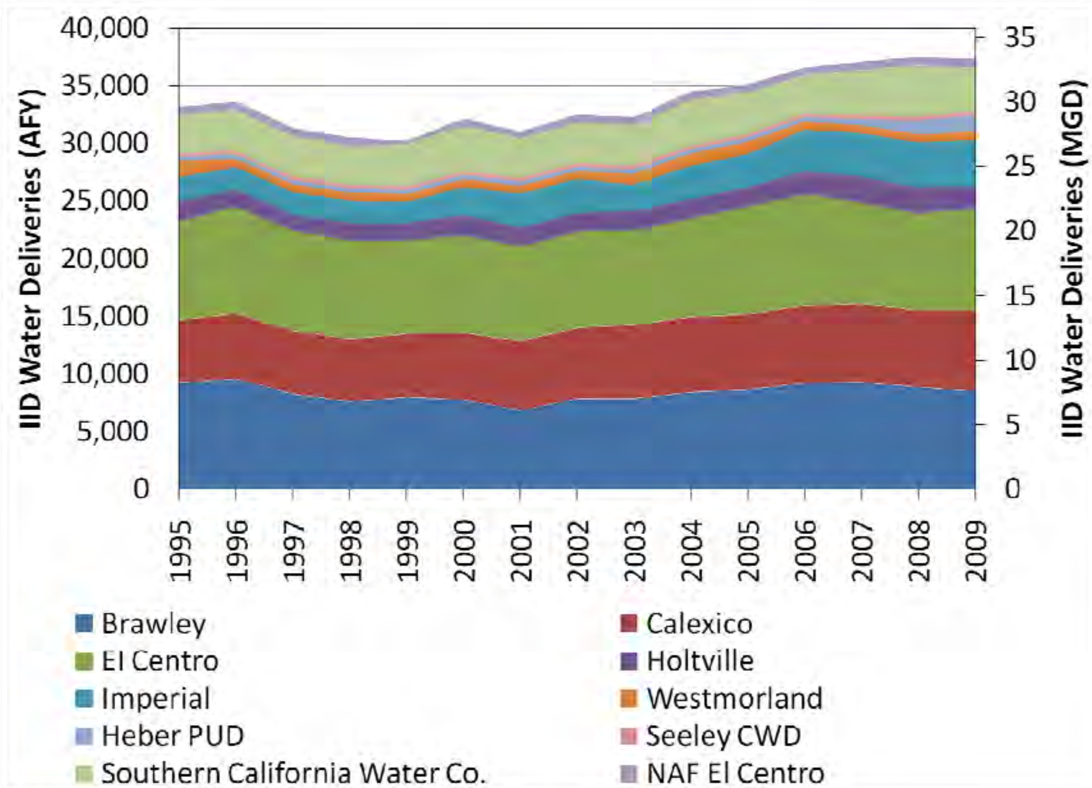
MCI water demand (also referred to as non-agricultural water demand) is defined by the EDP as water for domestic, municipal, geothermal/solar thermal energy, industrial, feedlot, dairy, fish, and environmental resources. Table 12 and Figure 5 provide a summary of IID MCI water deliveries from 2000 to 2009 (based on water sales). These values provide the baseline for future conservation estimates discussed later in the report. It is recognized that there are many other smaller MCI deliveries that do not significantly impact the volume of delivery.

Table 12 Historical IID MCI Water Deliveries, 2000-2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Acre-Feet Per Year										
Brawley	7,804	6,830	7,885	7,898	8,442	8,662	9,225	9,280	8,887	8,544
Calexico	5,766	6,048	6,097	6,382	6,506	6,522	6,709	6,833	6,623	6,954
El Centro	8,436	8,202	8,340	8,174	8,549	9,306	9,678	8,756	8,381	8,868
Holtville	1,795	1,666	1,625	1,718	1,700	1,693	1,983	2,260	2,304	1,971
Imperial	2,406	2,886	2,988	2,268	2,885	2,883	3,643	3,786	3,905	3,995
Westmorland	719	721	707	959	1,073	1,099	713	714	730	724
Heber Public Utilities District	362	358	341	385	355	352	344	503	1,193	1,415
Seeley County Water District	345	348	338	345	346	342	346	346	351	350
Southern California Water Co.[1]	3,974	3,420	3,539	3,522	3,982	3,591	3,301	3,927	4,441	3,744
NAF El Centro	592	610	686	655	694	682	685	690	713	761
Total	**32,199**	**31,089**	**32,546**	**32,306**	**34,533**	**35,132**	**36,627**	**37,095**	**37,527**	**37,325**
Million Gallons Per Day										
Brawley	6.97	6.10	7.04	7.05	7.54	7.73	8.24	8.28	7.93	7.63
Calexico	5.15	5.40	5.44	5.70	5.81	5.82	5.99	6.10	5.91	6.21
El Centro	7.53	7.32	7.45	7.30	7.63	8.31	8.64	7.82	7.48	7.92
Holtville	1.60	1.49	1.45	1.53	1.52	1.51	1.77	2.02	2.06	1.76
Imperial	2.15	2.58	2.67	2.02	2.58	2.57	3.25	3.38	3.49	3.57
Westmorland	0.64	0.64	0.63	0.86	0.96	0.98	0.64	0.64	0.65	0.65
Heber Public Utilities District	0.32	0.32	0.30	0.34	0.32	0.31	0.31	0.45	1.07	1.26
Seeley County Water District	0.31	0.31	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Southern California Water Co.[1]	3.55	3.05	3.16	3.14	3.56	3.21	2.95	3.51	3.96	3.34
NAF El Centro	0.53	0.54	0.61	0.58	0.62	0.61	0.61	0.62	0.64	0.68
Total	**28.75**	**27.75**	**29.06**	**28.84**	**30.83**	**31.36**	**32.70**	**33.12**	**33.50**	**33.32**

Source: Anisa Divine, Ph.D., Senior Planner-Agricultural Water Management Section, Imperial Irrigation District
1 – Southern California Water Co. provides water to Calipatria, Niland, Calipatria CDCR, and Centinela CDCR

Figure 5 IID MCI Water Deliveries, 2000-2009



The Definite Plan provides the most recent evaluation of MCI water uses. According to the Definite Plan, from 1998 to 2005, average consumptive use for residential water was 63.4 percent of total average MCI water delivery. In contrast, California's 20x2020 Water Conservation Plan estimates that consumptive use is about 30 percent of total average MCI water delivery.

3 Future MCI Water Demand

For the Imperial IRWMP, future MCI water demand is categorized into four main groups: municipal, geothermal/solar thermal energy and industrial, feedlots/dairies, and environmental resources. The data and method for forecasting future water demand for each category is discussed in this section.

A method used within the Imperial Region to calculate future apportionment of MCI water demand is described in the EDP. The EDP prescribes the amount of water that the IID water users receive during periods of supply/demand imbalance (SDI). Similar to UWMP methods, the EDP estimates future municipal water use based on population growth and then compares the resulting future water use with a baseline water use. Under SDI conditions, industrial and geothermal/solar thermal water users are placed into two categories: 1) for users with existing contracts (as of 2008), water allocated is based on past use, not-to-exceed contracted amount and contract terms; and 2) for contracts after 2008, water allocation is based on anticipated use. The contract terms include not-to-exceed amounts and considerations for water availability. Future water allocation for dairies and feed lots are is based on historical practices. Environmental resources use is based on the amount of mitigation area that has been developed.

3.1 Municipal Water Deliveries

For planning purposes, municipal water demand includes the water demand for residential, commercial, and industrial uses. Three methods were used to estimate municipal (residential, commercial, and urban industrial) water delivered:

Method 1: Supply/Demand Imbalance Apportionment (Equitable Distribution Plan)

Method 2: Water Use per Capita Model

Method 3: Land Use Model

Each method is discussed below along with the forecasted demand.

3.1.1 Method 1: Future Water Allocation for Municipal using Supply/Demand Imbalance

The EDP describes municipal water as based on the amount of municipal water used in 2006 plus the current District-wide average use per capita multiplied by the increase in population since 2006. The SDI Apportionment uses the EDP method by which future municipal water demand can be estimated and prescribes that forecasted municipal water use will be 0.26 AFCY (250 GPCD). Table 13 lists the 2006 population from Table 3 and Table 5 for each population center that is subject to the EDP, also presenting the forecasted growth through 2050.

Table 13 Incremental Forecasted Growth for Imperial Region

	2006 Population	Difference Between 2006 Population and Forecasted Population 2010	2015	2020	2025	2030	2035	2040	2045	2050
Within IID Water Service Area										
Brawley	22,037	8,668	14,169	19,670	23,815	27,959	30,229	36,237	42,935	50,404
Calexico	36,230	5,423	11,534	17,644	22,521	27,398	29,675	37,251	45,697	55,114
Calipatria	3,421	960	1,571	2,181	2,576	2,971	3,094	3,843	4,678	5,609
El Centro	39,797	5,206	11,609	18,011	22,460	26,908	29,039	36,952	45,774	55,610
Holtville	5,283	656	1,022	1,388	1,654	1,919	2,026	2,866	3,803	4,847
Imperial	11,406	915	3,550	6,185	7,377	8,568	9,137	11,498	14,131	17,067
Westmorland	2,170	676	1,075	1,474	1,764	2,053	2,197	2,699	3,259	3,883
Heber Public Utilities District	2,988	613	1,351	2,240	3,312	4,603	6,159	8,035	10,294	13,017
Seeley County Water District	1,624	333	734	1,217	1,800	2,502	3,348	4,367	5,595	7,075
Niland	1,143	234	517	857	1,267	1,761	2,356	3,074	3,938	4,979
Calipatria – CDCR	4,180	0	0	0	0	0	0	0	0	0
Centinela – CDCR	5,110	0	0	0	0	0	0	0	0	0
NAF El Centro	1,620	72	167	268	374	486	604	729	861	1,001
Specific Plan Area[1]	0	876	1,753	2,629	3,505	4,382	5,258	6,134	7,011	7,887
IID Water Service Area Total	**137,009**	**24,632**	**49,051**	**73,764**	**92,425**	**111,510**	**123,122**	**153,684**	**187,976**	**226,492**
Outside IID Water Service Area										
Ocotillo/Nomirage	574	33	77	124	174	228	285	347	413	485
Specific Plan Area[1]	0	24	47	71	95	118	142	166	189	213
Outside IID Water Service Area Total	**574**	**57**	**124**	**195**	**269**	**346**	**427**	**513**	**602**	**698**

1 – Population estimated using Specific Plan residential land use values and demographic data from Table 4.

Table 14 and Table 15 show forecasted municipal water apportionments using the population values in Table 6, the 2006 IID water delivery amounts from Table 12, and 0.26 AFCY (250 GPCD) for all population growth beyond 2006. Figure 6 shows the forecasted municipal water demand using SDI Apportionment through 2050.

Table 14 Future SDI Apportionment for Imperial Region, Present-2050, Acre-Feet Per Year

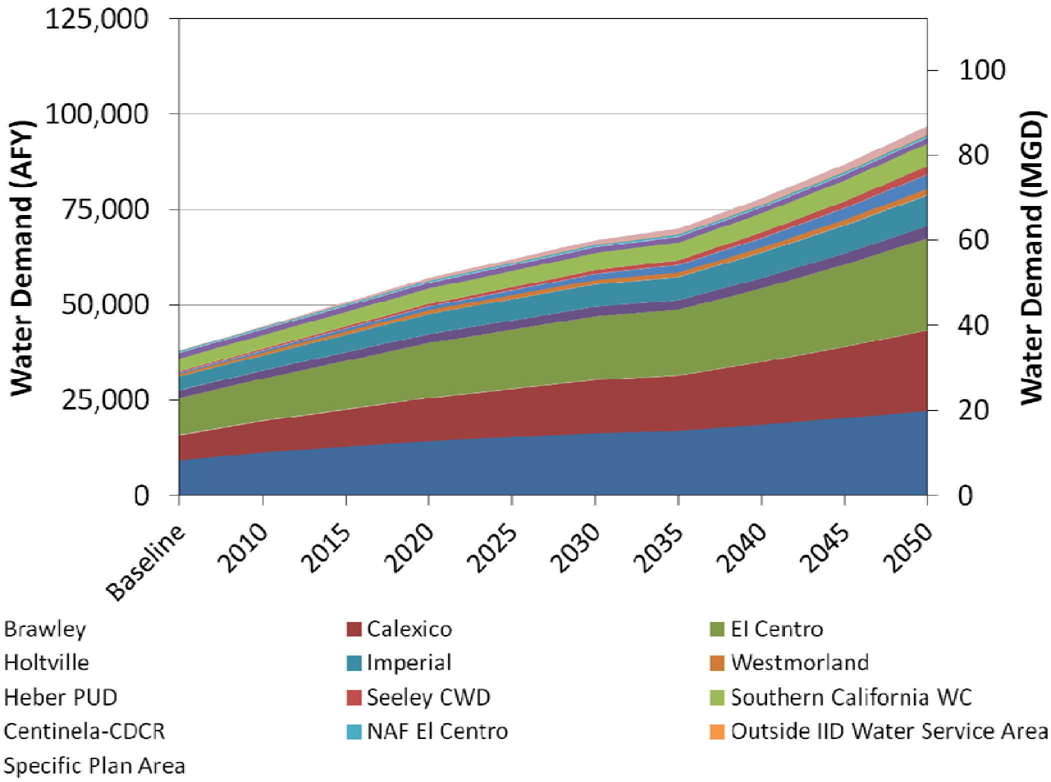
		Forecasted Apportionments								
	2006 Baseline	2010	2015	2020	2025	2030	2035	2040	2045	2050
Within IID Water Service Area										
Brawley	9,225	11,479	12,909	14,339	15,417	16,494	17,085	18,647	20,388	22,330
Calexico	6,709	8,119	9,708	11,296	12,564	13,832	14,425	16,394	18,590	21,039
El Centro	9,678	11,032	12,696	14,361	15,518	16,674	17,228	19,285	21,579	24,137
Holtville	1,983	2,154	2,249	2,344	2,413	2,482	2,510	2,728	2,972	3,243
Imperial	3,643	3,881	4,566	5,251	5,561	5,871	6,019	6,633	7,317	8,080
Westmorland	713	889	993	1,096	1,172	1,247	1,284	1,415	1,560	1,722
Heber Public Utilities District	344	503	695	926	1,205	1,541	1,945	2,433	3,021	3,728
Seeley County Water District	346	433	537	663	814	996	1,216	1,481	1,801	2,185
Southern California Water Company[1]	3,301	3,612	3,844	4,091	4,300	4,531	4,718	5,099	5,541	6,054
Centinela – CDCR	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515
NAF El Centro	433	452	476	503	530	559	590	623	657	693
Specific Plan Area	0	228	456	684	911	1,139	1,367	1,595	1,823	2,051
IID Water Service Area Total	**37,890**	**44,294**	**50,643**	**57,069**	**61,921**	**66,883**	**69,902**	**77,848**	**86,764**	**96,778**
Outside IID Water Service Area										
Ocotillo/Nomirage	106[2]	115	126	138	151	165	180	196	213	232
Specific Plan Area	0	6	12	18	25	31	37	43	49	55
Outside IID Water Service Area Total	**106**	**121**	**138**	**157**	**176**	**196**	**217**	**239**	**263**	**287**

1 – Southern California Water Company delivers water to Niland, Calipatria and Calipatria-CDCR from IID.
2 – Water use estimates from Ocotillo/Coyote Wells Hydrology and Groundwater Modeling Study, Table 4-3.

Table 15 Future SDI Apportionment for Imperial Region, Present-2050, Million Gallons Per Day										
		Forecasted Apportionments								
	2006 Baseline	2010	2015	2020	2025	2030	2035	2040	2045	2050
Within IID Water Service Area										
Brawley	8.24	10.25	11.52	12.80	13.76	14.73	15.25	16.65	18.20	19.93
Calexico	5.99	7.25	8.67	10.08	11.22	12.35	12.88	14.64	16.60	18.78
El Centro	8.64	9.85	11.33	12.82	13.85	14.89	15.38	17.22	19.26	21.55
Holtville	1.77	1.92	2.01	2.09	2.15	2.22	2.24	2.44	2.65	2.90
Imperial	3.25	3.46	4.08	4.69	4.96	5.24	5.37	5.92	6.53	7.21
Westmorland	0.64	0.79	0.89	0.98	1.05	1.11	1.15	1.26	1.39	1.54
Heber Public Utilities District	0.31	0.45	0.62	0.83	1.08	1.38	1.74	2.17	2.70	3.33
Seeley County Water District	0.31	0.39	0.48	0.59	0.73	0.89	1.09	1.32	1.61	1.95
Southern California Water Company[1]	2.95	3.22	3.43	3.65	3.84	4.05	4.21	4.55	4.95	5.40
Centinela - CDCR	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
NAF El Centro	0.39	0.40	0.43	0.45	0.47	0.50	0.53	0.56	0.59	0.62
Specific Plan Area	0.00	0.20	0.41	0.61	0.81	1.02	1.22	1.42	1.63	1.83
IID Water Service Area Total	**33.83**	**39.54**	**45.21**	**50.95**	**55.28**	**59.71**	**62.40**	**69.50**	**77.46**	**86.40**
Outside IID Water Service Area										
Ocotillo/Nomirage	0.09[2]	0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.19	0.21
Specific Plan Area	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05
Outside IID Water Service Area Total	**0.09**	**0.11**	**0.12**	**0.14**	**0.16**	**0.18**	**0.19**	**0.21**	**0.23**	**0.26**

1 – Southern California Water Company delivers water to Niland, Calipatria and Calipatria-CDCR from IID.
2 – Water use estimates from Ocotillo/Coyote Wells Hydrology and Groundwater Modeling Study, Table 4-3.

Figure 6 Future SDI Apportionment for the Imperial Planning Region



Using SDI Apportionment, municipal water demand for the IID water service area is expected to increase by over 250 percent by the year 2050. Municipal water demand outside of the IID water service area is expected to increase by over 270 percent by the year 2050.

Using the average water use of 0.26 AFCY (250 GPCD) and the land use demographics in Table 4, the expected SDI municipal water demand represents a total urban land use increase of about 170,000 acres by the year 2050 for the Imperial Region.

3.1.2 Method 2: Future Municipal Water Demand Using Per Capita Demand Model

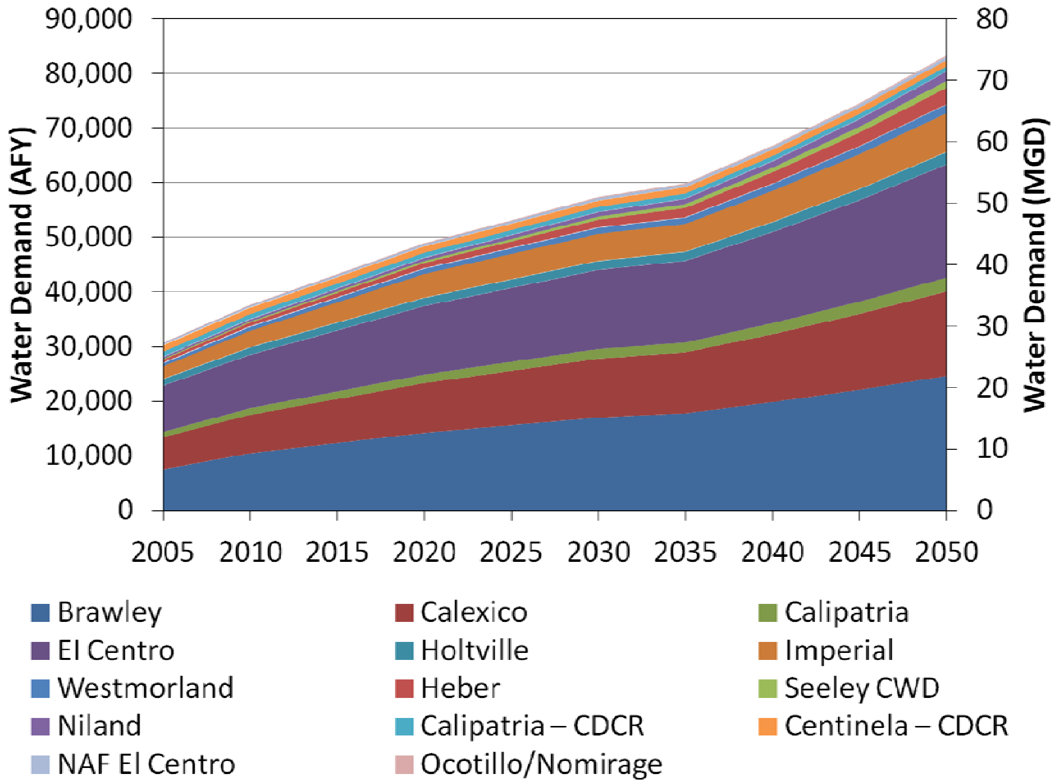
Future municipal water demand was forecasted using historical per capita water use. A model was developed using the demand per capita per day listed in Table 7, a distribution of the daily municipal demand to the different types of water use, and the population estimates listed in Table 6. For cities not listed in Table 6, the population weighted average per capita demand was used to calculate future municipal water demand. See Attachment B for the Per Capita Model calculations for individual cities. Table 16, Table 17, and Figure 7 show the resulting forecasted municipal water demand based on the water use Per Capita Model within the Imperial Region.

Table 16 Future Municipal Water Demand Calculated using Water Demand Per Capita Model, Present-2050, Acre-Feet Per Year										
	Forecasted Demand									
	2005	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Within IID Water Service Area										
Brawley	8,415	10,440	12,310	14,180	15,590	16,999	17,770	19,813	22,091	24,630
Calexico	6,202	7,081	8,120	9,159	9,988	10,817	11,204	12,492	13,928	15,529
Calipatria	968	1,227	1,398	1,569	1,679	1,790	1,824	2,034	2,268	2,528
El Centro	9,017	9,779	11,171	12,562	13,529	14,496	14,959	16,678	18,595	20,733
Holtville	1,275	1,307	1,387	1,468	1,526	1,584	1,608	1,793	1,999	2,229
Imperial	2,462	3,080	3,739	4,398	4,696	4,994	5,136	5,726	6,384	7,118
Westmorland	626	740	844	947	1,023	1,098	1,135	1,266	1,411	1,574
Heber Public Utilities District	547	684	824	993	1,197	1,442	1,738	2,094	2,524	3,041
Seeley County Water District	235	294	354	426	514	619	746	899	1,083	1,305
Niland	308	386	465	560	675	813	980	1,181	1,423	1,714
Calipatria – CDCR	961	961	961	961	961	961	961	961	961	961
Centinela – CDCR	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175
NAF El Centro	368	389	411	434	459	484	512	540	571	603
IID Water Service Area Total	**30,617**	**37,543**	**43,159**	**48,833**	**53,011**	**57,272**	**59,748**	**66,652**	**74,412**	**83,139**
Outside IID Water Service Area										
Ocotillo/Nomirage	130	140	150	161	172	184	198	212	227	244

Table 17 Future Municipal Water Demand Calculated using Water Demand Per Capita Model, Present-2050, Million Gallons Per Day

	Forecasted Demand									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Within IID Water Service Area										
Brawley	7.51	9.32	10.99	12.66	13.92	15.18	15.86	17.69	19.72	21.99
Calexico	5.54	6.32	7.25	8.18	8.92	9.66	10.00	11.15	12.43	13.86
Calipatria	0.86	1.10	1.25	1.40	1.50	1.60	1.63	1.82	2.02	2.26
El Centro	8.05	8.73	9.97	11.21	12.08	12.94	13.35	14.89	16.60	18.51
Holtville	1.14	1.17	1.24	1.31	1.36	1.41	1.44	1.60	1.78	1.99
Imperial	2.20	2.75	3.34	3.93	4.19	4.46	4.58	5.11	5.70	6.35
Westmorland	0.56	0.66	0.75	0.85	0.91	0.98	1.01	1.13	1.26	1.40
Heber Public Utilities District	0.49	0.61	0.74	0.89	1.07	1.29	1.55	1.87	2.25	2.71
Seeley County Water District	0.21	0.26	0.32	0.38	0.46	0.55	0.67	0.80	0.97	1.16
Niland	0.28	0.34	0.41	0.50	0.60	0.73	0.87	1.05	1.27	1.53
Calipatria – CDCR	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Centinela – CDCR	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
NAF El Centro	0.33	0.35	0.37	0.39	0.41	0.43	0.46	0.48	0.51	0.54
IID Water Service Area Total	**27.33**	**33.52**	**38.53**	**43.60**	**47.33**	**51.13**	**53.34**	**59.50**	**66.43**	**74.22**
Outside IID Water Service Area										
Ocotillo/Nomirage	0.12	0.12	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.22

Figure 7 Future Municipal Water Demand Per Capita Model



Using the Per Capita Model, municipal water demand for the IID water service area is expected to increase by over 170 percent by the year 2050. Municipal water demand outside of the IID water service area is expected to increase by nearly 90 percent by the year 2050.

