APPENDIX A

Hydrologic Modeling of SunCreek Specific Plan, Analysis of Impacts to Groundwater Flow Direction and Gradients

Hydrologic Modeling of SunCreek Specific Plan

Analysis of Impacts to Groundwater Flow Direction and Gradients

Prepared for:

LENNAR

RMC

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ACRONYMS AND ABBREVIATIONS

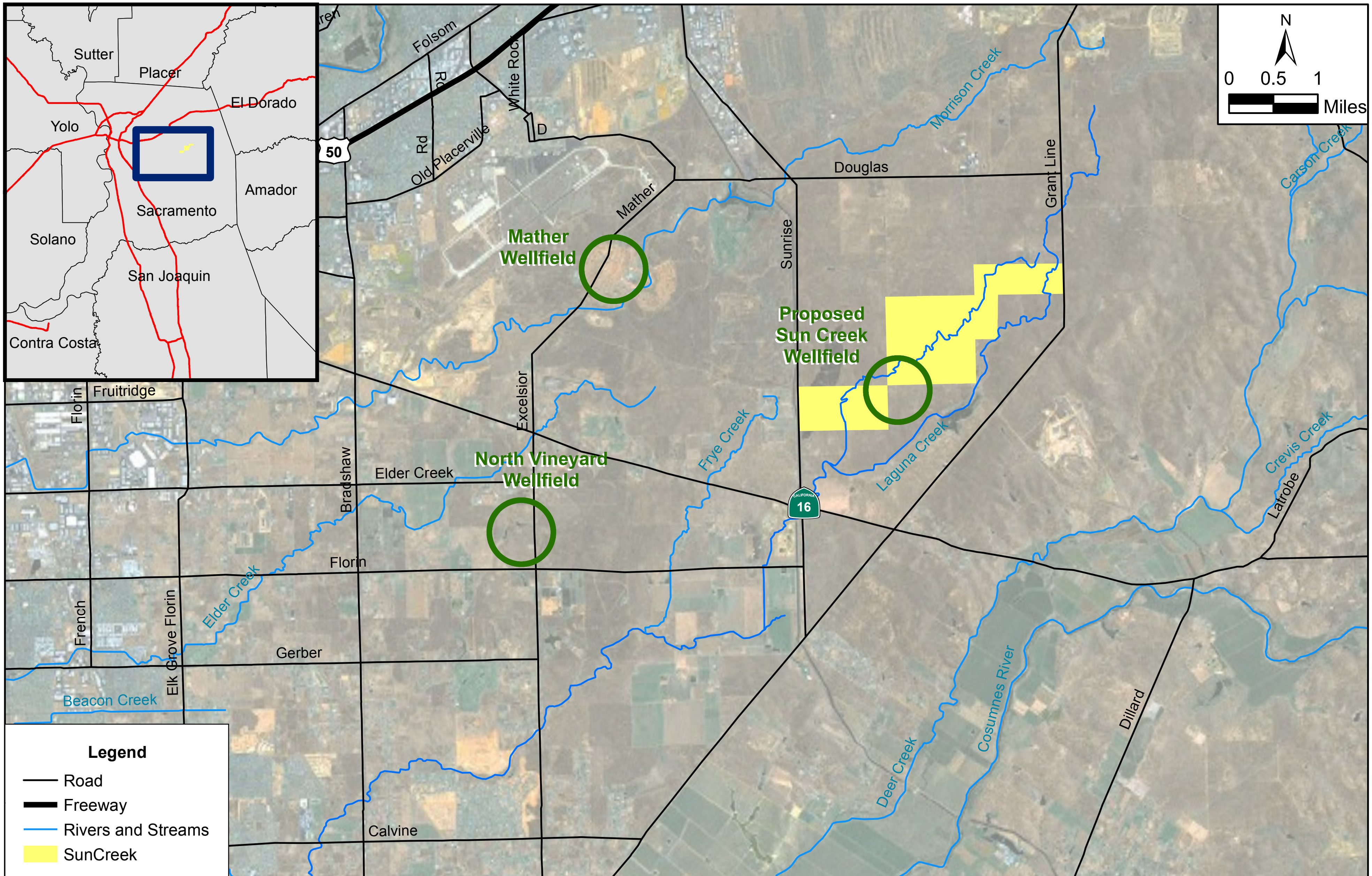
AC&W	Aircraft Control and Warning
AFY	acre-feet per year
Aerojet Site	Aerojet General Corporation Superfund Site
cfs	cubic feet per second
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
GET	Groundwater Extraction and Treatment
IGSM	Integrated Groundwater and Surface Water Model
IRCTS	Inactive Rancho Cordova Test Site
Mather	Former Mather Air Force Base
MBSA	Main Base/Strategic Air Command Area
mgd	million gallon(s) per day
MWS	*The Water Master Study for the SunCreek Specific Plan*
NDMA	n–nitrosodimethylamine
NSA	North Service Area
OU	Operable Unit
RWQCB	Central Valley Regional Water Quality Control Board
SacIWRM	Sacramento Area Integrated Water Resources Model
SCWA	Sacramento County Water Agency
TM2	*Technical Memorandum No. 2, Groundwater Specific Demands, Sun Creek Specific Plan*
WSIP	Water System Infrastructure Plan
WTP	Water treatment plant