Using the population-weighted average water use of 0.23 AFY and 205 MGD and the land use demographics in Table 4, the expected Per Capita Model municipal water demand represents a total urban land use increase of over 100,000 acres by the year 2050 for the Imperial Region.

3.1.3 Method 3: Future Municipal Water Demand Using Land Use Model

Future municipal water demand can also be estimated by projected land use. Each land use type can be assigned an amount of the water use associated on a volume-by-area basis (AF/AC). Knowing the total area for a certain land use type and multiplying it by unit water use associated with that land use type will provide an estimate of the future municipal water demand for the land use.

Using the developed municipal area listed in Table 9, as well as NAF El Centro's reported land use, and the 2006 IID water delivery data listed in Table 12, municipal water demand rates were calculated using the Land Use Model for each municipal area within the IID water service area and are shown in Table 18. In addition to calculating water demand rates for each city, average municipal unit water demand (AF/AC and Gal/AC) and area weighted average municipal unit water demand were calculated.

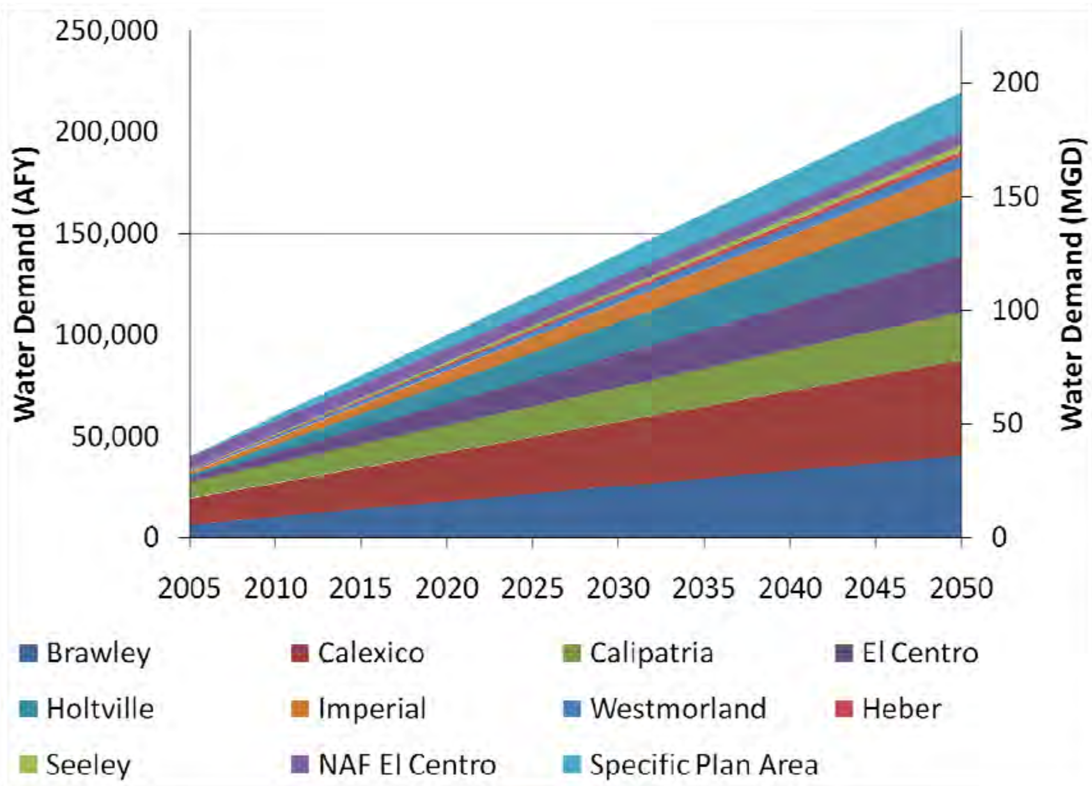
Table 18 Municipal Water Demand Rates within IID Water Service Area					
	Area, AC	2006 Water Demand, AF	Water Demand Per Acre, AF/AC	2006 Water Demand, Gallons	Water Demand Per Acre, Gallons/AC
Brawley	2,686	9,410	3.5	8,400,718	3,125
Calexico	3,188	6,717	2.1	5,996,559	1,875
Calipatria/Niland	467	2,208	4.7	1,971,178	4,196
El Centro	5,050	9,689	1.9	8,649,793	1,696
Holtville	525	1,984	3.8	1,771,203	3,392
Imperial	964	3,793	3.9	3,386,177	3,482
Westmorland	189	713	3.8	636,526	3,392
Heber	91	344	3.8	307,104	3,392
Seeley	92	346	3.8	308,889	3,392
NAF El Centro	1101	433	0.4	386,558	357
Total	**14,353**	**35,637**		**31,814,705**	
Average			**3.2**		**2,857**
Area-Weighted Average			**2.5**		**2,232**

Given the variability in municipal water demand rates per land use, the area-weighted average was used with the land area data shown in Table 9 to forecast municipal water demand. Table 19 and Figure 8 list the total forecasted municipal water demands based on the area-weighted average municipal water demand rate.

Table 19 Land Use-Based Future Municipal Water Demand within IID Water Service Area, Present – 2050										
	Forecasted Water Demand									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year										
Brawley	6,715	10,483	14,248	18,018	21,785	25,545	29,313	33,078	36,845	40,610
Calexico	12,625	16,440	20,263	24,078	27,895	31,713	35,533	39,348	43,168	46,985
Calipatria	7,970	9,733	11,498	13,258	15,020	16,785	18,548	20,310	22,073	23,835
El Centro	2,410	5,210	8,015	10,815	13,613	16,413	19,213	22,013	24,813	27,613
Holtville	1,168	4,128	7,093	10,053	13,015	15,973	18,935	21,895	24,858	27,818
Imperial	1,313	2,900	4,485	6,070	7,658	9,245	10,833	12,418	14,005	15,590
Westmorland	473	1,040	1,615	2,183	2,753	3,323	3,893	4,463	5,033	5,603
Heber	228	503	780	1,053	1,328	1,603	1,878	2,153	2,428	2,703
Seeley	230	505	783	1,060	1,335	1,613	1,890	2,165	2,443	2,720
NAF El Centro	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835	6,835
Specific Plan Area[1]	0	4,910	9,820	14,730	19,640	24,550	29,460	34,370	39,280	44,190
Total	39,965	59,930	79,923	99,886	119,856	139,821	159,799	179,762	199,740	219,708
Million Gallons Per Day										
Brawley	5.99	9.36	12.72	16.09	19.45	22.81	26.17	29.53	32.89	36.25
Calexico	11.27	14.68	18.09	21.50	24.90	28.31	31.72	35.13	38.54	41.95
Calipatria	7.12	8.69	10.26	11.84	13.41	14.98	16.56	18.13	19.71	21.28
El Centro	2.15	4.65	7.16	9.66	12.15	14.65	17.15	19.65	22.15	24.65
Holtville	1.04	3.68	6.33	8.97	11.62	14.26	16.90	19.55	22.19	24.83
Imperial	1.17	2.59	4.00	5.42	6.84	8.25	9.67	11.09	12.50	13.92
Westmorland	0.42	0.93	1.44	1.95	2.46	2.97	3.48	3.98	4.49	5.00
Heber	0.20	0.45	0.70	0.94	1.19	1.43	1.68	1.92	2.17	2.41
Seeley	0.21	0.45	0.70	0.95	1.19	1.44	1.69	1.93	2.18	2.43
NAF El Centro	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10
Specific Plan Area[1]	0.00	1.92	3.85	5.77	7.70	9.62	11.54	13.47	15.39	17.32
Total	35.68	53.50	71.35	89.17	107.00	124.82	142.66	160.48	178.32	196.14

1 – Assume linear growth to Specific Plan build-out by year 2050.

Figure 8 Land Use-Based Future Municipal Water Demand within the IID Water Service Area



Using the demographic data from Table 4 and the area-weighted municipal water demand rates in Table 18, the year 2050 municipal water demand calculated by the Land Use Model represents a population of 342,300, with an average population growth rate of 23 percent every five years and almost 450 percent population growth between 2005 and 2050.

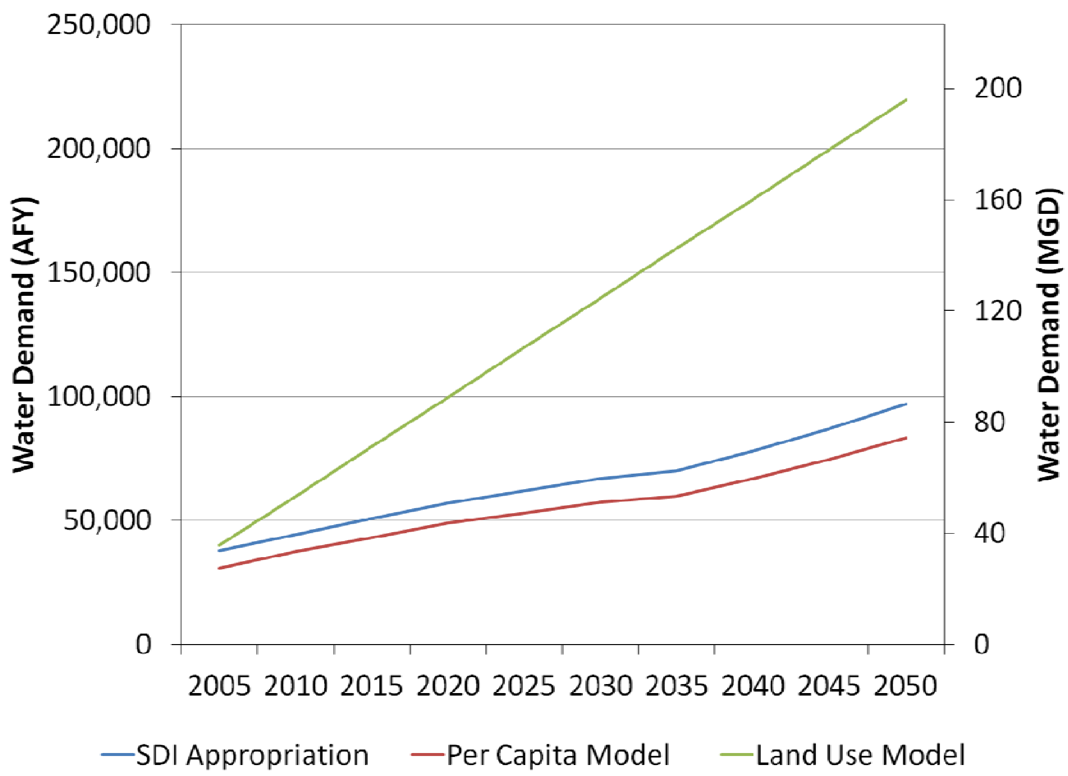
3.2 Future Municipal Water Demand Summary

Table 20 provides a summary of each of the methods used to estimate municipal water demand.

Table 20 Summary of Future Municipal Water Demand within Imperial Region, Present-2050										
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year										
SDI Appropriation	37,996	44,415	50,782	57,225	62,096	67,079	70,119	78,087	87,026	97,066
Per Capita Model	30,747	37,682	43,309	48,993	53,183	57,456	59,946	66,864	74,639	83,383
Land Use Model	39,965	59,930	79,923	99,886	119,856	139,821	159,799	179,762	199,740	219,708
Million Gallons Per Day										
SDI Appropriation	33.92	39.65	45.33	51.09	55.44	59.88	62.60	69.71	77.69	86.65
Per Capita Model	27.45	33.64	38.66	43.74	47.48	51.29	53.52	59.69	66.63	74.44
Land Use Model	35.68	53.50	71.35	89.17	107.00	124.82	142.66	160.48	178.32	196.14

From Table 20, the Per Capita Model estimates represent the low range of forecasted municipal water demand. The SDI Appropriation is representative of the medium range municipal water demand estimate and the land use model is representative of a high range municipal water demand estimate. These three estimates are shown in Figure 9 to provide the full range of municipal water demand forecasts.

Figure 9 Summary of Estimates of Future Municipal Water Demand



As shown in Figure 9, the Land Use Model forecasts a municipal water demand that is more than double the demand predicted by either SDI Appropriation or the Per Capita Model. The urban growth rate represented in the Land Use Model is not representative of past growth. Based on the type of data available and consistency with CDWR methods for calculating water use, it is recommended that the future municipal water demand and conservation will be based on the Per Capita Model.

3.3 Municipal Conservation Estimates

Conservation estimates were calculated using the Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (CDWR, 2010). See Attachment C for additional conservation calculations. Table 21 shows the baseline and a regional average target municipal water demand for 20 percent per capita water demand conservation by the year 2020, using the methods prescribed by CDWR. Table 22 and Figure 10 show future municipal water demand using the Per Capita Model, with and without conservation.

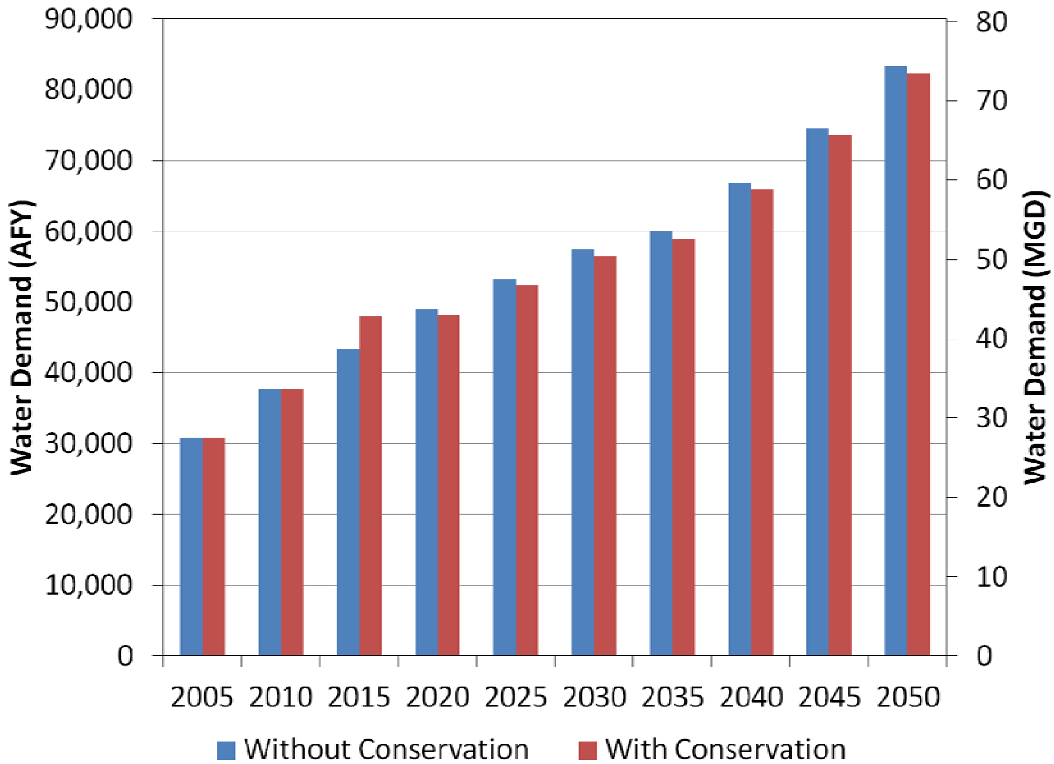
Table 21 Baseline and Target Municipal Water Demand Rates – Per Capita Model

	Baseline	2015 Interim Target (10% Demand Reduction)	2020 Target (20% Demand Reduction)
AFCY	0.25	0.23	0.20
GPCD	224	201	179

Table 22 Future Municipal Water Use Within Imperial Region, Present-2050

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Without Conservation										
AFY	30,747	37,682	43,309	48,993	53,183	57,456	59,946	66,864	74,639	83,383
MGD	27.45	33.64	38.66	43.74	47.48	51.29	53.52	59.69	66.63	74.44
With Conservation										
AFY	30,747	37,682	48,022	48,198	52,314	56,529	59,020	65,885	73,612	82,316
MGD	27	34	43	43	47	50	53	59	66	73

Figure 10 Future Municipal Water Demand for the Imperial Region, with and without Conservation



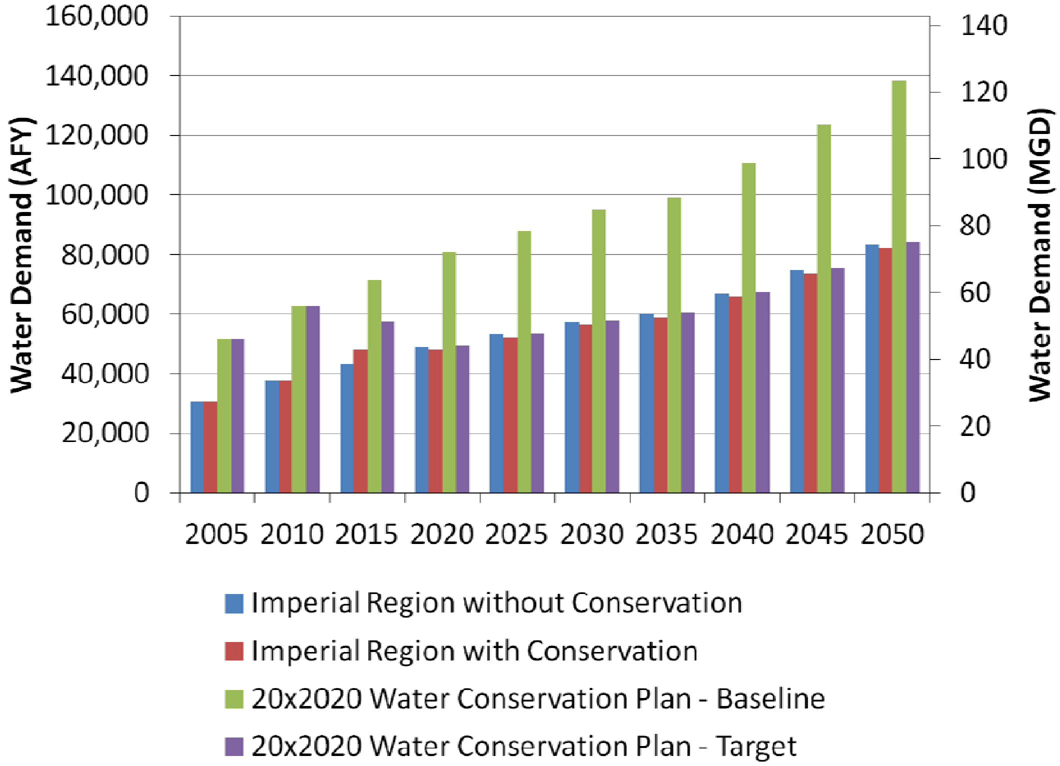
With conservation, the Imperial Region is expected to have a municipal water demand of 1,067 AFY (0.95 MGD) less than without conservation in the year 2050 based on CDWR methods.

The 20x2020 Water Conservation Plan establishes a baseline, interim (2015), and 2020 target for water demand in the Colorado River Hydrologic Region, shown below in Table 23. Figure 11 shows the forecasted municipal water demand estimated in this report with the forecasted municipal water demand using the 20x2020 Water Conservation Plan baseline and targets. For comparison, the forecasted municipal water demand using the 20x2020 Water Conservation Plan without conservation targets is shown as well.

Table 23 Baseline and Target Municipal Water Demand Rates for Colorado River Region

	Baseline	Interim Target (2015)	2020 Target
AFCY	0.39	0.31	0.24
GPCD	346	278	211

Figure 11 Future Municipal Water Demand for the Imperial Region – 20x202 Water Conservation Plan Comparison



As shown in Figure 11, the future Imperial Region municipal water demand without conservation is already below the required *20x2020 Water Conservation Plan* Colorado River Hydrologic Region target demand.

3.4 Future Geothermal/Solar Thermal and Industrial Water Demand

Solar thermoelectric plants require use of water for cooling, while solar mirror or photovoltaic typically do not. At these plants, water is for washing the mirrors and dust control, water usage is relatively low. For solar thermoelectric, water use varies with the cooling technology similar to binary geothermal plants. The wet cooling water use at these types of solar plants ranges from 10 to 2,000 AF/MWh, averaging 500 AF/MWh.

For geothermal and solar thermal plants, dry cooling systems are reported to provide less energy output than wet cooling systems (decrease plant efficiency). In comparison with wet cooling, dry cooling methods are estimated to result in a power generation cost of about 17 percent more, and would result in a decrease in power production of 5 percent to 10 percent on hotter days.[6] In their report to Congress in 2007, the United States Department of Energy (DOE) states the performance of a solar thermal trough plant drops by 4.6 percent, and a power tower drops by 1.3 percent. A dry cooled solar thermal plant

[6] Doering, Brandon; Jordan, Eddie. Memorandum on Imperial Irrigation District Power Plant Water Use Evaluation. 15 September 2009, Integrated Engineers and Contractors Corporation to GEI Consultants.

requires approximately 80 Gal/MWh for cycle makeup and mirror washing, as compared to a wet cooled plant that requires 800 Gal/MWh (0.90 AFY/MWh).[7]

Geothermal and solar thermal water demand for flash geothermal plants range from 2 to 40 acre-feet per megawatt-hour (AF/MWh) in the Imperial Region, averaging 15 AF/MWh. The binary geothermal plants listed all employ or propose to employ wet cooling and water demand ranges from 43 to 132 AF/MWh, averaging 96 AF/MWh. Geothermal electric power plants use the earth as the thermal energy source. Steam sources use steam Rankin-cycle turbines on a smaller scale than coal and nuclear power plants. The Northern California Power Authority operates two geothermal power plants and typically withdraws approximately 17.0 pounds of steam per kilowatt-hour (lbs/kWh) or 2000 gallons per megawatt-hour (Gal/MWh) from the geothermal field. According to the Geothermal Energy Association (GEA), these values are not representative of actual water use for geothermal power plants and point out that the DOE report fails to differentiate between geothermal fluid and freshwater.[8] According to the GEA, geothermal plants use five gallons of freshwater per megawatt hour, while binary air-cooled plants use no fresh water.[9] A recent article in IEEE Spectrum provided water use estimates for binary and flash systems in the Salton Sea geothermal area using surface water (Binary: 4,463 Gal/MWh (120 AFY), Flash: 361 Gal/MWh (9.7 AFY).[10]

Table 24 provides a summary of the water uses for power plants for both construction and operations in or around the Imperial Region. This information is from the California Energy Commission website and information submitted during the review and approval process for plants located in the Imperial Region or other similar desert environments. Project specific information is provided in Attachment D.

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[7] U.S. Department of Energy "Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar power Electricity Generation" 2007.

[8] Geothermal Energy Association. "GEA Issue Brief: Geothermal Energy and Water Consumption." http://www.geo-energy.org/pdf/Geothermal_Energy_and_Water_Consumption_Issue_Brief.pdf Accessed December 2010.

[9] Kagal, Alyssa; Bates, Diana; Gawell, Karl. Geothermal Energy Association. "A Guide to Geothermal Energy and the Environment." April 2007.

[10] Adde, Sally and Moore, Samuel K. "In the American Southwest, the Energy Problem is Water." IEEE Spectrum: Inside Technology (website). June 2010. http://spectrum.ieee.org/energy/environment/in-the-american-southwest-the-energy-problem-is-water.

Table 24 Water Use at Geothermal and Solar Thermal Power Plants in Imperial Region							
Power Plant Owner	**Plant Name**	**Type**	**Capacity (MW Net)**	**IID Water Use (AFY)**	**AFY/MW**	**IID Water Use (MGD)**	**MGD/MW**
CalEnergy	Salton Sea 1	Dual Flash	10	9.9* (Combined meter)	0.4	0.01	0.0004
	Salton Sea 2		17				
	Salton Sea 3	Dual Flash	50	399* (Combined meter)	4.4	0.36	0.0039
	Salton Sea 4		40				
	Salton Sea 5	Dual Flash	49	1200*	24.5	1.07	0.0219
	Del Ranch	Dual Flash	42	948*	22.6	0.85	0.0202
	Vulcan	Dual Flash	38	164*	4.3	0.15	0.0038
	Leathers	Dual Flash	42	1354*	32.2	1.21	0.0287
	Elmore	Dual Flash	42	1910*	45.5	1.71	0.0406
	CE Turbo	Single Flash	10	0*	0	0.00	0.0000
	Black Rock 1,2,3 (Proposed)	Single Flash	195	483 Est.*	2.5	0.43	0.0022
	Black Rock 4,5,6 (Proposed)	Single Flash	195	483 Est.*	2.5	0.43	0.0022
Catalyst Hannon Armstrong Renewables	Hudson Ranch 1	Dual Flash	49.9	850 Est.	17	0.76	0.0152
	Hudson Ranch 2	Dual Flash	49.9	850 Est.	17	0.76	0.0152
ORMAT	Ormesa 1	Binary	38	1665	43.8	1.49	0.0391
	Ormesa 1E	Binary	8	923	115.4	0.82	0.1030
	Ormesa 1H	Binary	12	1040	86.7	0.93	0.0774
	Ormesa 2	Binary	18	1993	110.7	1.73	0.0988
	GEM 2	Dual Flash	22	-	-	-	-
	GEM 3	Dual Flash	18	-	-	-	-
Heber KGRA (ormat)	Heber 1	Dual Flash/Binary	52	1156	22.2	1.03	0.0198
	Heber 2	Binary	48	3663	76.3	3.27	0.0681
Brawley KGRA (ormat)	North Brawley (Construction)	Binary	49.9	6600 Est.	132.3	5.89	0.1180
	East Brawley (Proposed)	Binary	49.9	5500 Est.	110.2	5500	4.91
Brawley KGRA (RAM)	Ram East Brawley	Dual Flash	50	800 Est.	16	0.71	0.0143

*Past 10 year average use from delivery gate meters.

From Table 24, the total water use in the Imperial Region for geothermal and solar thermal energy is approximately 31,931 AFY. This value will be used as the baseline in calculating future water demand for geothermal water use. Other renewable energy sources, such as wind and biomass, would be subject to similar terms. However, these other renewable energy sources do not rely on water as a significant component of the energy producing process. It is assumed for planning purposes that the water demand for other renewable energy sources is relatively small when compared to geothermal and solar thermal energy. As such, water demand for these other renewable energy sources was assumed to be included in the geothermal and solar thermal build-out demand.

Conservation for geothermal and solar thermal water uses assumes 10 percent savings by the year 2015 and 20 percent savings by the year 2020.

3.4.1 Non-Urban Industrial Water Demand

Industrial water users outside municipal areas are governed by the same terms as geothermal and solar thermal energy in the EDP. The 1997 to 2008 average water demand for industrial uses in the Imperial region was 7,092 AFY (6.33 MGD). Outside of the IID water service area, the U.S. Gypsum Company, working in West Mesa estimates a baseline groundwater demand of 767 AFY (0.68 MGD, according to the *Ocotillo*/Coyote Wells Hydrology and Groundwater Modeling Study (GEI Consultants, Inc, 2004). For planning purposes, it was assumed that industrial water demand will not change going into the future. According to the 20x2020 Water Conservation Plan, industrial water use reduction is 5 percent by the year 2015 and 10 percent reduction by the year 2020.

3.4.2 Future Geothermal/Solar Thermal and Industrial Water Demand

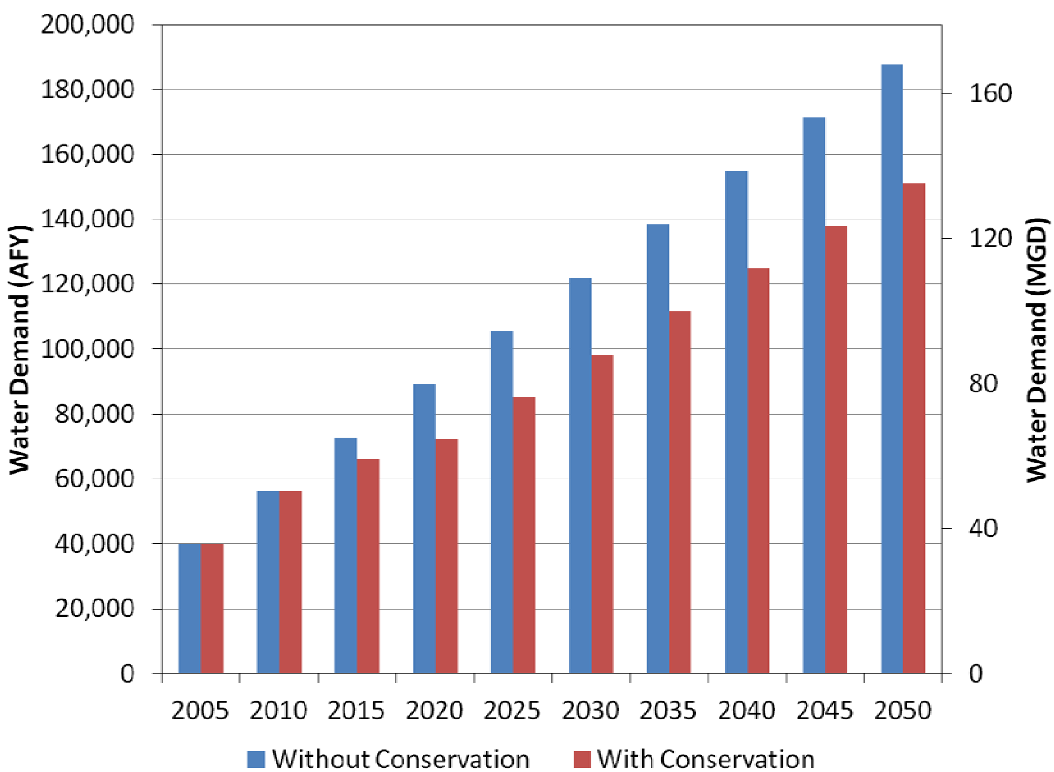
Table 26, Table 27, and Figure 12 show the expected future water demand for geothermal and solar thermal and industrial water uses through 2050. Geothermal and solar thermal water use for 2005 assumes the total IID water use in Table 24. The Imperial County General Plan estimates that at full build-out, the water demand for all geothermal and solar thermal, and other renewable energy will be 180,000 AFY (161 MGD).

Table 25 Future Geothermal and Solar Thermal and Industrial Water Use Within Imperial Region, Present-2050, Acre-Feet Per Year

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Without Conservation										
Geothermal and Solar Thermal	31,931	48,383	64,835	81,287	97,739	114,192	130,644	147,096	163,548	180,000
Industrial	7,859	7,859	7,859	7,859	7,859	7,859	7,859	7,859	7,859	7,859
Total	**39,790**	**56,242**	**72,694**	**89,146**	**105,598**	**122,051**	**138,503**	**154,955**	**171,407**	**187,859**
With Conservation										
Geothermal and Solar Thermal	31,931	48,383	58,352	65,030	78,192	91,353	104,515	117,677	130,838	144,000
Industrial	7,859	7,859	7,466	7,073	7,073	7,073	7,073	7,073	7,073	7,073
Total	**39,790**	**56,242**	**65,818**	**72,103**	**85,265**	**98,426**	**111,588**	**124,750**	**137,911**	**151,073**

Table 26 Future Geothermal and Solar Thermal and Industrial Water Use Within Imperial Region, Present-2050, Million Gallons Per Day										
	2005	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Without Conservation										
Geothermal and Solar Thermal	28.51	43.19	57.88	72.57	87.26	101.94	116.63	131.32	146.01	160.69
Industrial	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02
Total	**35.52**	**50.21**	**64.90**	**79.58**	**94.27**	**108.96**	**123.65**	**138.33**	**153.02**	**167.71**
With Conservation										
Geothermal and Solar Thermal	28.51	43.19	52.09	58.05	69.81	81.56	93.31	105.06	116.81	128.56
Industrial	7.02	7.02	6.67	6.31	6.31	6.31	6.31	6.31	6.31	6.31
Total	**35.52**	**50.21**	**58.76**	**64.37**	**76.12**	**87.87**	**99.62**	**111.37**	**123.12**	**134.87**

Figure 12 Future Geothermal and Solar Thermal and Industrial Water Demand for the Imperial Region



With conservation, the Imperial Region can expect a geothermal and solar thermal and industrial water demand of 36,786 AFY (32.84 MGD) less than without conservation in the year 2050.

3.5 Future Feedlots/Dairies Water Demand

The 1997 to 2008 adjusted annual average water use by feedlots and dairies was 20,000 AFY (17.85 MGD). Under the EDP, future use by feedlots and dairies was based upon past use and other considerations. It is assumed that future feedlot and dairy water demand will remain unchanged from the 1998 to 2008 average. The 20x2020 Water Conservation Plan only addresses potable water use. Therefore, 20 percent reduction in water use is not calculated for feedlots and dairies' water demand.

3.6 Future Environmental Resources Water Demand

Environmental resources water is needed for the Quantification Settlement Agreement (QSA) and Related Agreements mitigation. A total of 960 acres of freshwater marsh habitat will be constructed, with 320 acres completed in October 2009, another 320 acres scheduled for December 2014, and the final acreage to be constructed by December 2019. This project, which is part of the Habitat Conservation Plan, is being developed as mitigation for the QSA transfer program and operations and maintenance impacts on drains. The water demand for the habitat is 12 AF/AC per year (3.91MG/AC per year) and it must be equivalent to the Colorado River water quality. The marsh complex is designed as a flow-through system, and small volumes of water will be discharged to the IID drain system. Additional mitigation efforts may include a 2,000 acre saline habitat complex (does not use freshwater); up to 100 acres of native tree habitat to mitigate for impacts to tamarisk scrub vegetation (will use approximately 500 AFY or 0.45 MGD of fresh water); and desert mitigation (which has no water demand). For 2009, EDP includes 1,500 AF (489 MG) for environmental resources water. Using the marsh complex development schedule, water demand for 320 acres should be 3,840 AFY (3.43 MGD) and this grows to 11,520 AFY (10.28 MGD) by October 2019. With a fully developed tamarisk mitigation area, the environmental resource water requirement should be 12,020 AFY (10.73 MGD) by 2020.

3.7 Cumulative Future Water Demand

Without conservation, the total future water demand for non-agricultural uses in the Imperial Region is estimated to be 302,251 AFY (1,076 MGD) in the year 2050. With conservation the total future water demand for the Imperial Region is estimated to be 253,356 AFY (955 MGD). The cumulative future water demand for non-agricultural uses within and outside the IID water service area from the year 2005 to the year 2050 is summarized below in Tables 28 through 31.

Table 27 Cumulative Future MCI Water Demand within the IID Water Service Area, Present-2050, Acre- Feet Per Year										
	2005	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Without Conservation										
Municipal	30,617	37,543	43,159	48,833	53,011	57,272	59,748	66,652	74,412	83,139
Geothermal	31,931	48,383	64,835	81,287	97,739	114,192	130,644	147,096	163,548	180,000
Industrial	7,092	7,092	7,092	7,092	7,092	7,092	7,092	7,092	7,092	7,092
Feedlots/Dairies	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Environmental Resources	0	3,840	7,930	12,020	12,020	12,020	12,020	12,020	12,020	12,020
Total	**89,640**	**116,858**	**143,016**	**169,232**	**189,862**	**210,576**	**229,504**	**252,860**	**277,072**	**302,251**
With Conservation										
Municipal	30,617	37,543	47,853	48,037	52,141	56,344	58,822	65,672	73,384	82,071
Geothermal	31,931	48,383	58,352	65,030	78,192	91,353	104,515	117,677	130,838	144,000
Industrial	7,092	7,092	6,737	6,064	6,064	6,064	6,064	6,064	6,064	6,064
Feedlots/Dairies	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Environmental Resources	0	3,840	7,930	12,020	12,020	12,020	12,020	12,020	12,020	12,020
Total	**89,640**	**116,858**	**134,575**	**144,830**	**161,556**	**178,367**	**193,680**	**212,791**	**232,650**	**253,356**

Table 28 Cumulative Future MCI Water Demand within the IID Water Service Area, Present-2050, Million Gallons Per Day

	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Without Conservation										
Municipal	27.33	33.52	38.53	43.60	47.33	51.13	53.34	59.50	66.43	74.22
Geothermal	28.51	43.19	57.88	72.57	87.26	101.94	116.63	131.32	146.01	160.69
Industrial	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33
Feedlots/Dairies	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85
Environmental Resources	0.00	3.43	7.08	10.73	10.73	10.73	10.73	10.73	10.73	10.73
Total	**80.03**	**104.32**	**127.68**	**151.08**	**169.50**	**187.99**	**204.89**	**225.74**	**247.35**	**269.83**
With Conservation										
Municipal	27.33	33.52	42.72	42.88	46.55	50.30	52.51	58.63	65.51	73.27
Geothermal	28.51	43.19	52.09	58.05	69.81	81.56	93.31	105.06	116.81	128.56
Industrial	6.33	6.33	6.01	5.41	5.41	5.41	5.41	5.41	5.41	5.41
Feedlots/Dairies	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85	17.85
Environmental Resources	0.00	3.43	7.08	10.73	10.73	10.73	10.73	10.73	10.73	10.73
Total	**80.03**	**104.32**	**120.14**	**129.30**	**144.23**	**159.24**	**172.91**	**189.97**	**207.70**	**226.18**

Table 29 Cumulative Future MCI Water Demand Outside the IID Water Service Area, Present-2050, Acre-Feet Per Year

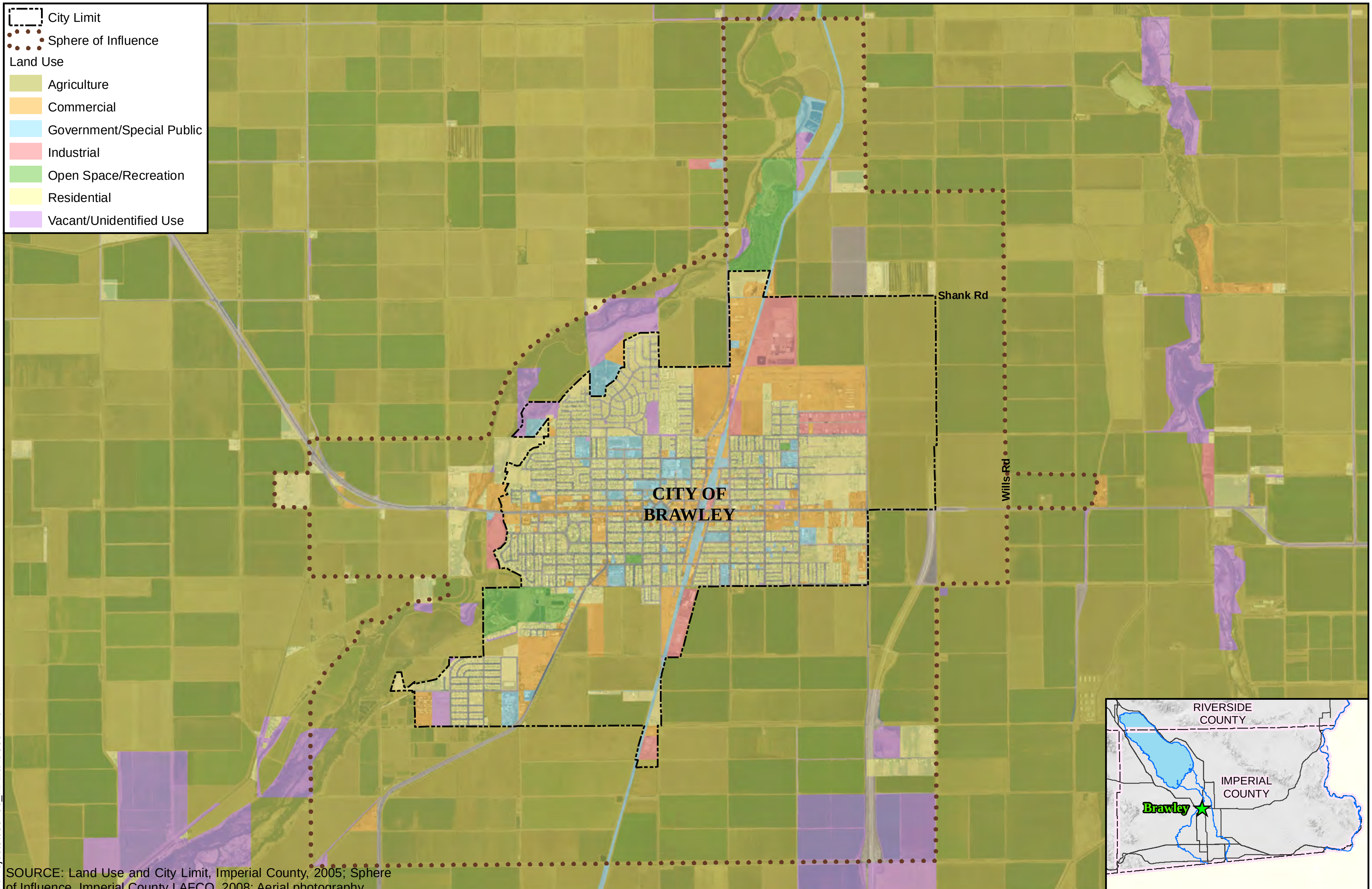
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Without Conservation										
Municipal[1]	130	147	164	182	201	221	241	262	285	309
Industrial	767	767	767	767	767	767	767	767	767	767
Total	**897**	**914**	**931**	**949**	**968**	**988**	**1,008**	**1,029**	**1,052**	**1,076**
With Conservation										
Municipal[1]	130	147	160	157	173	190	207	225	244	264
Industrial	767	767	729	690	690	690	690	690	690	690
Total	**897**	**914**	**888**	**848**	**863**	**880**	**897**	**915**	**934**	**955**

1 – Includes Coyote Wells/Wind Zero expected water use

Table 30 Cumulative Future MCI Water Demand Outside the IID Water Service Area, Present-2050, Million Gallons Per Day										
	2005	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Without Conservation										
Municipal[1]	0.12	0.13	0.15	0.16	0.18	0.20	0.22	0.23	0.25	0.28
Industrial	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Total	**0.80**	**0.82**	**0.83**	**0.85**	**0.86**	**0.88**	**0.90**	**0.92**	**0.94**	**0.96**
With Conservation										
Municipal[1]	0.12	0.13	0.14	0.14	0.15	0.17	0.18	0.20	0.22	0.24
Industrial	0.68	0.68	0.65	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Total	**0.80**	**0.82**	**0.79**	**0.76**	**0.77**	**0.79**	**0.80**	**0.82**	**0.83**	**0.85**

1 – Includes Coyote Wells/Wind Zero expected water use

Appendix A – Imperial Region Maps



SOURCE: Land Use and City Limit, Imperial County, 2005; Sphere of Influence, Imperial County LAFCO, 2008; Aerial photography,

5,000 2,500 0 5,000

Feet

IID IRWMP
Imperial County, California

Imperial Irrigation District

GEI Consultants
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CITY OF BRAWLEY CURRENT LAND USE

MARCH 2011

FIGURE A-1

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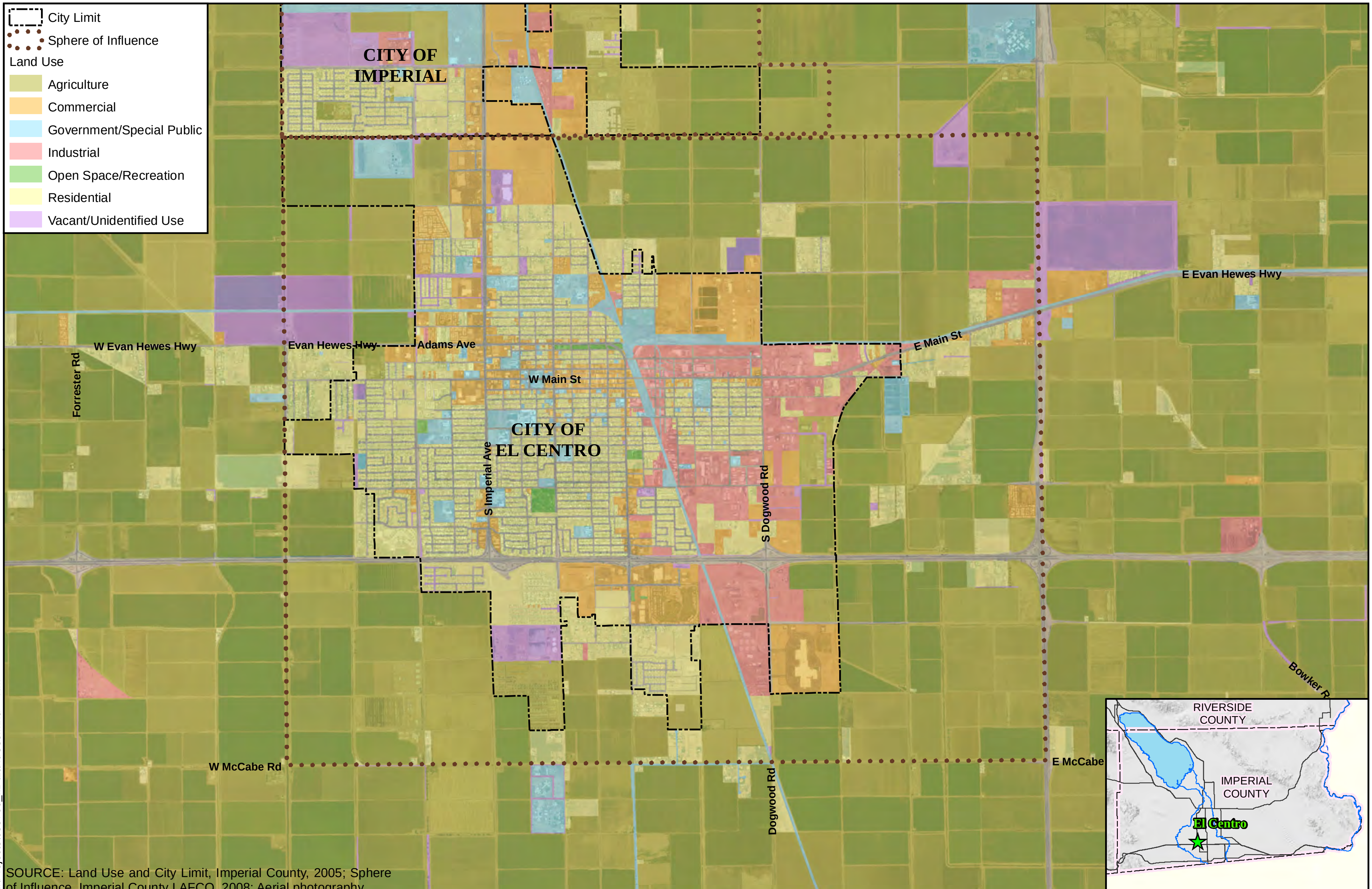
18-Feb-2011