SECTION 1 INTRODUCTION

The SunCreek Specific Plan covers 1,264 acres in eastern Sacramento County, as shown in Figure 1-1. The Specific Plan is located within the North Service Area (NSA) of Sacramento County Water Agency's (SCWA) Zone 40 Service Area. Hydrologic modeling analysis of the proposed project and four land use alternatives (for a total of five land use alternatives) was performed under the Delayed NSA Pipeline Construction water supply scenario utilizing the Sacramento Area Integrated Water Resources Model (SacIWRM).

This modeling was used to estimate project impacts on groundwater flow direction and gradients at regional contamination sites.

This section contains a brief introduction to the project. Section 2 describes the regional contaminated sites. Section 3 contains information on the groundwater model and the model baselines used in the analysis. The development and definitions of the simulated scenarios are presented in Section 4. The impacts of the proposed project and the four land use alternatives on groundwater flow gradient and direction are presented in Section 5. Section 6 presents the references.



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Location of SunCreek

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Figure 1-1

SECTION 2 REGIONAL CONTAMINATED SITES

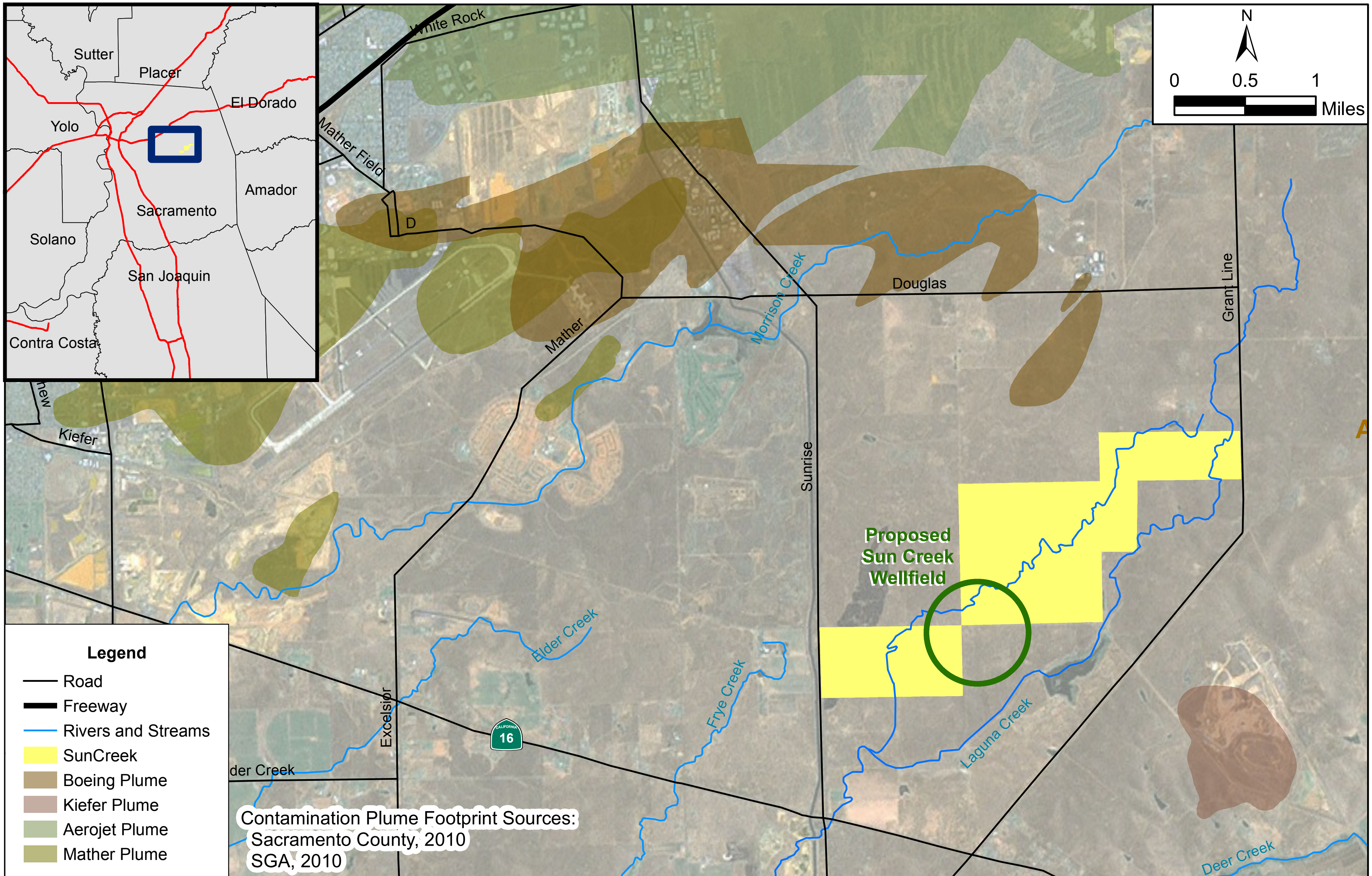
SunCreek is located near several regionally significant contaminated sites. These sites are:

- Aerojet General Corporation Superfund Site (Aerojet Site)
- Inactive Rancho Cordova Test Site (Boeing Site)
- Kiefer Landfill
- Former Mather Air Force Base

Additionally, a search was performed to identify nearby sites of Leaking Underground Storage Tanks (within a distance of 3 miles from the SunCreek site). A review of data on the State Water Resources Control Board's GeoTracker database (California State Water Resources Control Board, 2013) indicated only one nearby open site: Rana Sunrise Inc. (Former Shell Station) (T10000001538). Further investigation indicated that the GeoTracker database contained the incorrect latitude and longitude coordinates for the facility, which is located north of U.S. Highway 50 at the intersection of Sunrise Boulevard and Zinfandel Drive. Thus, no open Leaking Underground Storage Tanks sites were identified in GeoTracker within a distance of 3 miles from the SunCreek site.

The plumes of the regionally significant contaminated sites are shown on Figure 2-1; information on the nature and movement of the plumes are provided in the subsections below.

The modeling performed for this study analyzed the potential impacts of the proposed SunCreek development on the regional flow direction and gradient in the vicinity of these plumes.



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Location of Sun Creek and Regional Contamination Plumes

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Figure 2-1

AEROJET GENERAL CORPORATION SUPERFUND SITE

The following provides a brief summary of the background of groundwater contamination at the Aerojet General Corporation Superfund Site and the status of plume migration. This information is summarized based on the following documents: *Aerojet General Corporation Superfund Site* (United States Environmental Protection Agency, 2006) and *EPA Selects Cleanup Plan for Operable Unit 5 of the Aerojet General Corporation Superfund Site* (United States Environmental Protection Agency, 2011).

BACKGROUND

The Aerojet General Corporation Superfund Site covers 8,500 acres (this number includes the carved out property to be used for development) near Rancho Cordova, 15 miles east of Sacramento. Since 1953, Aerojet and its subsidiaries have manufactured liquid and solid propellant rocket engines for military and commercial applications. In this process, they have formulated a number of chemicals, including rocket propellant agents and agricultural, pharmaceutical, and other industrial chemicals. Cordova Chemical Company (1974-1979) and Aerojet disposed of unknown quantities of hazardous waste chemicals. Some wastes were disposed of in surface impoundments, landfills, deep injection wells or leachate fields or by open burning. In addition, underlying most of the site are extensive 40-100 feet-deep dredge tailings, remnants of past gold mining operations.

Under the oversight of the California Environmental Protection Agency Department of Toxic Substances Control (DTSC) and the Central Valley Regional Water Quality Control Board (RWQCB), the Aerojet General Corporation began investigating the nature and extent of groundwater and soil contamination throughout the site in 1979. In 1981, the United States Environmental Protection Agency (EPA) proposed the site for inclusion on the National Priorities List. The site was placed on the list in 1983. The National Priorities List is a national inventory of hazardous waste sites that are eligible for cleanup under federal Superfund law.

In 1979, volatile organic compounds were found off-site in private wells. volatile organic compounds were also found in the American River in 1983. Aerojet submitted recommendations for control of groundwater contamination north of the American River in 2004. EPA directed Aerojet to install more monitoring wells to better define the plume.