SOURCE: Land Use and City Limit, Imperial County, 2005; Sphere of Influence, Imperial County LAFCO, 2008; Aerial photography,

5,000 2,500 0 5,000
Feet

IID IRWMP
Imperial County, California

Imperial Irrigation District

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CITY OF EL CENTRO CURRENT LAND USE

MARCH 2011

FIGURE A-2

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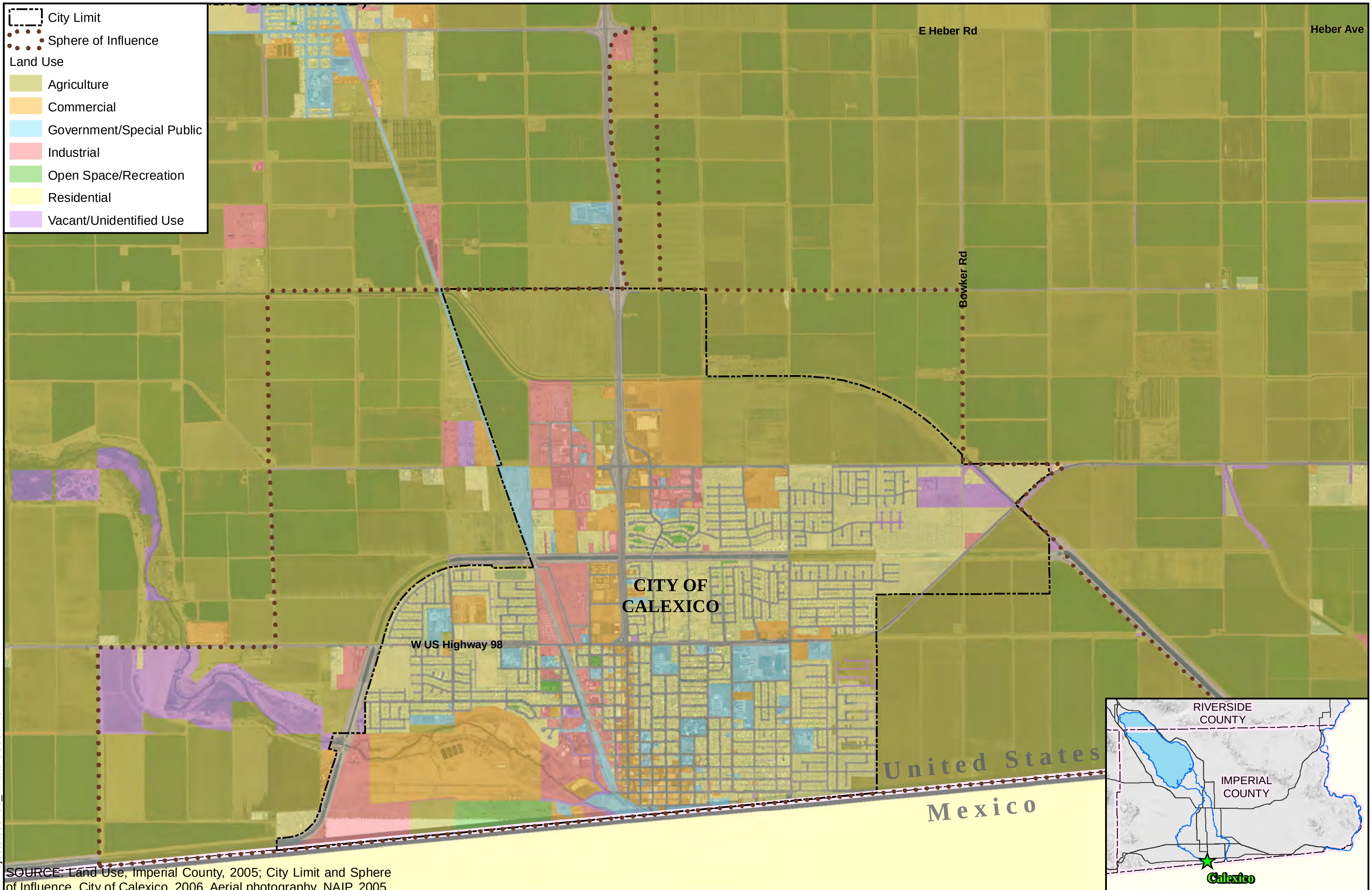
18-Feb-2011



SOURCE: Land Use, Imperial County, 2005; City Limit and Sphere of Influence, City of Calexico, 2006, Aerial photography, NAIP, 2005

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CITY OF CALEXICO CURRENT LAND USE

MARCH 2011

FIGURE A-3

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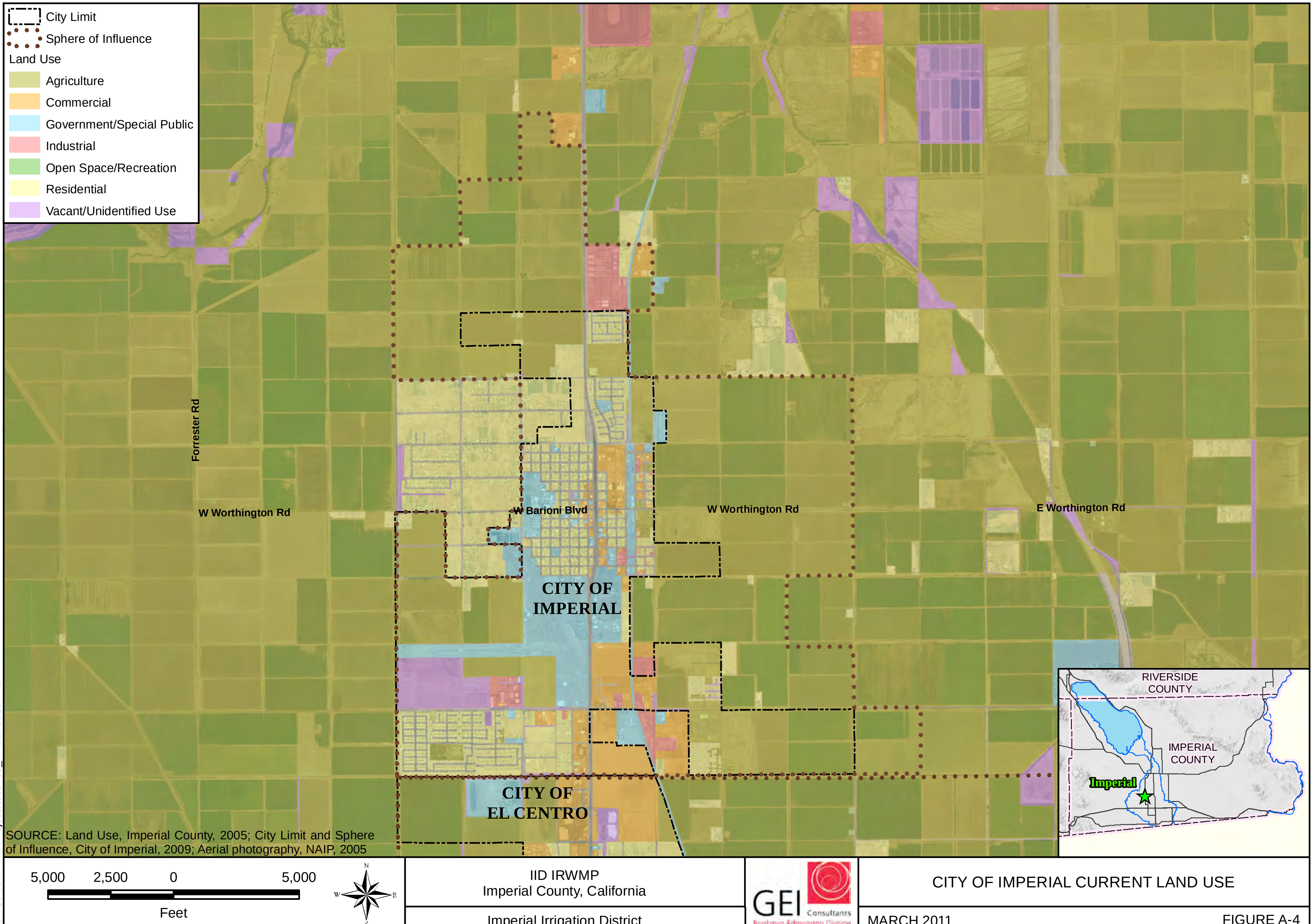
18-Feb-2011



SOURCE: Land Use, Imperial County, 2005; City Limit and Sphere of Influence, City of Imperial, 2009; Aerial photography, NAIP, 2005

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18-Feb-2011

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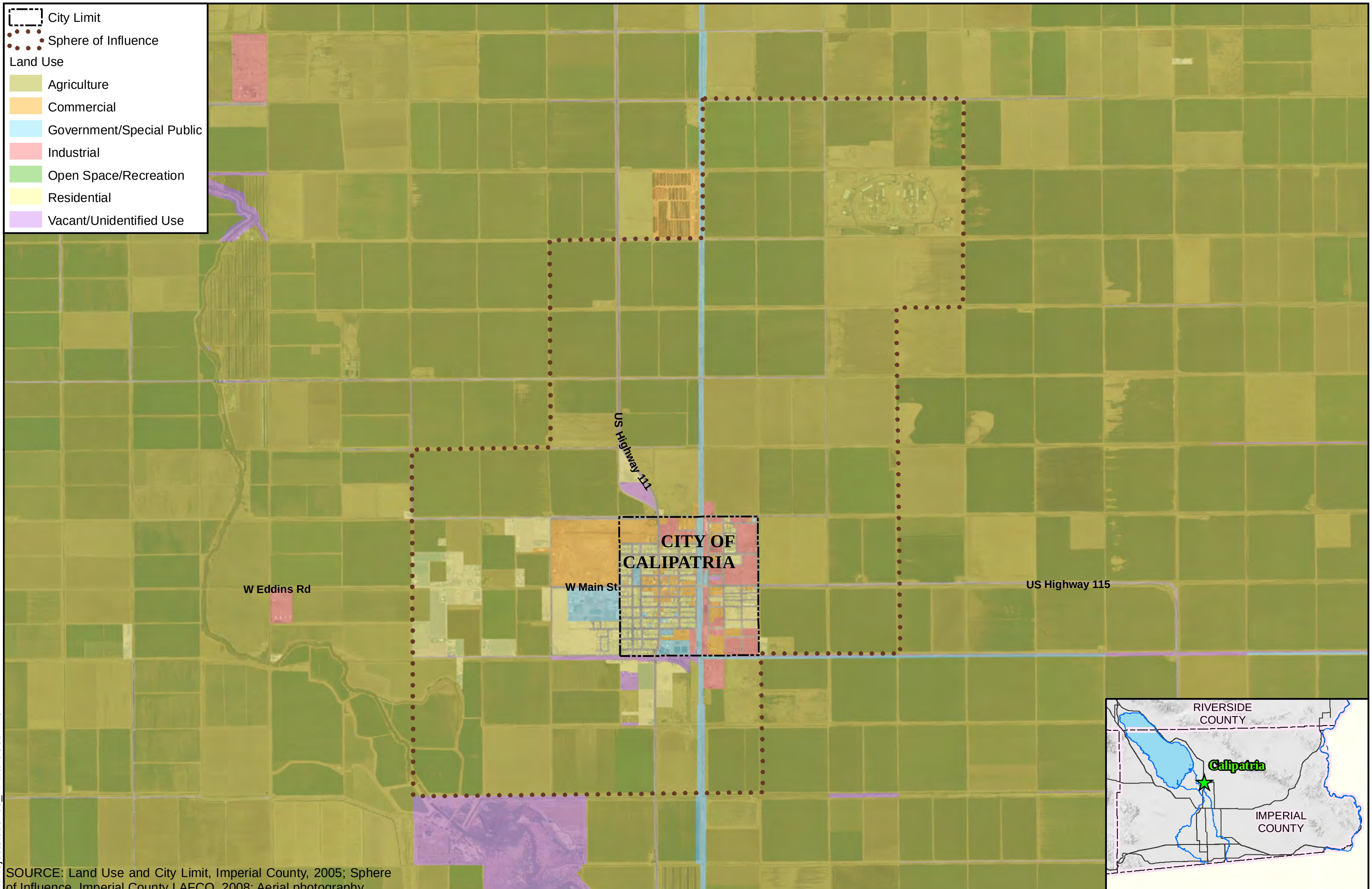
CITY OF IMPERIAL CURRENT LAND USE

MARCH 2011

FIGURE A-4



SOURCE: Land Use and City Limit, Imperial County, 2005; Sphere of Influence, Imperial County LAFCO, 2008; Aerial photography,

5,000 2,500 0 5,000

Feet

IID IRWMP
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CITY OF CALIPATRIA CURRENT LAND USE

MARCH 2011

FIGURE A-5

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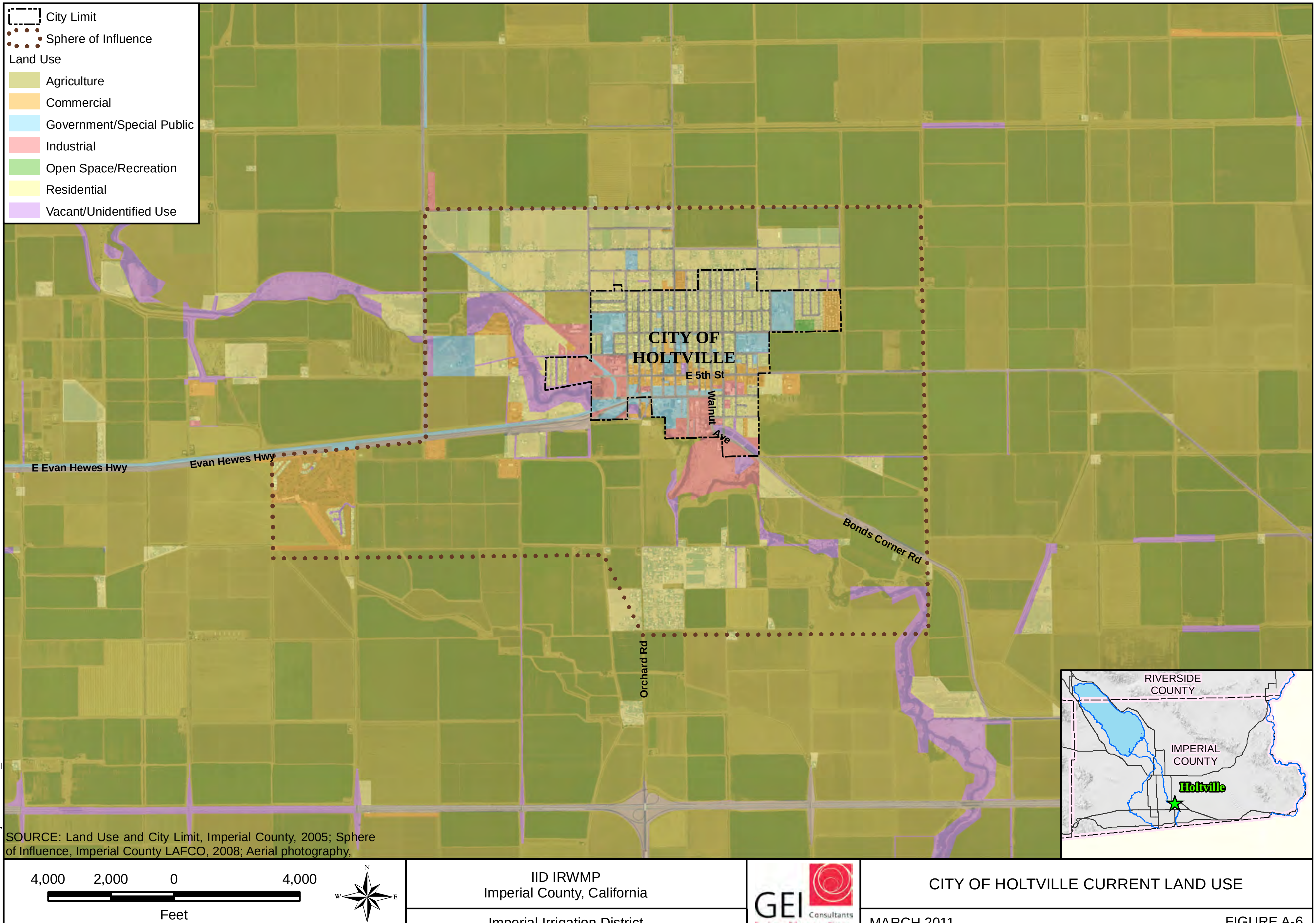

SOURCE: Land Use and City Limit, Imperial County, 2005; Sphere of Influence, Imperial County LAFCO, 2008; Aerial photography,

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CITY OF HOLTVILLE CURRENT LAND USE

MARCH 2011

FIGURE A-6

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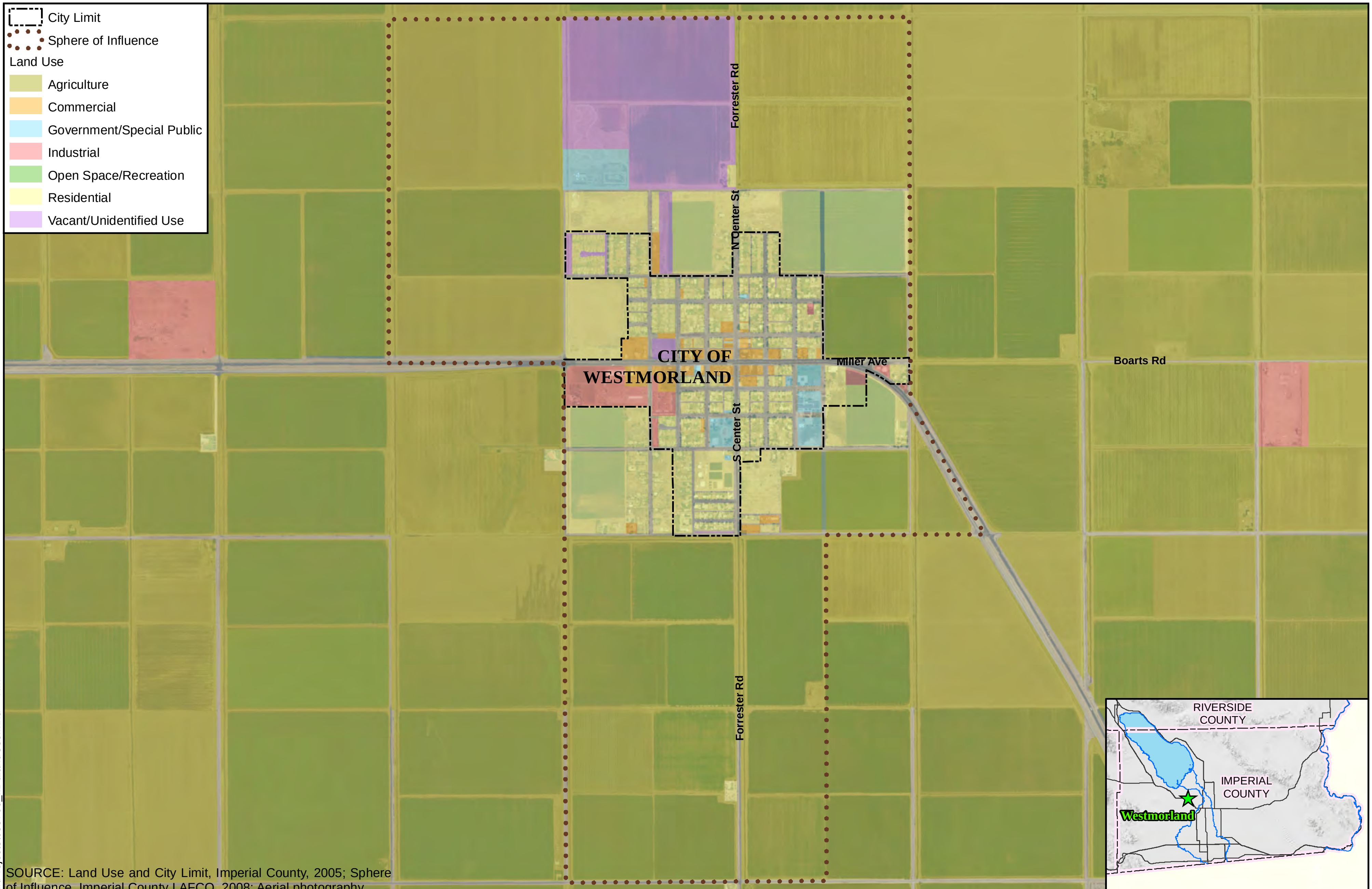
18-Feb-2011



SOURCE: Land Use and City Limit, Imperial County, 2005; Sphere of Influence, Imperial County LAFCO, 2008; Aerial photography,

2,000 1,000 0 2,000
Feet

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CITY OF WESTMORLAND CURRENT LAND USE

MARCH 2011

FIGURE A-7

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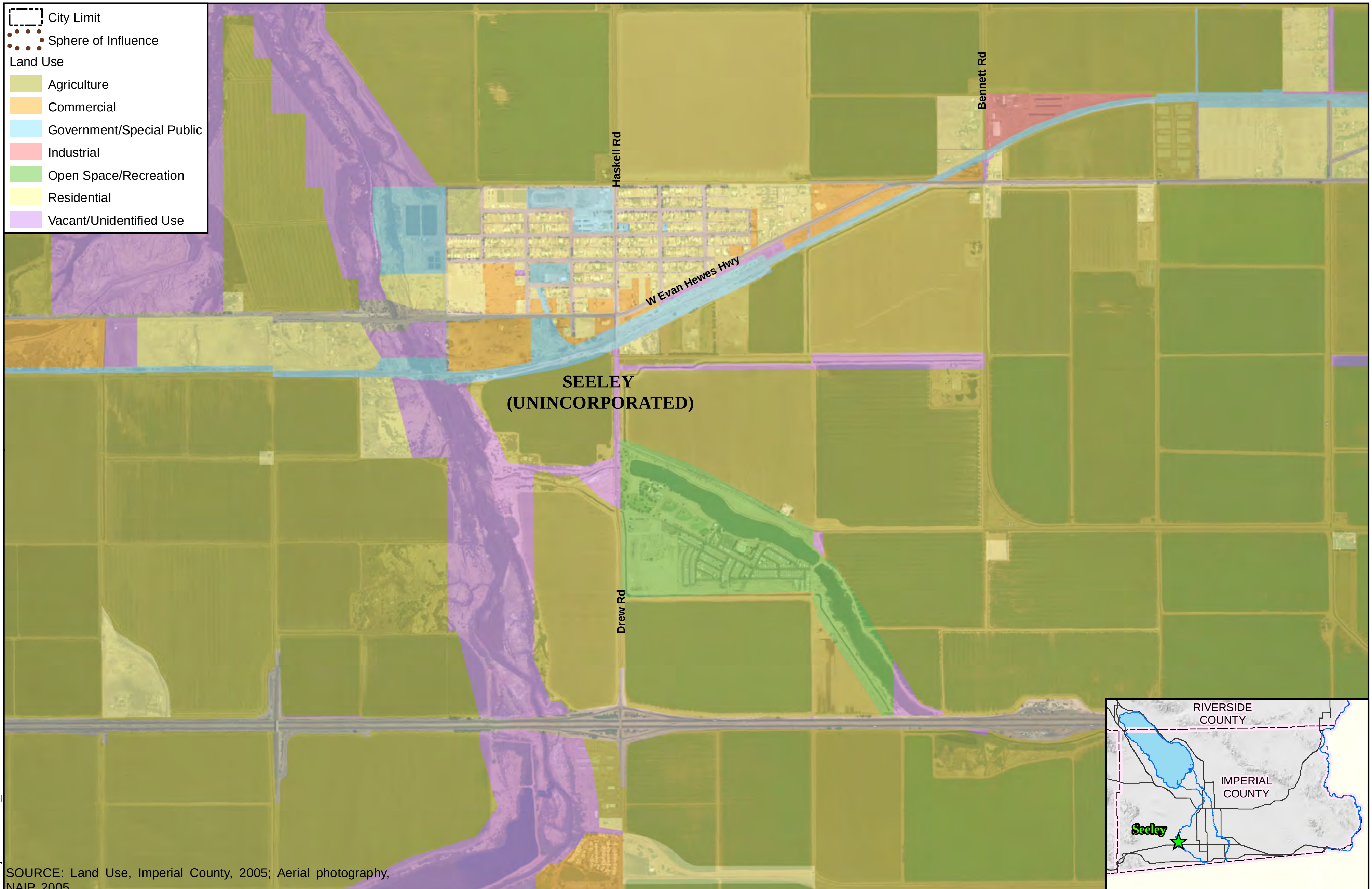
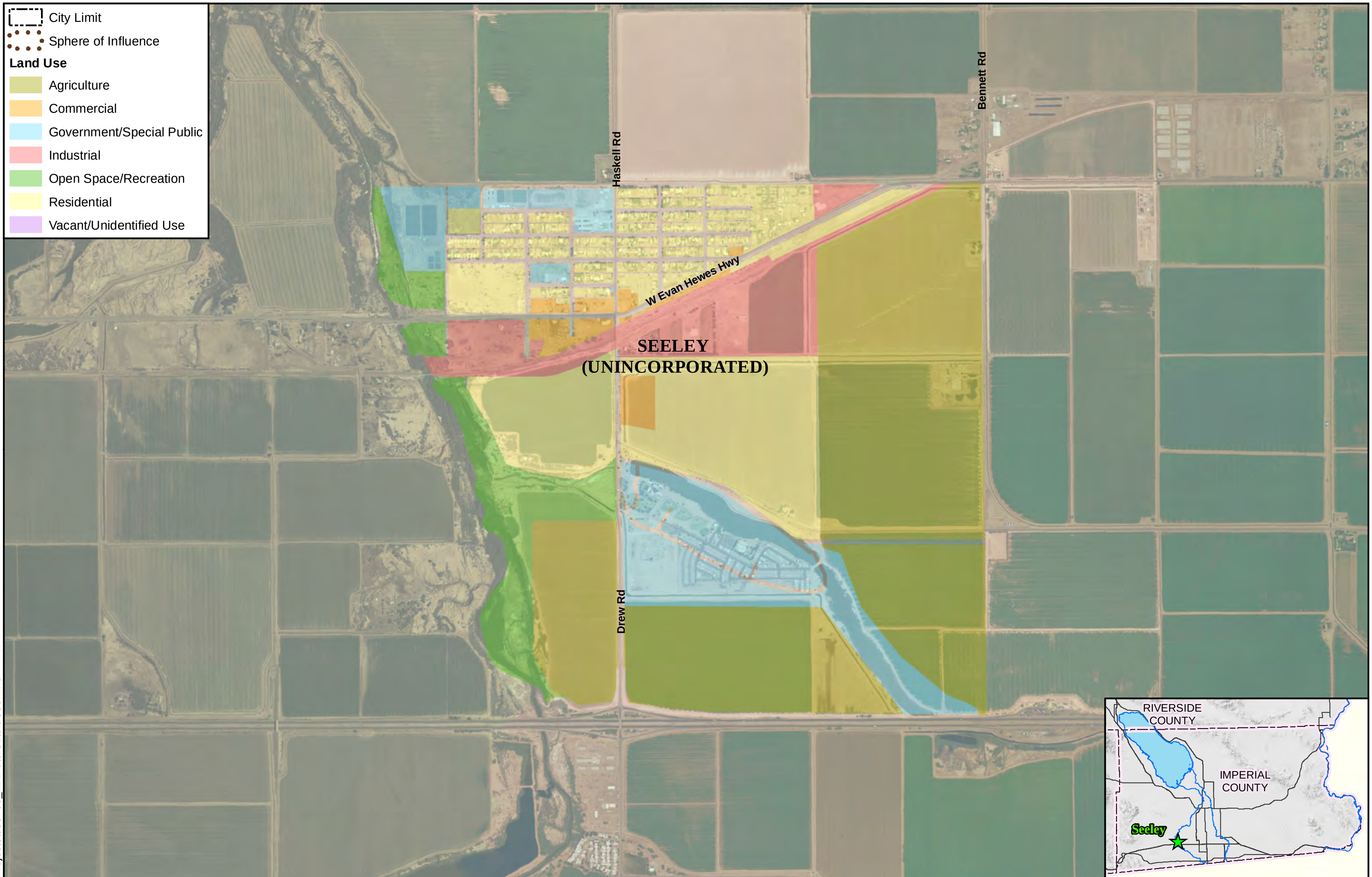
18-Feb-2011



SOURCE: Land Use, Imperial County, 2005; Aerial photography, NAIP, 2005

IID IRWMP Imperial County, California	GEI Consultants Bookman-Edmonston Division	SEELEY CURRENT LAND USE
Imperial Irrigation District		MARCH 2011 FIGURE A-8

18-Feb-2011 Z:\Projects\083760_IID\LandUse.mxd KM



SOURCE: Future Land Use, General Plan, 2006; Aerial photography, NAIP, 2005

2,000 1,000 0 2,000

Feet

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Imperial County, California

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SEELEY FUTURE LAND USE

MARCH 2011

FIGURE A-9

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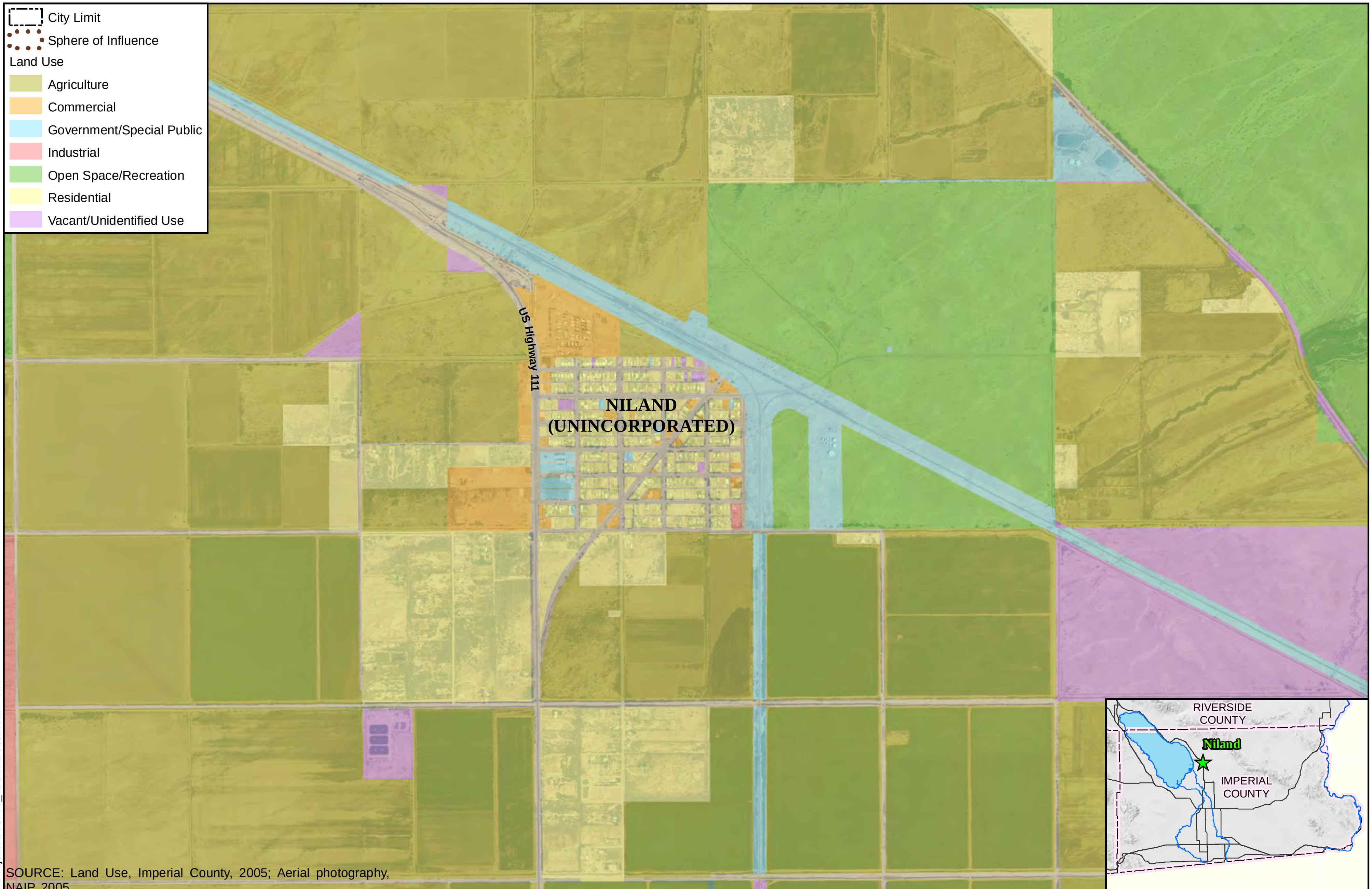

SOURCE: Land Use, Imperial County, 2005; Aerial photography, NAIP, 2005

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Feet

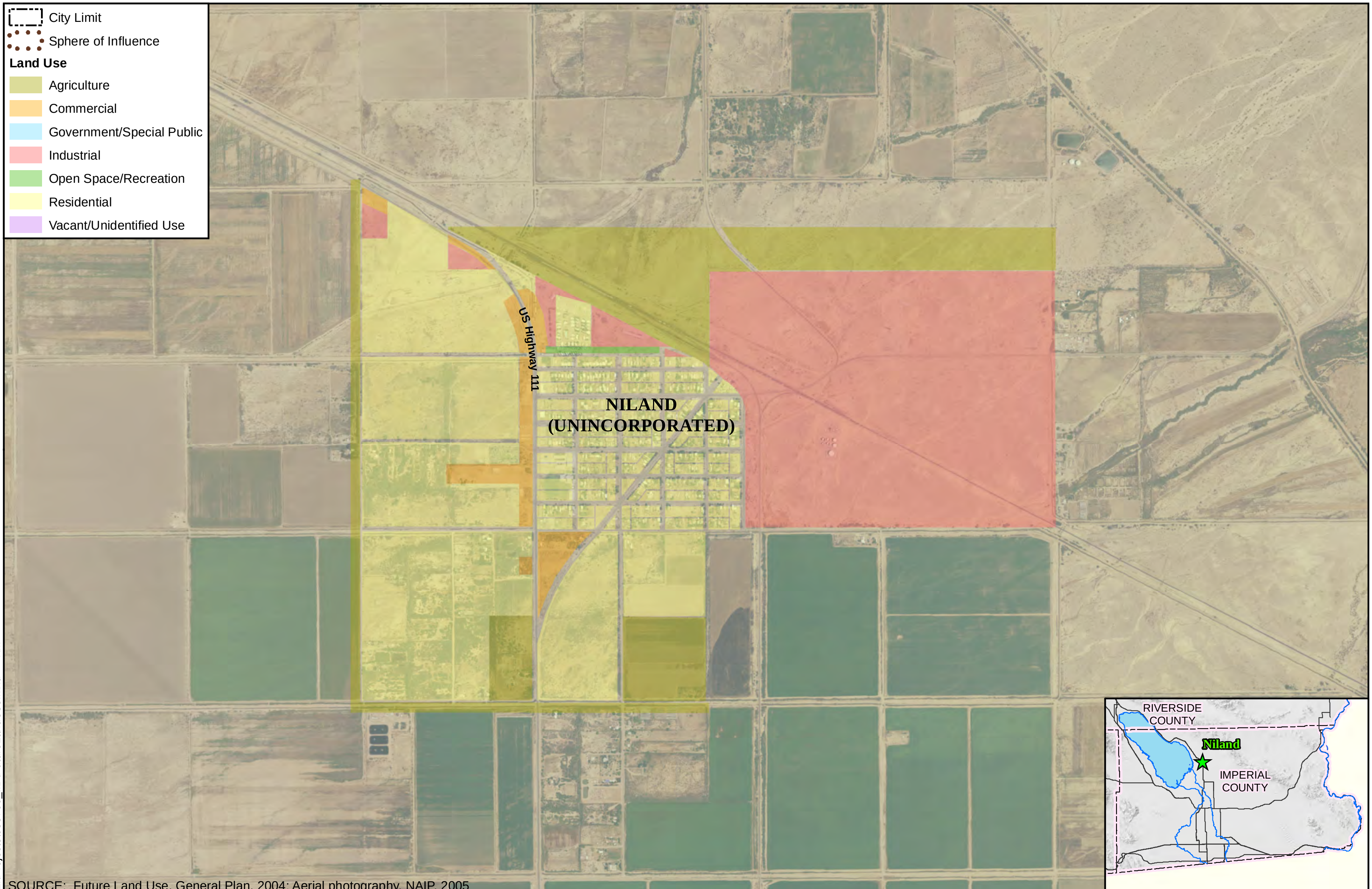
IID IRWMP
Imperial County, California

Imperial Irrigation District

NILAND CURRENT LAND USE

MARCH 2011

FIGURE A-10



2,000 1,000 0 2,000

Feet

IID IRWMP
Imperial County, California

Imperial Irrigation District

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NILAND FUTURE LAND USE

MARCH 2011

FIGURE A-11

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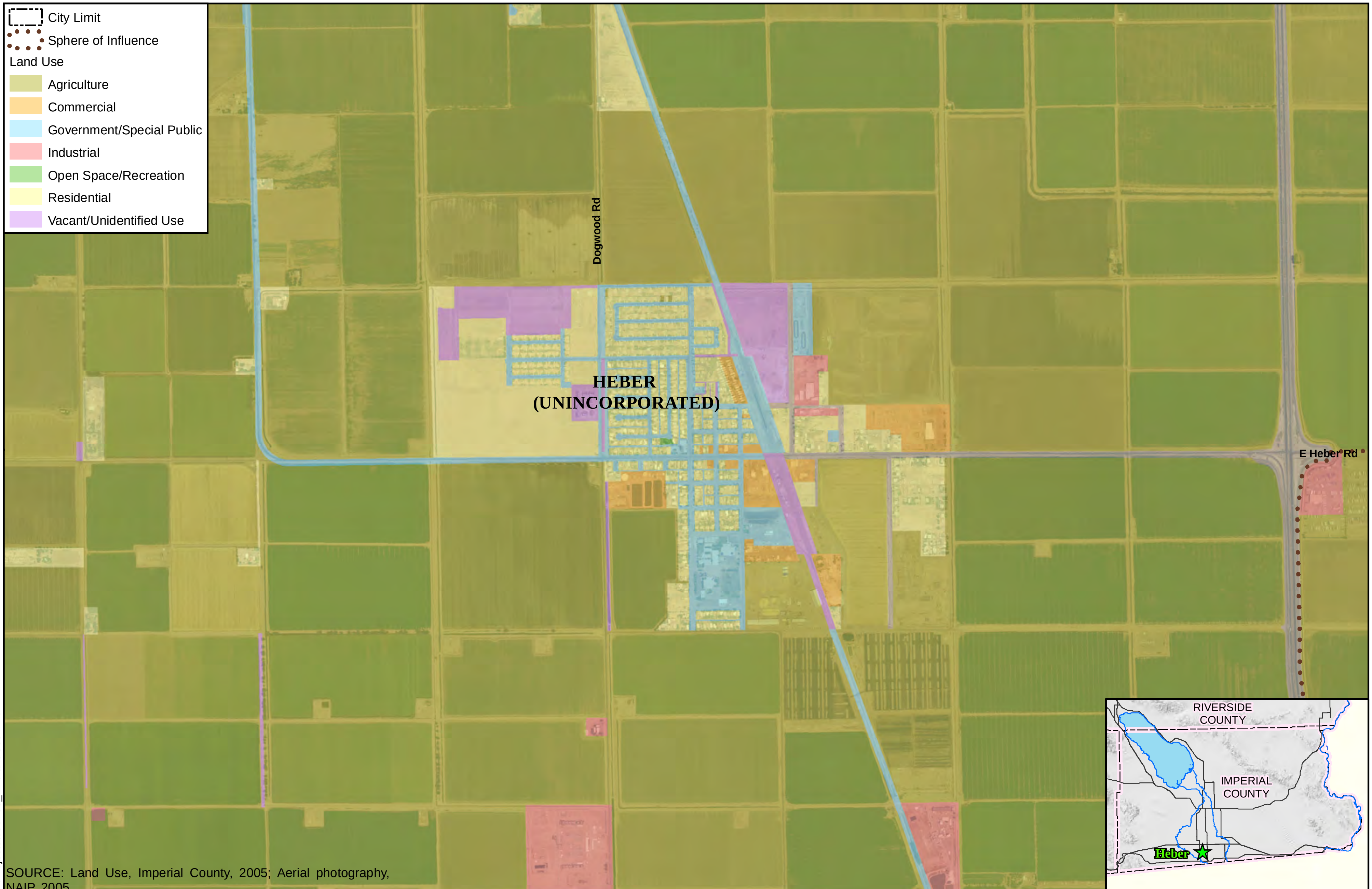
18-Feb-2011



SOURCE: Land Use, Imperial County, 2005; Aerial photography, NAIP, 2005

2,000 1,000 0 2,000
Feet

IID IRWMP
Imperial County, California

Imperial Irrigation District

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HEBER CURRENT LAND USE

MARCH 2011

FIGURE A-12

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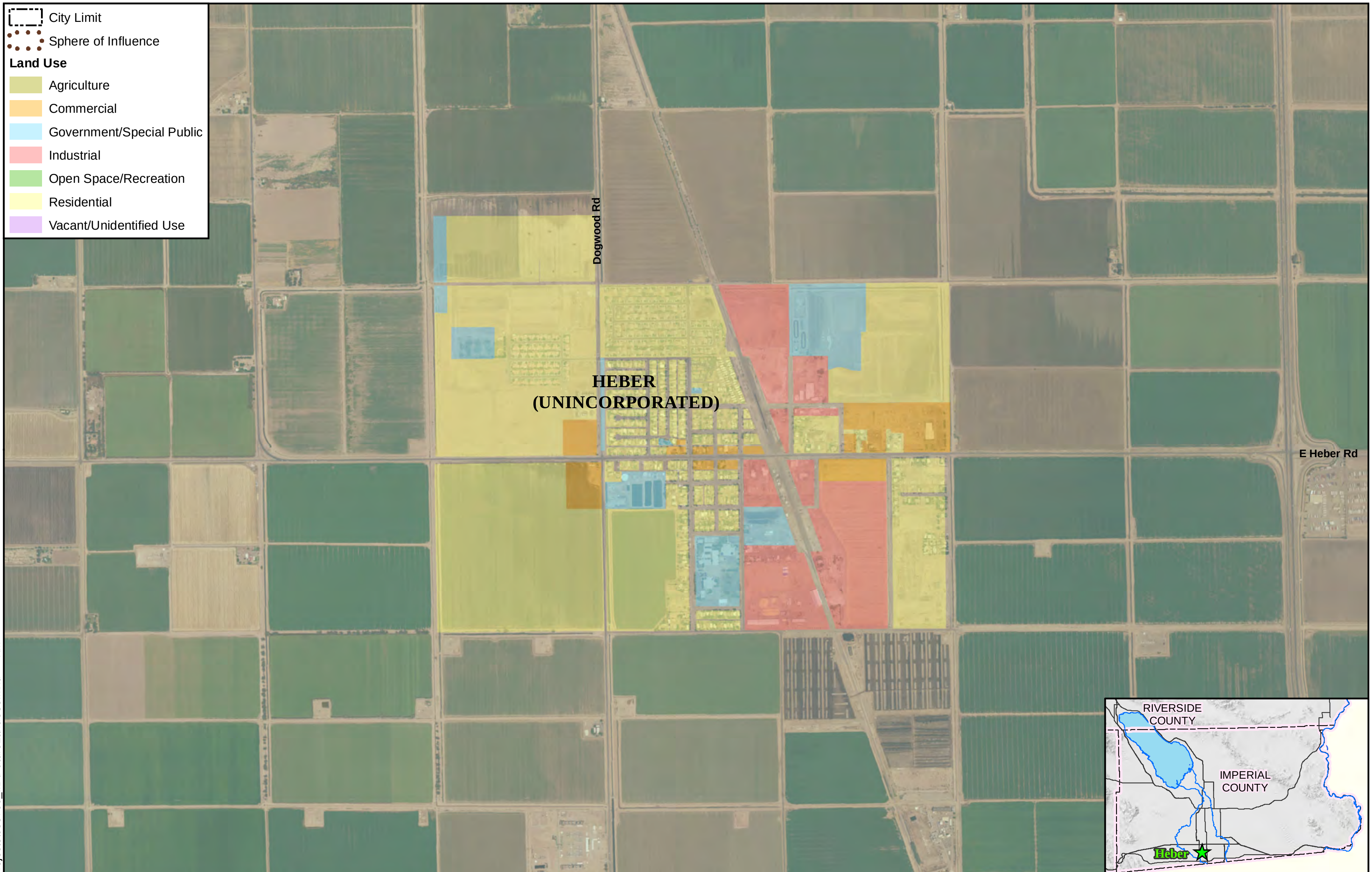

SOURCE: Future Land Use, General Plan, 2004; Aerial photography, NAIP, 2005

2,000 1,000 0 2,000
Feet

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HEBER FUTURE LAND USE

MARCH 2011

FIGURE A-13

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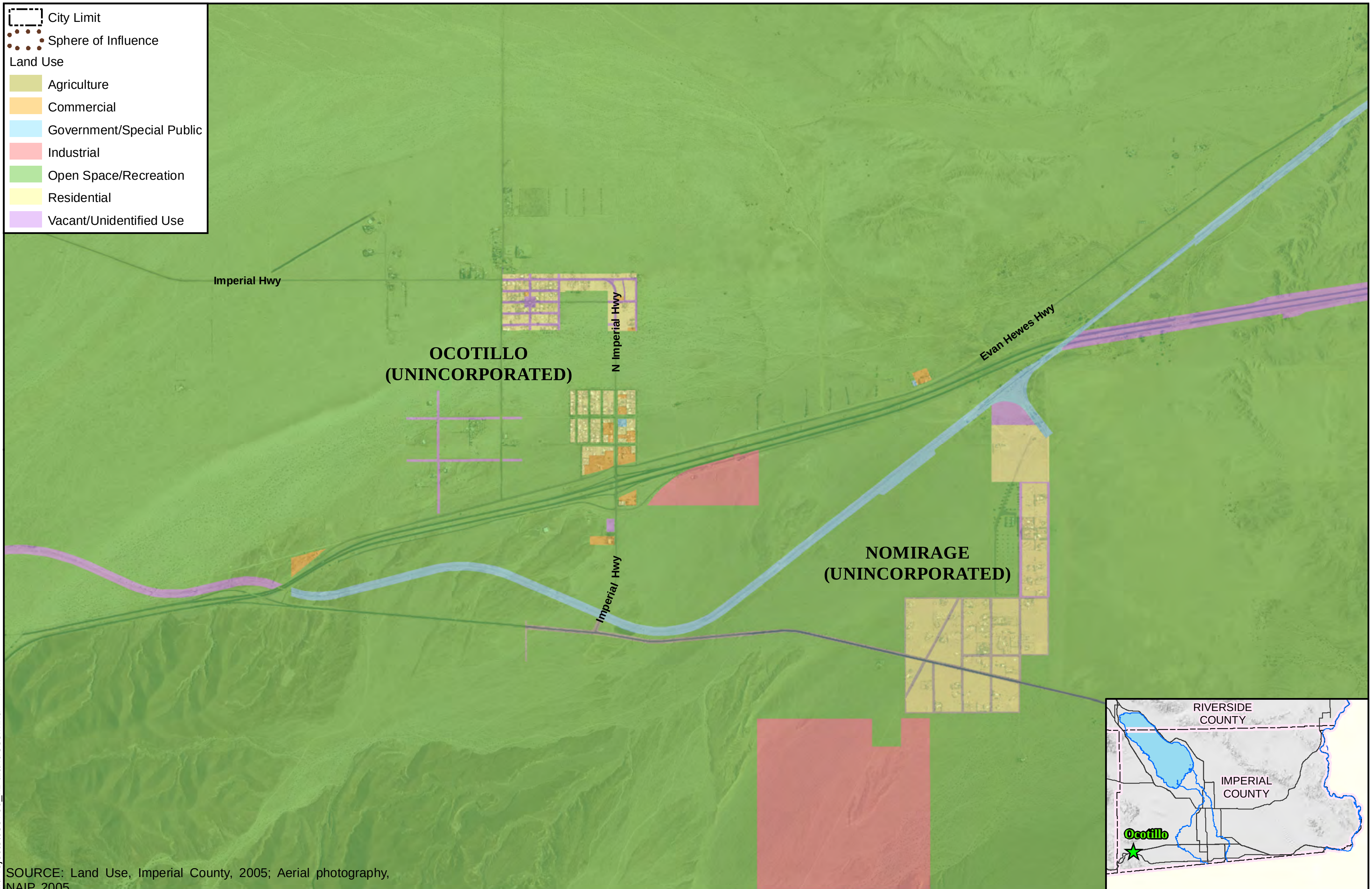

3,000 1,500 0 3,000
Feet

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OCOTILLO AND NOMIRAGE CURRENT LAND USE

MARCH 2011

FIGURE A-14

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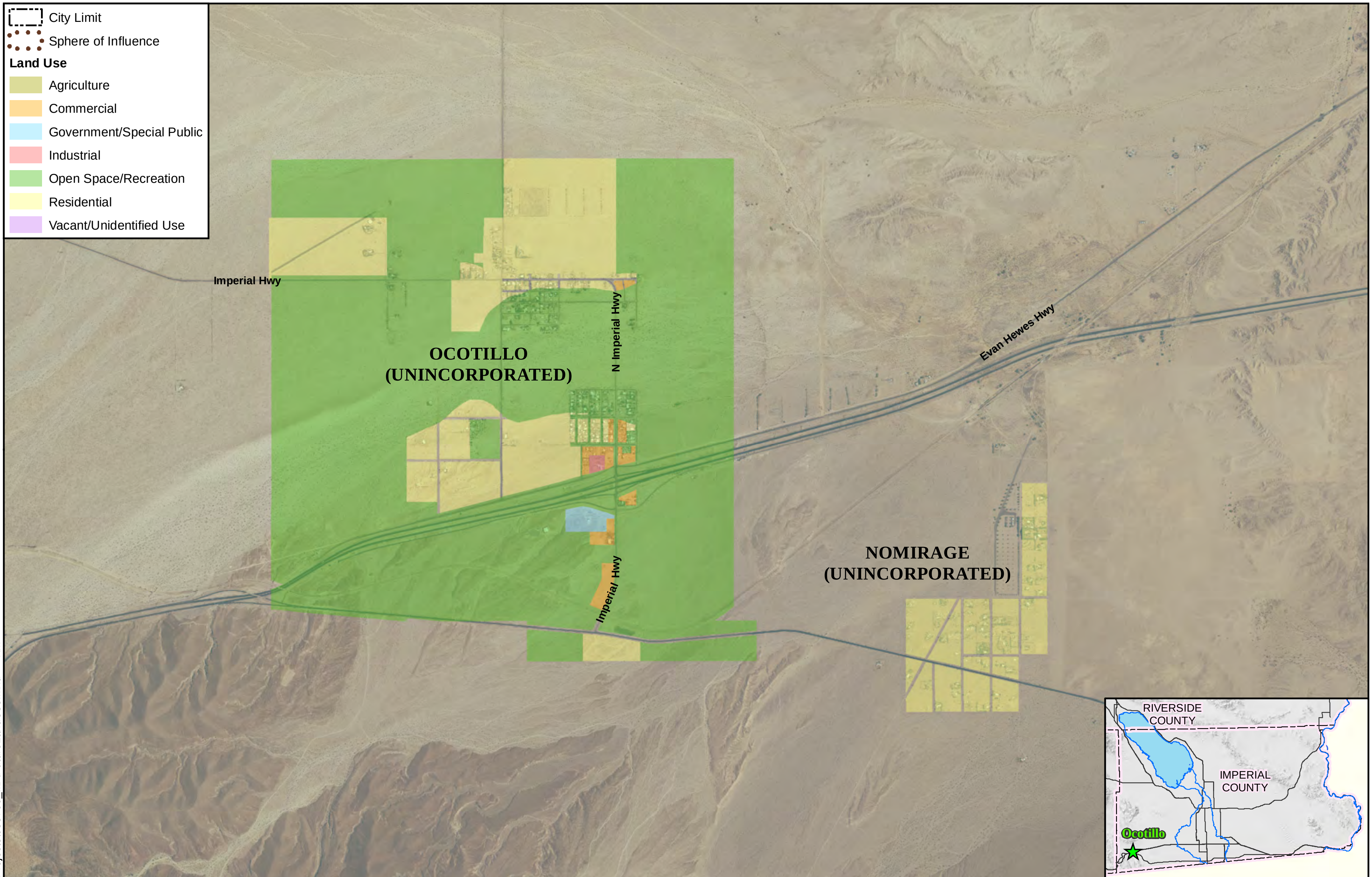

SOURCE: Future Land Use, General Plan, 1994; Aerial photography, NAIP, 2005

3,000 1,500 0 3,000
Feet

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Imperial Irrigation District

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OCOTILLO AND NOMIRAGE FUTURE LAND USE

MARCH 2011

FIGURE A-15

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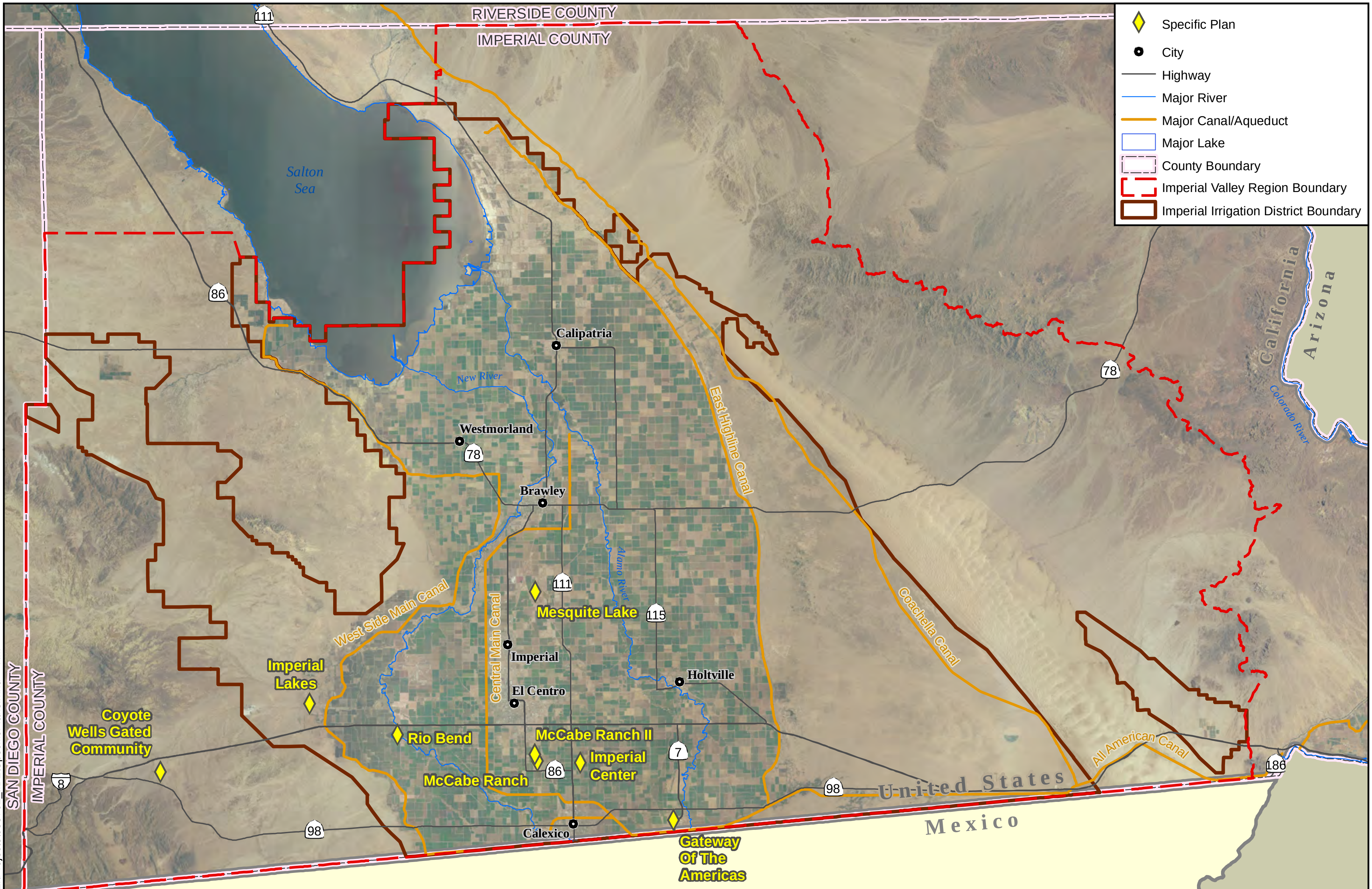
18-Feb-2011



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Miles

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Imperial County, California

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SPECIFIC PLAN LOCATIONS

MARCH 2011

FIGURE A-16

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18-Feb-2011

Appendix B – Per Capita Model Water Demand Calculations

The Per Capita Model uses population data primarily from the Imperial Valley Association of Governments (IVAG), as well as from the United States Census Bureau (Census). Population data from the California Department of Finance was applied to the Per Capita Model as well, however, in keeping with Imperial Irrigation District methods, final future water demand estimates were based on only IVAG and Census population data.

This Attachment presents the Per Capita Model calculation tables used to develop the future water demand for the Imperial Region.

Table B-1

Brawley Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	3,210	3,785	4,360	4,794	5,227	5,464	6,092	6,793	7,573
Multi Family Residential	4,095	4,829	5,563	6,115	6,668	6,971	7,772	8,666	9,662
Commercial	582	686	791	869	948	991	1,105	1,232	1,373
Industrial	940	1,108	1,276	1,403	1,530	1,600	1,783	1,988	2,217
Parks	1,219	1,437	1,655	1,820	1,984	2,074	2,313	2,579	2,875
Other	394	465	535	588	642	671	748	834	930
Total	**10,440**	**12,310**	**14,180**	**15,590**	**16,999**	**17,770**	**19,813**	**22,091**	**24,630**
Million Gallons Per Day									
Single Family Residential	2.87	3.38	3.89	4.28	4.67	4.88	5.44	6.06	6.76
Multi Family Residential	3.66	4.31	4.97	5.46	5.95	6.22	6.94	7.74	8.63
Commercial	0.52	0.61	0.71	0.78	0.85	0.88	0.99	1.10	1.23
Industrial	0.84	0.99	1.14	1.25	1.37	1.43	1.59	1.78	1.98
Parks	1.09	1.28	1.48	1.62	1.77	1.85	2.06	2.30	2.57
Other	0.35	0.41	0.48	0.53	0.57	0.60	0.67	0.74	0.83
Total	**9.32**	**10.99**	**12.66**	**13.92**	**15.18**	**15.86**	**17.69**	**19.72**	**21.99**

Table B-2 El Centro Water Use Demand, Per Capita Model with IVAG Population									
	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	5,687	6,496	7,305	7,867	8,430	8,699	9,699	10,814	12,057
Multi Family Residential	1,122	1,281	1,441	1,552	1,663	1,716	1,913	2,133	2,378
Commercial	1,810	2,067	2,325	2,504	2,683	2,768	3,086	3,441	3,837
Industrial	130	149	168	180	193	200	222	248	277
Parks	176	201	226	244	261	269	300	335	373
Other	854	976	1,097	1,182	1,266	1,307	1,457	1,625	1,811
Total	**9,779**	**11,171**	**12,562**	**13,529**	**14,496**	**14,959**	**16,678**	**18,595**	**20,733**
Million Gallons Per Day									
Single Family Residential	5.08	5.80	6.52	7.02	7.53	7.77	8.66	9.65	10.76
Multi Family Residential	1.00	1.14	1.29	1.39	1.48	1.53	1.71	1.90	2.12
Commercial	1.62	1.85	2.08	2.24	2.39	2.47	2.76	3.07	3.43
Industrial	0.12	0.13	0.15	0.16	0.17	0.18	0.20	0.22	0.25
Parks	0.16	0.18	0.20	0.22	0.23	0.24	0.27	0.30	0.33
Other	0.76	0.87	0.98	1.06	1.13	1.17	1.30	1.45	1.62
Total	**8.73**	**9.97**	**11.21**	**12.08**	**12.94**	**13.35**	**14.89**	**16.60**	**18.51**

Table B-3 Calexico Water Use Demand, Per Capita Model with IVAG Population									
	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	4,024	4,615	5,205	5,676	6,147	6,367	7,099	7,915	8,825
Multi Family Residential	1,047	1,201	1,355	1,477	1,600	1,657	1,848	2,060	2,297
Commercial	802	919	1,037	1,131	1,225	1,269	1,415	1,577	1,758
Industrial	2	3	3	3	4	4	4	5	5
Parks	1,205	1,382	1,559	1,700	1,841	1,907	2,126	2,371	2,643
Other	0	0	0	0	0	0	0	0	0
Total	7,081	8,120	9,159	9,988	10,817	11,204	12,492	13,928	15,529
Million Gallons Per Day									
Single Family Residential	3.59	4.12	4.65	5.07	5.49	5.68	6.34	7.07	7.88
Multi Family Residential	0.94	1.07	1.21	1.32	1.43	1.48	1.65	1.84	2.05
Commercial	0.72	0.82	0.93	1.01	1.09	1.13	1.26	1.41	1.57
Industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parks	1.08	1.23	1.39	1.52	1.64	1.70	1.90	2.12	2.36
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.32	7.25	8.18	8.92	9.66	10.00	11.15	12.43	13.86

Table B-4 Imperial Water Use Demand, Per Capita Model with IVAG Population									
	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	2,464	2,991	3,518	3,757	3,995	4,109	4,581	5,107	5,695
Multi Family Residential	462	561	660	704	749	770	859	958	1,068
Commercial	46	56	66	70	75	77	86	96	107
Industrial	46	56	66	70	75	77	86	96	107
Parks	0	0	0	0	0	0	0	0	0
Other	62	75	88	94	100	103	115	128	142
Total	3,080	3,739	4,398	4,696	4,994	5,136	5,726	6,384	7,118
Million Gallons Per Day									
Single Family Residential	2.20	2.67	3.14	3.35	3.57	3.67	4.09	4.56	5.08
Multi Family Residential	0.41	0.50	0.59	0.63	0.67	0.69	0.77	0.85	0.95
Commercial	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.10
Industrial	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.10
Parks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.05	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.13
Total	2.75	3.34	3.93	4.19	4.46	4.58	5.11	5.70	6.35

Table B-5
Heber Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	369	445	536	645	778	937	1,129	1,361	1,640
Multi Family Residential	129	155	187	225	271	327	393	474	571
Commercial	80	96	116	139	168	202	244	294	354
Industrial	17	20	24	29	36	43	52	62	75
Parks	64	77	93	111	134	162	195	235	283
Other	26	32	38	46	56	67	81	98	118
Total	**684**	**824**	**993**	**1,197**	**1,442**	**1,738**	**2,094**	**2,524**	**3,041**
Million Gallons Per Day									
Single Family Residential	0.33	0.40	0.48	0.58	0.69	0.84	1.01	1.21	1.46
Multi Family Residential	0.11	0.14	0.17	0.20	0.24	0.29	0.35	0.42	0.51
Commercial	0.07	0.09	0.10	0.12	0.15	0.18	0.22	0.26	0.32
Industrial	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.07
Parks	0.06	0.07	0.08	0.10	0.12	0.14	0.17	0.21	0.25
Other	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.09	0.11
Total	**0.61**	**0.74**	**0.89**	**1.07**	**1.29**	**1.55**	**1.87**	**2.25**	**2.71**

Table B-6

Calipatria/Niland Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Day									
Single Family Residential	1,501	1,636	1,779	1,901	2,035	2,143	2,365	2,621	2,919
Multi Family Residential	523	570	620	662	709	747	824	913	1,017
Commercial	324	353	384	410	439	463	510	566	630
Industrial	69	75	81	87	93	98	108	120	133
Parks	259	282	307	328	351	370	408	453	504
Other	108	117	128	136	146	154	170	188	210
Total	**2,783**	**3,033**	**3,299**	**3,524**	**3,773**	**3,974**	**4,385**	**4,861**	**5,413**
Million Gallons Per Day									
Single Family Residential	1.34	1.46	1.59	1.70	1.82	1.91	2.11	2.34	2.61
Multi Family Residential	0.47	0.51	0.55	0.59	0.63	0.67	0.74	0.82	0.91
Commercial	0.29	0.32	0.34	0.37	0.39	0.41	0.46	0.50	0.56
Industrial	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.11	0.12
Parks	0.23	0.25	0.27	0.29	0.31	0.33	0.36	0.40	0.45
Other	0.10	0.10	0.11	0.12	0.13	0.14	0.15	0.17	0.19
Total	**2.48**	**2.71**	**2.95**	**3.15**	**3.37**	**3.55**	**3.91**	**4.34**	**4.83**

Table B-7

Holtville Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	705	748	791	823	854	867	967	1,078	1,202
Multi Family Residential	245	261	276	287	298	302	337	376	419
Commercial	152	161	171	178	184	187	209	233	259
Industrial	32	34	36	38	39	40	44	49	55
Parks	122	129	137	142	148	150	167	186	208
Other	51	54	57	59	61	62	69	77	86
Total	**1,307**	**1,387**	**1,468**	**1,526**	**1,584**	**1,608**	**1,793**	**1,999**	**2,229**
Million Gallons Per Day									
Single Family Residential	0.63	0.67	0.71	0.73	0.76	0.77	0.86	0.96	1.07
Multi Family Residential	0.22	0.23	0.25	0.26	0.27	0.27	0.30	0.34	0.37
Commercial	0.14	0.14	0.15	0.16	0.16	0.17	0.19	0.21	0.23
Industrial	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05
Parks	0.11	0.12	0.12	0.13	0.13	0.13	0.15	0.17	0.19
Other	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.08
Total	**1.17**	**1.24**	**1.31**	**1.36**	**1.41**	**1.44**	**1.60**	**1.78**	**1.99**

Table B-8 Westmorland Water Use Demand, Per Capita Model with IVAG Population									
	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Day									
Single Family Residential	399	455	511	552	592	612	683	761	849
Multi Family Residential	139	158	178	192	206	213	238	265	296
Commercial	86	98	110	119	128	132	147	164	183
Industrial	18	21	23	25	27	28	31	35	39
Parks	69	79	88	95	102	106	118	131	147
Other	29	33	37	40	43	44	49	55	61
Total	740	844	947	1,023	1,098	1,135	1,266	1,411	1,574
Million Gallons Per Day									
Single Family Residential	0.36	0.41	0.46	0.49	0.53	0.55	0.61	0.68	0.76
Multi Family Residential	0.12	0.14	0.16	0.17	0.18	0.19	0.21	0.24	0.26
Commercial	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.15	0.16
Industrial	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Parks	0.06	0.07	0.08	0.09	0.09	0.09	0.11	0.12	0.13
Other	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05
Total	0.66	0.75	0.85	0.91	0.98	1.01	1.13	1.26	1.40

Table B-9

Seeley Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Acre-Feet Per Year									
Single Family Residential	158	191	230	277	334	402	485	584	704
Multi Family Residential	55	66	80	96	116	140	169	203	245
Commercial	34	41	50	60	72	87	105	126	152
Industrial	7	9	10	13	15	18	22	27	32
Parks	27	33	40	48	58	69	84	101	122
Other	11	14	17	20	24	29	35	42	51
Total	**294**	**354**	**426**	**514**	**619**	**746**	**899**	**1,083**	**1,305**
Million Gallons Per Day									
Single Family Residential	0.14	0.17	0.21	0.25	0.30	0.36	0.43	0.52	0.63
Multi Family Residential	0.05	0.06	0.07	0.09	0.10	0.13	0.15	0.18	0.22
Commercial	0.03	0.04	0.04	0.05	0.06	0.08	0.09	0.11	0.14
Industrial	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03
Parks	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.09	0.11
Other	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05
Total	**0.26**	**0.32**	**0.38**	**0.46**	**0.55**	**0.67**	**0.80**	**0.97**	**1.16**

Table B-10

Ocotillo Water Use Demand, Per Capita Model with IVAG Population

	Estimated Demand								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Acre-Feet Per Year									
Single Family Residential	75	81	87	93	99	107	114	122	131
Multi Family Residential	26	28	30	32	35	37	40	43	46
Commercial	16	17	19	20	21	23	25	26	28
Industrial	3	4	4	4	5	5	5	6	6
Parks	13	14	15	16	17	18	20	21	23
Other	5	6	6	7	7	8	8	9	9
Total	**140**	**150**	**161**	**172**	**184**	**198**	**212**	**227**	**244**
Million Gallons Per Day									
Single Family Residential	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12
Multi Family Residential	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
Commercial	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Parks	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Other	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	**0.12**	**0.13**	**0.14**	**0.15**	**0.16**	**0.18**	**0.19**	**0.20**	**0.22**

Appendix C – Municipal Water Demand Conservation Calculations

Water demand forecasts for the Imperial Region also incorporated the methodologies for calculating baseline and compliance per capita water use as required by California's Water Conservation Plan.[1] This attachment contains the tables and calculations as presented required for 2010 Urban Water Management Plans.[2]

Table C-1 Base period ranges			
Base	**Parameter**	**Value**	**Units**
10- to 15-year base period	2008 total water deliveries	-	see below
	2008 total volume of delivered recycled water	-	see below
	2008 recycled water as a percent of total deliveries	-	percent
	Number of years in base period[1]	10	years
	Year beginning base period range	2000	
	Year ending base period range[2]	2009	
5-year base period	Number of years in base period[1]	5	years
	Year beginning base period range	2005	
	Year ending base period range[3]	2009	

1 – If the 2008 recycled water percent is less than 10 percent, then the first base period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first base period is a continuous 10- to 15-year period.
2 – The ending year must be between December 31, 2004 and December 31, 2010.
3 – The ending year must be between December 31, 2007 and December 31, 2010.

[1] California Department of Water Resources, Division of Statewide Integrated Water Management, Water Use and Efficiency Branch. *Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (For the Consistent Implementation of the Water Conservation Act of 2009*, October 2009.

[2] State of California, Natural Resources Agency, Department of Water Resources. *Guidebook to Assist Urban Water Suppliers to Prepare a 2010 Urban Water Management Plan, Draft*, December 2010.

Table C-2 Base daily per capita water use - 10- to 15-year range				
Base period year		Distribution System Population	Daily system gross water use (MGD)	Annual daily per capita water use (GPCD)
Sequence Year	Calendar Year			
Year 1	2000	110,185	29	261
Year 2	2001	126,078	28	220
Year 3	2002	131,591	29	221
Year 4	2003	135,570	29	213
Year 5	2004	139,631	31	221
Year 6	2005	143,689	31	218
Year 7	2006	147,366	33	222
Year 8	2007	151,043	33	219
Year 9	2008	154,719	34	217
Year 10	2009	147,945	33	225
Year 11				
Year 12				
Year 13				
Year 14				
Year 15				
			Base Daily Per Capita Water Use[1]	224
			2020 Per Capita Water Use (1)	179
1 – Add the values in the column and divide by the number of rows				

Table C-3 Base daily per capita water use - 5-year range				
Base period year		Distribution System Population	Daily system gross water use (MGD)	Annual daily per capita water use (GPCD)
Sequence Year	Calendar Year			
Year 1	2006	147,366	33	222
Year 2	2007	151,043	33	219
Year 3	2008	154,719	34	217
Year 4	2009	147,945	33	225
Year 5	2010	162,292	31	189
			Base Daily Per Capita Water Use[1]	214
			95% of Base Daily Per Capita Water Use (2)	203
1 – Add the values in the column and divide by the number of rows				

Since the base daily per capita water use in Table C-3 is greater than 100 gpcd, then an intermediate calculation is needed. If the 10-year 2020 per capita water use target (1) in Table C-2 is greater than 95% of the 5-year base daily per capita water use (2) in Table C-3, then the 2020 per capita water use target should be set to (2). Since (1) is less than (2), no adjustment is needed to the 2020 target. The Interim 2015 water use target is set halfway between the baseline and the 2020 target.

Table C-4

Baseline and Target Municipal Water Demand Rates

	Baseline	2015 Interim Target (10% Demand Reduction)	2020 Target (20% Demand Reduction)
Imperial Region	224	201	179

Units: GPCD

Appendix D – Solar and Geothermal Energy Water Use Technical Memorandum

GEI Consultants

Technical Memo

To: Jeff Garber

From: Matt Zidar

CC: Anisa Divine

Date: February 14, 2011

Re: Solar and Geothermal Energy Water Use

Background and Purpose

The Imperial Water Forum is updating the future water demand forecast as part of the Imperial Integrated Regional Water Management Plan. The largest increase in water demand, potentially up to 180,000 acre-feet per year (AFY),[3] is expected to be from the renewable energy sector, primarily for cooling water. As part of the updated demand forecast, research was conducted to document the types and volumes of water uses in this demand sector. This included researching the California Energy Commission's website to identify projects and supporting decision documents for specific projects, and internet research to document other sources. The purpose was to document unit water requirements (e.g.; gpm/MWh, AF/MWh) for the different types of water use at solar and geothermal plants. The Imperial Water Forum is also investigating demand management measures by the different water use sectors to ensure that best management practices are applied to conserve supplies and ensure reasonable beneficial use of all of the imported Colorado River.

The information obtained is to be used to update and document the water demand forecast assumptions for the Integrated Regional Water Management Plan. It may further be used to develop findings for water use efficiency measures for power plant cooling (best management measures); and potentially for standards and guidelines for project proponents to prepare water budgets to be submitted with development proposal applications to Imperial County and/or the Imperial Irrigation District (IID) to support determinations on water supply apportionment, to evaluate potential environmental effects to existing water users, and to help the County and IID in making findings pursuant to state law.[4]

Summary of Water Uses at Power Plants

Thermoelectric generating technologies creates heat from a variety of sources, including coal, nuclear, natural gas, oil, biomass (e.g., wood or crop waste), concentrated solar energy, and geothermal energy. Generally speaking, water is heated into steam or heat is exchanged with a

[3] Imperial County General Plan Geothermal Element

[4] SB 610/SB 221 Water Supply Assessments, CEQA initial studies, compliance with the California Water Code, etc.

volatile liquid to move turbines and create energy, then cooled and condensed, removed as waste, or recycled for re-use in the plant or elsewhere. Water is also used to wash equipment, fulfill personnel needs (e.g., restrooms and break rooms), and dust control during construction. The USGS reports on water usage throughout the country every five years. As of 2005, the water use for thermoelectric plants in the state of California was 12,600 MGD (14.1 MAFY) for 56,200 GW of power. [5] This report does not delineate types of thermoelectric power.

Climatic conditions, water quality, and other variables influence how much cooling water is needed. Towers are constructed and employed as part of the generating cycle to cool the steam so it condenses back into water. Cooling towers are primarily classified as dry, wet, or hybrid (dry and wet). Sub-classifications based on draft construction and heat transfer medium are also available. Wet cooling towers transfer heat through a wetted medium commonly called "fill" to promote evaporation, and rely on the latent heat of water evaporation to exchange heat between the process and the air passing through the cooling tower. Dry cooling towers are used in the closed-circuit cooling of water with no direct contact between the water to be cooled, and rely on the air to cool the water before it is returned to the condenser. Hybrid cooling combines wet cooling and dry cooling technologies to reduce water use as compared to wet cooling systems, and improve performance during times of hot weather as compared to dry cooling systems.[6]

Table 1 provides a comparison of consumptive water use of various power plant technologies and cooling methods. Table 2 provides water use data for solar and geothermal power plants as reported from a number of sources.

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[5] Kenny, Joan F., Barber, Nancy L., Hutson, Susan S., Linsey, Kristin S., Lovelace, John K., Maupin, Molly A. "Estimated Use of Water in the United States in 2005." United States Geological Survey. 2005.

[6] U.S. Environmental Protection Agency Office of Air Quality Planning and Standards "Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources." January 1995. Research Triangle Park, NC.

Table 1: Comparison of consumptive water use of various power plant technologies using various cooling methods (DOE 2007)

Technology	Cooling	Gallons/MWH	AFY/MWH	Perform Penalty*	Cost Penalty**
Coal Nuclear	Once-Through	23,000 – 27,000	618.5 – 345.4		
	Recirculating	400 – 750	10.8 – 20.2		
	Air cooling	50 - 65	1.34 – 1.75		
Natural Gas	Recirculating	200	5.4		
Power Tower	Recirculating	500 – 750	13.4 – 18.8		
	Combination Hybrid Parallel	90 - 250	2.4 – 6.7	1 – 3%	5%
	Air Cooling	90	2.4	1.3%	
Parabolic Trough	Recirculating	800	21.5		
	Combination Hybrid Parallel	100 – 450	2.7 – 12.1	1 – 4%	8%
	Air Cooling	78	2.1	4.5-5%	2-9%
Dish/Engine	Mirror Washing	20	0.5		
Fresnel	Recirculating	1000	26.9		

* Annual energy output loss is relative to the most efficient cooling technique
**Added cost to produce the electricity

Table 1-A: Excerpt from Table B-1: Water Use by Thermoelectric Power Plant (DOE 2007)

Plant-Type	Process	Water Intensity (Gal/MWH)		Water Intensity (AFY/MWH)		
		Steam Condensing				Other Use
		Withdrawal	Consumption	Withdrawal	Consumption	Withdrawal/ Consumption
Geothermal Steam	CL Tower	~2000	~1400	53.8	37.7	Not Available
Solar Trough	CL Tower	760-920	760-920	20.4 – 24.7	20.4 – 24.7	8**
Solar Tower	CL Tower	~750	~750	20.2	20.2	8**

CL = Closed Loop Cooling

Other Use includes water for other cooling loads such as gas turbines, equipment washing, emission treatment, restrooms, etc.

**References did not specify whether values are for withdrawal or consumption.

Table 2: Summary of Water Uses at Solar and Geothermal Power Plants

Project Name or Source	Plant Type	Project Type	Cooling Type	Proposed Power Generation (MW)	Construction		Operations			
					GPD	AFY	GPD	AFY	Calculated (Gal/MWh)	Calculated (AF/MWh)*
Imperial Valley Solar (Formerly called SES Solar Two Project)	Solar	Solar Mirror/Dish--Stirling Engines	Wet	750	45,000 - 90,000	50 - 100	33,500	32.7	8	9
(Solar Millennium) Palen Solar Power Project	Solar	Solar Trough	Dry	500	1,500,000	1,769	270,700	300	99	76
Victorville 2 Hybrid Power Project	Solar	Integrated	Wet	563	65,000 - 650,000	73 - 730	2,800,0 00	3,15 0	---	784
Calico Solar Project	Solar	Stirling Engines	Wet	850	163,000	183	32,300	36.2	6	9
Beacon Solar Energy Project	Solar	Parabolic Solar Trough	Wet	250	288,300	323	1,400,0 00	1,60 0	852	392
Abengoa Mojave Solar Project	Solar	Solar Trough	Wet	250	977,000	1,095	1,900,0 00	2,16 0	1101	532
Solar Millennium Blythe Solar Power Project	Solar	Parabolic Solar Trough	Dry	1000	645,000	4,100	535,400	600. 0	93	150
Ivanpah Solar Electric Generating System	Solar	Power Tower and Heliostat Mirror Technology	Dry	400	---	---	89,200	100. 0	34	25
Genesis Solar Energy Project	Solar	Parabolic Solar Trough	Wet	250	550,000 - 1,200,000	616 - 1,350	180,000	200	110	50
Rice Solar Energy Project	Solar	Power Tower and Heliostat Mirror Technology	Dry	150	607,000	680	160,000	180. 0	130	45

Note: Values converted assuming a 365 day operational year.
* Values calculated for one calendar year of 8760 hours (365 days).

Table 2 (Cont'd): Summary of Water Uses at Solar and Geothermal Power Plants

Project Name or Source	Plant Type	Project Type	Cooling Type	Operations			
				GPD	AFY (1)	Reported (Gal/MWh)	Reported (AF/MWh)
DOE 2007	Solar	Parabolic Trough	Dry	---	---	80	2.2
DOE 2007	Solar	Parabolic Trough	Wet	---	---	800	21.5
DOE 2007	Solar	Parabolic Trough	Hybrid	---	---	100-450	2.7 - 12.1
DOE 2007	Solar	Power Tower	Wet	---	---	500-750	13.5 - 20.2
DOE 2007	Solar	Power Tower	Hybrid	---	---	90-250	2.4 - 6.7
DOE 2007	Solar	Power Tower	Dry	---	---	90	2.4
DOE 2007	Solar	Fresnel	Wet	---	---	1,000	26.9
REAT 2010	Geothermal	---	Wet-Binary	---	---	1,600	43.0
DOE 2006	Geothermal	---	Hybrid	---	---	1,400-1,700	37.7 - 45.7
DOE 1984	Geothermal	---	---	---	60 - 120	---	---

Note: Values converted assuming a 365 day operational year.
* Values calculated for one calendar year of 8760 hours (365 days).
(1) Reported

Summary of Water Use at Solar and Geothermal Plants

Flash geothermal plants range from 2 to 40 AF/MWh in the Imperial Region, averaging 15 AF/MWh. The binary geothermal plants listed all employ or propose to employ wet cooling and water use ranges from 43 to 132 AF/MWh, averaging 96 AF/MWh.

Table 3 provides a summary of the water uses for solar plants for both construction and operations at solar power plants in or around the Imperial Region. This information is from the CEC site and information submitted during the review and approval process for plants located in Imperial or other similar desert environments. Project specific information is provided in section A.4. Solar thermoelectric plants require use of water for cooling, while solar mirror or photovoltaic typically do not. At these plants water is for washing the mirrors and dust control water usage is relatively low. For solar thermoelectric, water use varies with the cooling technology similar to binary geothermal plants. The wet cooling water use at these types of solar plants ranges from 10 to 2,000 AF/MWh, averaging 500 AF/MWh.

For geothermal and solar plants, dry cooling systems are reported to provide less energy output than wet cooling systems (decrease plant efficiency). In comparison with wet cooling, dry cooling methods are estimated to result in a power generation cost of about 17 percent more, and would result in a decrease in power production of 5 percent to 10 percent on hotter days.[7] In their Report to Congress, 2007, the Department of Energy states the performance of a solar trough plant drops by 4.6 percent, and a power tower drops by 1.3 percent. A dry cooled solar plant requires approximately 80 gal/MWh for cycle makeup and mirror washing, as compared to a wet cooled plant that requires 800 gal/MWH (0.90 AFY/MWH).[8]

[7] Doering, Brandon; Jordan, Eddie. Memorandum on Imperial Irrigation District Power Plant Water Use Evaluation. 15 September 2009, Integrated Engineers and Contractors Corporation to GEI Consultants

[8] U.S. Department of Energy "Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar power Electricity Generation" 2007

Table 3: Summary of Water Use at Geothermal Power Plants for the Imperial Region (Doering, 2005)

Power Plant Owner:	Plant Name:	Type:	Capacity (MW Net)	IID Water Use (AFY)	AFY/MW
CalEnergy	**Salton Sea 1** **Salton Sea 2**	Dual Flash	10 17	9.9* (Combined meter)	0.4
	Salton Sea 3 **Salton Sea 4**	Dual Flash	50 40	399* (Combined meter)	4.4
	Salton Sea 5	Dual Flash	49	1200*	24.5
	Del Ranch	Dual Flash	42	948*	22.6
	Vulcan	Dual Flash	38	164*	4.3
	Leathers	Dual Flash	42	1354*	32.2
	Elmore	Dual Flash	42	1910*	45.5
	CE Turbo	Single Flash	10	0*	0
	Black Rock 1,2,3 (Proposed)	Single Flash	195	483 Est.*	2.5
	Black Rock 4,5,6 (Proposed)	Single Flash	195	483 Est.*	2.5
Catalyst Hannon Armstrong Renewables	**Hudson Ranch 1**	Dual Flash	49.9	850 Est.	17
	Hudson Ranch 2	Dual Flash	49.9	850 Est.	17
ORMAT	**Ormesa 1**	Binary	38	1665	43.8
	Ormesa 1E	Binary	8	923	115.4
	Ormesa 1H	Binary	12	1040	86.7
	Ormesa 2	Binary	18	1993	110.7
	GEM 2	Dual Flash	22	-	-
	GEM 3	Dual Flash	18	-	-
Heber KGRA (ormat)	**Heber 1**	Dual Flash/Binary	52	1156	22.2
	Heber 2	Binary	48	3663	76.3
Brawley KGRA (ormat)	**North Brawley (Construction)**	Binary	49.9	6600 Est.	132.3
	East Brawley (Proposed)	Binary	49.9	5500 Est.	110.2
Brawley KGRA (RAM)	**Ram East Brawley**	Dual Flash	50	800 Est.	16

*Past 10 year average use from delivery gate meters.

Geothermal electric power plants use the earth as the thermal energy source. Steam sources use steam Rankin-cycle turbines on a smaller scale than coal and nuclear power plants. The Northern California Power Authority operates two geothermal power plants and typically withdraws approximately 17.0 lbs of steam/kWh (2000 gal/MWh) from the geothermal field. According to the Geothermal Energy Association (GEA), these values are not representative of actual water use for geothermal power plants and points out the DOE report fails to differentiate between geothermal fluid and freshwater.[9] According to the GEA, geothermal plants use 5 gallons of freshwater per megawatt hour, while binary air-cooled plants use no fresh water.[10] A recent article in IEEE Spectrum provided water use estimates for binary and flash systems in the Salton Sea geothermal area using surface water (Binary: 4,463 gal/MWH (120 AFY), Flash: 361 gal/MWH (9.7 AFY).[11]

Project Information

Imperial Valley Solar Project (Formerly SES Solar Two Project[12])

- **Project Type** Solar Mirror/Dish - Sterling Engines
- **Status**: Approved by CEC 9/29/10
- **Project Description**: Nominal 750-megawatt (MW) Stirling engine project to include the approximately 30,000, 25-kilowatt solar dish Stirling systems SunCatchers located on 6,500 acre project site (6,140 acres of Bureau of Land Management (BLM) and approximately 360 acres of privately owned land). South of Plaster City, 14 miles west of El Centro, and approximately 4 miles east of Ocotillo, California
- **Cooling Type:** Wet Cooling
- **Water Source**: Water from tertiary treatment upgrade to Seeley WWTP delivered via 12 mile pipeline. Potable water will be trucked to the site.

Water Use

The following types of water will be required for the project: equipment washing water, potable water, dust control water, and fire protection water. When completed, the SES Solar Two Project would require a total of approximately 32.7 AFY. The applicant is working to reduce this

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[9] Geothermal Energy Association. "GEA Issue Brief: Geothermal Energy and Water Consumption." http://www.geo-energy.org/pdf/Geothermal_Energy_and_Water_Consumption_Issue_Brief.pdf Accessed December 2010.

[10] Kagal, Alyssa; Bates, Diana; Gawell, Karl. Geothermal Energy Association. "A Guide to Geothermal Energy and the Environment." April 2007.

[11] Adde, Sally and Moore, Samuel K. "In the American Southwest, the Energy Problem is Water." IEEE Spectrum: Inside Technology (website). June 2010. http://spectrum.ieee.org/energy/environment/in-the-american-southwest-the-energy-problem-is-water

[12] California Energy Commission. "Imperial Valley Solar Energy Project Commission Decision," September 2010. CEC-800-2010-006 CMF.

consumption by developing alternative mirror washing methods and schedules; however, the Draft Environmental Impact Statement (EIS) analyzed the originally proposed 32.7 AFY total demand. SunCatcher mirror washing and operations dust control under regular maintenance routines will require an average of approximately 23.3 gpm of raw water, with a daily maximum requirement of approximately 39.2 gpm during the summer peak months each year; when each SunCatcher receives a single mechanical wash.

Potable Water

To meet plant requirements, potable water would be delivered by truck and stored in a 5000 gallon tank in the water treatment area. This tank would be able to provide all required potable water for the operating facility for two to three days at which time it would need to be replenished. The SES Solar Two Project water supply requirements are tabulated in Table 3, Water Usage Rates for Imperial Valley Solar Operations. The table provides both the expected maximum water usage rates and the annual average usage rates. (See next page)

Construction

Approximately 45,000 GPD (50 AFY) of water are expected to be used on average, primarily for dust control. Peak water use during construction would be approximately 90,000 GPD (100 AFY), with approximately half used for dust control and half used for soil preparation on concrete pours. Fifteen peak days are expected during construction. Assuming a 39-month construction period, with 15 peak days, total construction water use would be approximately 54 million gallons (166 AF).

Operations Water

Operations water use after full construction would be approximately 33,550 GPD, with total annual use approximately 32.7 AFY. The largest water use, approximately 14,980 GPD (17 AFY), would be solar mirror washing. Each mirror would be washed using an average of 14 gallons of water once per month, with another wash of approximately 42 gallons every 3 months. Other operations water uses include: 184 GPD (0.21 AFY) for production of hydrogen through electrolysis in the hydrogen generator (hydrogen gas is used in the Solar Stirling Engine); 7,920 GPD (8.9 AFY) of brine resulting from the water demineralization process; 5,600 GPD (6.3 AFY) for on-site staff for drinking and sanitary purposes; and 5,000 GPD (5.6 AFY) for dust control.

Table 4: Water Usage Rates for Imperial Valley Solar Operations

Water Use	Daily Average (GPM)	Daily Max (GPM)	Annual Usage (AFY)
Equipment Water Requirements			
Sun Catcher Mirror Washing	10.4	17.4	14.2
Hydrogen System	0.13	0.13	0.0133
Water Treatment System Discharge			
Brine from Demineralization Process	5.5	10.2	7.5
Potable Water Use			
For Drinking and Sanitary Water Requirements	3.9	4.7	5.4
Dust Control			
Raw Water for Dust Control During Operations	3.5	6.9	5.6
Totals	23.3	39.2	32.7

Solar Millennium, BLYTHE SOLAR POWER PROJECT (09-AFC-6). Riverside County[13]

- **Project Type**: Solar Trough. 1000 Mw
- **Status:** AFC Filed 8/24/2009, Approved 9/15/2010
- **Project Description**: The Blythe Solar Power Project is a concentrated solar thermal electric generating facility with four adjacent, independent, and identical units of 250 megawatts (MW) nominal capacity each for a total nominal capacity of 1,000 MW. The project is proposed to be located in the Southern California inland desert, approximately eight miles west of the city of Blythe and two miles north of the Interstate-10 freeway in Riverside County. The applicants are seeking a right-of-way grant for approximately 9,400 acres of lands administered by the BLM Palm Springs-South Coast Field Office. Construction and operation of the project would disturb a total of about 7,044 acres. The Blythe Solar Power Project proposes to utilize solar parabolic trough technology to generate electricity. With this technology, arrays of parabolic mirrors collect heat energy from the sun and refocus the radiation on a receiver tube located at the focal point of the parabola. A heat transfer fluid (HTF) is heated to high temperature (750°F) as it circulates through the receiver tubes. The HTF is then piped through a series of heat exchangers where it releases its stored energy to generate high pressure steam. The steam is then fed to a traditional steam turbine generator where electricity is produced
- **Cooling Type:** Dry Cooling

[13] California Energy Commission. “Blythe Solar Power Project Commission Decision.” September 2010. CEC-800-2010-009-CMF.

- **Water Source:** Project will obtain its supply from ten groundwater wells on site**.**

Water Use

The project's primary water uses include solar mirror washing, feedwater makeup, fire water supply, on-site domestic use, and cooling water for auxiliary equipment and heat rejection. An average of 146,000 gallons of water per day (160 AFY) would be consumed by the auxiliary cooling water system; the maximum rate of consumption is 223,000 in summer (0.2 AFY).

The average total annual water usage for all four units combined is estimated to be about 600 AFY, which corresponds to an average flow rate of about 388 GPM based on pumping 24 hours per day, 350 days per year. Usage rates during operation would vary during the year and would be higher in the summer months when the peak maximum flow rate could be as much as about 50 percent higher (about 568 gpm).

Potable Water

The project water needs would be met by use of groundwater pumped from wells on the plant site. Water for domestic uses by project employees would also be provided by on-site groundwater treated to potable water standards.

Construction

The average water use for the project's construction is estimated to be about 645,000 gallons per calendar day. Total water use for the duration of project construction is estimated to be about 4,100 acre feet. Construction water would be sourced from on-site wells. Potable water during construction would be brought on site in trucks and held in day tanks.

Operations

There are four solar fields that use two cooling systems: 1) the air-cooled steam cycle heat rejection system and, 2) the closed cooling water system for ancillary equipment cooling. The auxiliary cooling water systems use a wet cooling tower for cooling plant equipment, including the STG lubrication oil cooler, the STG generator cooler, steam cycle sample coolers, large pumps, etc. An average of 146,000 GPD would be consumed by the auxiliary cooling water system; the maximum rate of consumption is 223,000 GPD in summer. Calculated annual water usage for the cooling systems is approximately 200 AFY.

At each solar field, to facilitate dust and contaminant removal, water from the demineralization process would be sprayed on the solar collectors for cleaning. The collectors would be cleaned once or twice per week, determined by the reflectivity monitoring program. This mirror washing operation would be done at night and involves a water truck spraying treated water on the mirrors in a drive-by fashion. The applicant expects that the mirrors would be washed weekly in winter and twice weekly from mid-spring through mid-fall. Because the mirrors are angled down for washing, water does not accumulate on the mirrors; instead, it would fall from the mirrors to the ground and, due to the small volume, is expected to soak in with no appreciable runoff. Any remaining rinse water from the washing operation would be expected to evaporate on the mirror surface. The treated water production facilities would be sized to accommodate the solar mirror washing demand of about 230 AFY.

Calico Solar Project [14]

(Formerly SES Solar One Project). Calico Solar LLC/Tessera Solar (formerly Stirling Energy Systems), San Bernardino County.

- **Type:** Mirror/ Stirling engine. Capacity 663.5 MW
- **Status:** Approved 10/28/2010. Docket Log
- **Project Description**: Approximately 34,000 38-foot diameter solar dish Stirling systems and associated equipment and infrastructure within a fenced boundary. The proposed Calico Solar Project site is approximately 8,230 acres of undeveloped land located within the Mojave Desert in the central portion of San Bernardino County. The site is located approximately 37 miles east of Barstow, California with its southern boundary adjacent to Interstate 40 (I-40)
- **Cooling Type**: Not Listed
- **Water Source:** Groundwater

Water Use

The following types of water would be required for the project: equipment washing water; potable water; dust control water, and fire protection water. When completed, the Calico Solar Project would require a total of approximately 36.2 AFY. SunCatcher mirror washing and operations dust control under regular maintenance routines will require an average of approximately 10.4 gallons of raw water per minute.

Construction

The timeframe for construction was calculated to be approximately 40 months. The calculated water demand for combined construction and dust suppression would be approximately 556 AFY.

Operations

Potable water consumption, groundwater treatment, and SunCatcher mirror washing under regular monthly maintenance routines will require approximately 12.5 gpm of water per day. A maximum requirement of approximately 21 gpm of water per day will be needed during the months when each SunCatcher receives a scrub wash. Water consumption during operation will be limited to mirror washing (13.98 AFY), water treatment (0.84 AFY), potable use (2.59 AFY), and dust control (2.5 AFY). Additionally, water will be used to generate hydrogen used in the SunCatcher engines. The applicant estimates that 205 (0.23 AFY) of water will be required to produce a sufficient volume of hydrogen for power plant use. The applicant estimates that the total maximum consumptive use of groundwater for operation of the power plant will be approximately 20.14 AFY.

[14] California Energy Commission. "Calico Solar Power Project Commission Decision". December 2010. CEC-800-2010-012-CMF. http://www.energy.ca.gov/sitingcases/solar_millennium_blythe/documents/index.html and http://www.energy.ca.gov/sitingcases/calicosolar/documents/index.html

Water Use	Daily Average (gpm)	Daily Maximum (gpm)	Annual Usage (AFY)
Equipment Water Requirements			
SunCatcher Mirror Washing	11.8	19.7	16.1
Water Treatment System Discharge			
Brine to Evaporation Ponds	6.0	11.1	8.1
Potable Water Use			
For drinking and sanitary water requirements	3.8	4.6	5.2
Dust Control			
Well water for dust control during operations	4.2	8.3	6.7
Totals	**25.8**	**43.7**	**36.2**

Victorville 2 Hybrid Power Project[15]

- **Project Type**: A hybrid of natural gas-fired combined cycle generating equipment integrated with solar thermal generating equipment.
- **Status**: Approved 7/16/2008
- **Project Description**: The proposed Victorville 2 project would have a net electrical output of 563 megawatts (MW) combining two natural gas-fired combustion turbine-generators (CTGs) rated at 154 MW each, two heat recovery steam generators (HRSGs), one steam turbine-generator (STG) rated at 268 MW, and 250 acres of parabolic solar-thermal collectors with associated heat transfer equipment. The solar-thermal collectors would contribute up to 50 MW of the STGs 268 MW output. This project is located immediately north of the Southern California Logistics Airport (SCLA) which is the site of the former George Air Force Base. The project site is situated approximately 3.5 miles east of Highway 395 and approximately 0.5 mile west of the Mojave River
- **Cooling Type**: Wet
- **Water Source**: Reclaimed

Water Use

The Reclaimed Water from the nearby Victor Valley Wastewater Reclamation Authority (VVWRA) treatment plant via a new 1.5-mile pipeline for cooling tower makeup and other non-potable water use. Groundwater is proposed as the operational backup water supply.

The Victorville 2 project would have two sources of water. Recycled water would be the primary water supply for project process needs during operations, and groundwater that serves local municipal needs would be used to meet the project's potable water demands. Groundwater is also proposed to be used as the project's operational backup water supply. Victorville Water, a

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15 California Energy Commission. "Victorville 2 Hybrid Power Project Final Commission Decision." July 2008. CEC-800-2008-003-CMF. http://www.energy.ca.gov/sitingcases/victorville2/documents/index.html

division of the city of Victorville, which operates the area's domestic groundwater supply system, would provide the potable groundwater supply. Recycled water would be supplied by VVWRA. A 1.5-mile pipeline will be constructed from the VVWRA treatment plant to the Victorville 2 project to supply recycled water to the project. Water will be trucked from the treatment plant to the Victorville 2 construction site for dust suppression until the pipeline is constructed.

Table 5: Victorville 2's Annual Water Needs

Water Use	Maximum Annual Use (AFY)	Water Supply Source	Water Supplier
Process Water	3,150	Recycled Water	Victor Valley Water Reclamation Authority (VVRCA)
Process Water Backup Supply	45	Groundwater	Victorville Water
Potable Water	3.6	Groundwater	Victorville Water

Construction

During construction, recycled water would be used to meet all of the project's non-potable water demands, including dust suppression and compaction. During the first stage of construction grading 225 for the power block area, the applicant estimates that the daily maximum water demand would be 65,000 GPD. During the next stage for grading of the solar field, average daily water use would increase to a maximum of 650,000 GPD. During non-grading construction periods, the average daily water demand would be about 58,000 GPD.

Operations

During operations, recycled water would be used for cooling, other process needs, mirror washing, fire protection and landscaping. The applicant estimates plant operations will require a maximum annual water supply of 3,150 AFY, including 46 AFY for mirror washing. The average maximum daily rate would be 2,603 gallons per minute (gpm) and the peak daily rate would be 2,965 gpm. The effect of the project's recycled water use would be to reduce return flows and thereby remove water from the basin's hydrologic system. Recycled water used by the project, except for landscape irrigation, would be completely consumed through evaporation. (*Id*.)

Beacon Solar Energy Project[16]

- **Project Type**: Parabolic trough solar thermal technology to produce electrical power using a steam turbine generator (STG) fed from a solar steam generator (SSG). The SSG receives heated heat transfer fluid (HTF) from solar thermal equipment comprised of arrays of parabolic mirrors that collect energy from the sun.

- **Status**: Approved

[16] California Energy Commission. "Beacon Solar Energy Project Commission Decision." August 2010. CEC-800-2010-005 CMF

- **Project Description**: The project will have a nominal electrical output of 250 megawatts (MW) and commercial operation is planned to commence by the third quarter of 2011, subject to timing of regulatory approvals and applicant achievement of project equipment procurement and construction milestones. The solar thermal technology will provide 100 percent of the power generated by the plant; no supplementary energy source (e.g., propane to generate electricity at night) is proposed to be used for electric energy production. The project will utilize two auxiliary boilers fueled by propane to reduce startup time and for HTF freeze protection. The auxiliary boilers will supply steam to the HTF freeze protection heat exchangers during nighttime hours to keep the HTF in a liquid state when ambient temperatures are not sufficient to keep the temperature of the HTF above its relatively high freezing point (54 degrees Fahrenheit). The project will also have a diesel fueled firewater pump for fire protection. (1,244 acres)
- **Cooling Type:** Wet
- **Water Source:** Recycled and groundwater

Water Use

Water for cooling will be tertiary treated recycled water supplied either by California City or Rosamond Community Services District. Water for other industrial uses such as mirror washing, would be supplied from on-site groundwater wells, which also would be used to supply water for employee use (e.g., drinking, showers, sinks, and toilets). Additional water will be required for make-up to the solar thermal and steam turbine system, washing of solar reflectors and collectors, potable water needs, and fire protection.

Potable Water

A package water treatment system would be used to treat the groundwater to meet potable standards for employee use and a septic system and on-site leach field would be used to dispose of sanitary wastewater.

It is estimated that the project would use approximately 1,400-acre feet per year of recycled water and 153 acre feet per year of groundwater with another 47 acre feet per year held for emergency reserve. According to pumping test data provided in the AFC, groundwater supply wells on the plant site have sufficient capacity (at least 2,000 gallons per minute) to meet the project's water supply requirements.

Construction

During construction, the record indicates that water usage will be between 5 million and 10 million GPD, five days per week for a total period of 22 days per month for five months (or 110 days). Approximately 7,000 to 14,000 gallons per minute (gpm) of water will be required daily from seven wells to support initial construction activities. Following the initial five-month grading period, water will be used primarily for dust suppression and used in the construction of the solar field, power block and other site buildings and hydrostatic testing of the facility's pressure vessels and piping.

Operations

During operations, BSEP will use recycled water imported from either the Rosamond Community Sanitary District (RCSD) or California City for power plant cooling. On a temporary basis, groundwater may be used for cooling purposes if the applicant elects to use the California City recycled water option, as discussed below. The applicant estimates that 1,388 AF of water will be consumed annually for power plant operation and potable water needs.

Abengoa Mojave Solar Project[17]

- **Project Type**: Solar Trough
- **Status**: Approved 9/8/2010
- **Project Description**: On August 10, 2009, Abengoa Solar Inc., the sole member of Mojave Solar LLC, filed an Application For Certification (AFC) for its Abengoa Mojave Solar Project. The proposed project is a nominal 250 megawatt (MW) solar electric generating facility to be located near Harper Dry Lake in an unincorporated area of San Bernardino County. The project would be located approximately halfway between Barstow, CA and Kramer Junction, CA, and is approximately nine miles northwest of Hinkley, CA. The project will implement well-established parabolic trough technology to solar heat a heat transfer fluid (HTF). This hot HTF will generate steam in solar steam generators, which will expand through a steam turbine generator to produce electrical power from twin, independently-operable solar fields, each feeding a 125-MW power island. The sun will provide 100 percent of the power supplied to the project through solar-thermal collectors; no supplementary fossil-based energy source (like natural gas) is proposed for electrical power production
- **Cooling Type:** Wet
- **Water Source**: On-site wells (Harper Valley Ground Basin groundwater).

Water Use

Water uses for the project include makeup for the circulating water system and cooling tower, makeup for the solar steam generators, water for solar collector arrays, service water, potable water and fire protection water. Groundwater from adjudicated water rights to the Harper Valley Groundwater Basin will be the sole source of water supply for these various water uses. The Mojave Water Agency administers the adjudicated water rights.

Potable Water

The proposed groundwater supply has a total dissolved solids (TDS) concentration of approximately 1,200 50 1,500 mg/L, and is therefore considered brackish and unsuitable for municipal supply or other potable uses without treatment. A packaged water treatment system will be used by the project to treat the groundwater to meet potable standards.

Construction

During construction of the AMS project, the groundwater demand would be as high as 1,098 AFY. Construction of the AMS project is estimated to take 26 months to complete. During

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[17] California Energy Commission. "Abengoa Mojave Solar Project Commission Decision." September 2010. CEC-800-2010-008-CMF.

operation, the project would use groundwater for potable and plant processes at a maximum rate of approximately 2,160 AFY.

Operations

Groundwater will meet the project's process and cooling water needs and domestic needs. Both the Alpha and Beta plants will have a production well and a backup well. Each plant's power block would also have a dedicated water treatment unit for plant process needs and a package treatment unit for potable water.

Water Use	Average Rate (GPM)	Peak Rate (GPM)	Estimated Annual Use (AFY)	Estimated Maximum Annual Use (AFY)
Plant Operation	667	1,093	850	1,077
Potable Water	3.1	3.1	5, max	5

Table 6: Proposed Annual Project Water Source and Use—Abengoa Solar

Water Use	Water Demand	Est. Avg. Volume of Water Required GPD	Est. Avg. Volume of Water Required (AFY)	Est. Max Volume of Water Required GPD	Est. Max Volume of Water Required (AFY)
Construction	Soil Compaction and Dust Suppressant	1,716,000	1,025	1,716,000	1,025
	Ongoing Construction Needs	59,800	1.9	61,750	2.6
	Drinking Water	1,660	1.9	---	---
	Total	**1,777,460**	**1,095**	**1,777,750**	**1,098**
Operations	Cooling Water Makeup, Mirror Wash Water, and Maintenance	1,910,469	2,140	1,910,469	2,140
	Landscaping	Included in Total Water Requirement			
	Fire Protection (use as necessary)	100	0.1	100	0.1
	Drinking and Sanitation	17,855	20	17,855	20
	Total	**1,928,324**	**2,160**	**1,928,324**	**2,160**

Ivanpah Solar Electric Generating System[18]

- **Project Type**: Heliostat Mirror and Power Tower Technology
- **Status**: Approved 9/22/2010
- **Project Description**: The proposed project includes three solar concentrating thermal power plants, based on distributed power tower and heliostat mirror technology, in which heliostat (mirror) fields focus solar energy on power tower receivers near the center of each heliostat array. Each 100-MW site would require approximately 850 acres (or 1.3 square miles) and would have three tower receivers and arrays; the 200-MW site would require approximately 1,600 acres (or 2.5 square miles) and would have 4 tower receivers and arrays. The total area required for all three phases would including the administration building/operations and maintenance building and substation and be approximately 3,400 acres (or 5.3 square miles). Given that the three plants would be developed in concert, the proposed solar plant projects would share the common facilities mentioned above to include access roads, and the reconductored transmission lines for all three phases. Construction of the entire project is anticipated to begin in the first quarter of 2009, with construction being completed in the last quarter of 2012
- **Cooling Type:** Dry
- **Source**: Proposed groundwater wells

[18] California Energy Commission. “Ivanpah Solar Electric Generating System.” September 2010. CEC-800-2010-004-CMF. http://www.energy.ca.gov/2010publications/CEC-800-2010-004/CEC-800-2010-004-CMF.PDF

Water Use

The applicant estimates the combined maximum annual use of groundwater for project operations to be 76.4 AFY, but rounded this number up to 100 AFY in the AFC and supplemental documents.

Potable

During project construction, potable (primarily drinking) water would be provided by construction contractors and purchased from an offsite source. During plant operation, potable water would either be brought into the project from a delivery service or pumped from one of the on-site groundwater wells and filtered and purified to meet the project's workforce potable water needs. The estimated annual potable water demand during plant operation is approximately 3 AFY for all three project phases.

Construction

All water for the construction and operation of the power plants would be drawn from one of two wells located on the northwest corner of Ivanpah 1. One well would be used as the primary water supply with the other well used as a backup for redundancy. A monitoring well would be installed approximately 2,300 feet northeast of the project's wells to monitor project impacts to local groundwater levels. Pumped water would be stored for each power block in a 250,000 gallon combined raw water and fire water tank. Construction of each phase of the proposed project is expected to take 24 months. Groundwater would be used daily for dust suppression and vehicle washing. Average daily water demand during construction is 99,333 GPD for Ivanpah 1 and 2 and 194,000 GPD for Ivanpah 3. During hydrostatic testing of the project piping, up to 47,000 gallons of water could be used. The used water from this testing would either be trucked to a wastewater treatment and disposal facility or allowed to percolate/evaporate on-site, pending analytical results of the used water. If discharged to land, discharge of this water would be subject to the requirements of the State Water Resources Control Board's DWQ Order No. 2003-0003-DWQ (Statewide General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality).

Operations

Approximately 16,000 gallons of water per night would be used for mirror washing. To minimize the amount of water use, a pressure washer or other method would be used. Each heliostat within an array would be washed once every two weeks. The applicant estimates that 100 heliostats can be washed per hour with 4 trucks working 10 hours per night at about 0.4 mile per hour (mph) (CH2ML2008b). Due to the high evaporation rates and minimal amount of water used, the applicant estimated that the wash water would evaporate at or just below the ground surface.

Genesis Solar Energy Project[19]

- **Project Type**: Parabolic Solar Trough
- **Status**: Approved 9/29/2010

[19] California Energy Commission. "Genesis Solar Energy Project Commission Decision." September 2010. CEC-800-2010-011 CMF.

- **Project Description**: The project consists of two independent solar electric generating facilities with a nominal net electrical output of 125 megawatts (MW) each, for a total net electrical output of 250 MW. Electrical power would be produced using steam turbine generators fed from solar steam generators. The solar steam generators receive heated transfer fluid from solar thermal equipment comprised of arrays of parabolic mirrors that collect energy from the sun. The project would use a wet cooling tower for power plant cooling. Water for cooling tower makeup, process water makeup, and other industrial uses such as mirror washing would be supplied from on-site groundwater wells. Project cooling water blow down will be piped to lined, on-site evaporation ponds

- **Cooling Type:** Wet

Water

All water used in association with the GSEP project would be derived from local ground-water aquifers associated with the Bouse Formation and/or the underlying fanglomerate deposits. Based on the currently proposed dry cooling system for the GSEP, the evidence indicates that proposed groundwater used during project construction (between approximately 616 and 1,368AFY and operation (202 AFY) will not exceed the positive yearly balance of 2,600 AFY. Accordingly, Project-related impacts to the local groundwater basin balance will be less than significant.

- **Source**: Groundwater

Solar Millennium Palen[20]

- **Project Type**: Solar Trough

- **Status**: Approved 12/15/2010

- **Project Description**: The Project will utilize solar parabolic trough technology to generate electricity. With this technology, arrays of parabolic mirrors collect heat energy from the sun and refocus the radiation on a receiver tube located at the focal point of the parabola. A heat transfer fluid (HTF) is heated to high temperature (750 degrees Fahrenheit) as it circulates through the receiver tubes. The heated HTF is then piped through a series of heat exchangers where it releases its stored heat to generate high-pressure steam. The steam is then fed to a traditional steam turbine generator where electricity is produced. The project site would be located approximately 10 miles east of Desert Center, along Interstate 10 approximately halfway between the cities of Indio and Blythe, in Riverside County, California. An application has been filed with BLM for a right-of-way (ROW) grant of approximately 5,200 acres

- **Cooling Type:** Dry

- **Source:** Groundwater

[20] California Energy Commission. “Palen Solar Power Project.” December 2010. CEC-800-2010-010 CMF.

Water Use

The project is proposing to use annually about 300 AFY of groundwater pumped from up to ten wells on the plant site, including mirror washing, process makeup, equipment cooling, dust suppression and potable uses. Because groundwater is the only source of water for the proposed project, if the proposed rule is established and the applicant is found to be using Colorado River water based on the proposed rule the applicant will be required to obtain an entitlement to the groundwater. Currently, a preliminary timeline for final implementation of the accounting surface rule is summer 2011.

Potable

The project water needs would be met by use of groundwater pumped from up to ten wells on the plant site. Water for domestic uses by project employees would also be provided by on-site groundwater treated to potable water standards.

Construction

Project construction is expected to occur over a total of 39 months. Construction water requirements cover all construction related activities including:

- Dust control for areas experiencing construction work as well as mobilization and demobilization
- Dust control for roadways
- Water for grading activities associated with both cut and fill work
- Water for soil compaction in the utility and infrastructure trenches
- Water for soil compaction of the site grading activities
- Water for stockpile sites
- Water for the various building pads
- Water for concrete pours on site
- Concrete batch plant operations

The predominant use of water would be for grading activities. Average water use at the site is estimated to be about 1,619,899 GPD (1,815 AFY). Total construction water use for the duration of the project is estimated to be about 5,750 acre-feet. Construction water would be sourced from on-site wells. Potable water during construction would be brought on-site in trucks and held in day tanks.

Operations

The average water requirement for each of the two power plants is estimated to be about 150AFY for a total of 300 AFY, which corresponds to an average flow rate of about 188 gpm, based on pumping 24 hours per day, 350 days per year. Usage rates during operation would vary during the year and would be higher in the summer months when the peak maximum flow rate could be as much as about 50 percent higher (about 275 gpm).

Water Demand	Est. Avg. Volume of Water Required GPD	Est. Avg. Volume of Water Required (AFY)
Construction	1,619,899	5,750
Operations	267,823	300

Rice Solar Energy Project[21]

- **Project Type**: Heliostat Mirror Technology
- **Status**: Approved 12/15/2010
- **Project Description**: The proposed facility will use concentrating solar power (CSP) technology, with a central receiver tower and an integrated thermal storage system. The RSEP's technology generates power from sunlight by focusing energy from a field of sun-tracking mirrors called heliostats onto a central receiver. Liquid salt (The salt is a mixture of sodium nitrate, a common ingredient in fertilizer, and potassium nitrate, a fertilizer and food additive. These mineral products will be mixed on-site as received directly from mines in solid crystallized form and used without additives or further processing other than mixing and heating.), which has viscosity and appearance similar to water when melted, is circulated through tubes in the receiver, collecting the energy gathered from the sun. The heated salt is then routed to an insulated storage tank where it can be stored with minimal energy losses. When electricity is to be generated, the hot salt is routed to heat exchangers (or steam generation system). The steam is then used to generate electricity in a conventional steam turbine cycle. After exiting the steam generation system, the salt is sent to the cold salt thermal storage tank and the cycle is repeated. The salt storage technology was demonstrated successfully at the U.S. Department of Energy-sponsored 10-MW Solar Two project near Barstow, California, in the 1990s
- **Cooling Type:** Air cooled condenser
- **Source**: Groundwater (on-site treatment)

Water Use

One well will be the primary water source and the other will be a secondary source. The primary well is currently installed. The secondary well will be drilled early in the construction phase. Two wells already exist at the project site.

Potable

It is estimated potable water use will be approximately 3 AFY during operations. The RSEP will provide employees with drinking water during construction and operation from the on-site well. The well water must be treated to comply with the California Safe Drinking Water Act requirements. The RSEP would qualify as a Public Supply System by serving more than 25 people for more than 60 days. The facility would also qualify as a non-transient non-community water system, serving 25 persons for over 6 months per year.

[21] California Energy Commission. “Rice Solar Energy Project.” December 2010. CEC-800-2010-019 CMF

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