Between 1983 and 1987, Aerojet installed five groundwater extraction and treatment (GET) facilities (GETs A, B, D, E and F) primarily to prevent further movement of volatile organic compounds off the property. The American River groundwater extraction and treatment system was added in 1998 and GETs E and F were combined in 1999 and expanded in 2002. Each GET facility consists of a series of extraction wells to intercept the contaminant plume and a groundwater treatment system to remove the contamination. The treated water is either injected back into the aquifer, discharged to land for recharge into the ground, or discharged to surface water bodies that flow to the American River.

Perchlorate, a component of solid rocket fuel, was found in drinking water wells off-site at levels above the provisional health based standard in January 1997.

In 2001, EPA, DTSC and RWQCB sought public comment to modify their legal agreement with Aerojet called a partial consent decree. This modification included dividing the site into different areas called operable units (OUs) to help speed up the cleanup. The partial consent decree modification was completed in 2002. The cleanup approach for the Aerojet site under the modified partial consent decree is to control groundwater contamination moving across the facility boundary with two OUs (Western Groundwater OU and Perimeter Groundwater OU).

In 2003, analysis revealed that a portion of the groundwater just north of the American River in Carmichael is contaminated with n–nitrosodimethylamine (NDMA). (United States Environmental Protection Agency, 2006)

PLUME MIGRATION

Implementation of a cleanup action for OU-5, in conjunction with the existing OU-3 cleanup to the west and other state enforcement actions to the south will fully contain groundwater contamination around the boundary of the Aerojet Site. The OU-5 cleanup decision is to complete a system to pump groundwater at the outer edge of the contaminated area to prevent further spread of contaminated groundwater. This system will be improved by pumping additional water from more heavily contaminated areas near the Aerojet property. EPA considers this an interim groundwater remedy since final cleanup relies on eliminating source areas to be addressed in future OUs. Together, the containment actions at OU-3 and OU-5 will pump and treat over 20 million gallons of contaminated groundwater every day to prevent the loss of additional drinking water supplies in a populated area dependent on groundwater supplies. (United States Environmental Protection Agency, 2011)

BOEING (INACTIVE RANCHO CORDOVA TEST SITE)

The following provides a brief summary of the background of groundwater contamination at the Boeing Site, also known as the Inactive Rancho Cordova Test Site (IRCTS), and the status of plume migration. This information is summarized based on the following documents: *Fact Sheet: DTSC Proposes Groundwater Cleanup at the Inactive Rancho Cordova Test Site* (California Department of Toxic Substances Control, 2005) and *2011 Annual Groundwater Monitoring Report, Inactive Rancho Cordova Test Site, Rancho Cordova, California* (The Boeing Corporation and Aerojet-General Corporation, 2012).

BACKGROUND

McDonnell Douglas Corporation, now owned by The Boeing Company, and the Aerojet General Corporation used the IRCTS between 1956 and 1969. Among other aerospace related activities, McDonnell Douglas Corporation tested solidrocket motors and liquid rocket engines in three areas on the south half of the IRCTS. Two of these areas, the Administration Area (now Security Park) and the Alpha/IOC-1 Complex are sources for solvents found in groundwater below the IRCTS. The Alpha/IOC-1 Complex has been identified as the source for perchlorate in groundwater below the south half of the IRCTS.

The Administration Area occupies about 70 acres within the southeastern portion of the IRCTS and was developed in phases beginning in 1956 with the construction of a Modification Hanger for the Thor rocket program. Beginning in 1959 this area was used to support the Saturn manned-space vehicle program up to 1969. From 1977 to 1984, McDonnell Douglas Corporation leased or sold portions of the former Administration Area.

The Alpha/IOC-1 Complex is about 45 acres within the southeastern section of the IRCTS. McDonnell Douglas Corporation built two test stands and used them from 1956 to 1969 to test rockets.

The Kappa/Gamma Complex is about 33 acres on the eastern side of the IRCTS and was used by McDonnell Douglas Corporation and Aerojet to evaluate the launch procedures for the Thor missile under simulated adverse weather conditions and to test rocket systems and fuels. The last tests at Kappa/Gamma occurred about 1969. (California Department of Toxic Substances Control, 2005)

PLUME MIGRATION

Active regional groundwater remedies currently in operation for the IRCTS include the Mather GET HB system and the Southern Groundwater Study Area GET system. The DTSC concluded in a letter dated July 27, 2011 that the Mather GET HB system and the Southern Groundwater Study Area GET system are operating properly and are effective at capturing and treating contaminant plumes at the sites. (The Boeing Corporation and Aerojet-General Corporation, 2012)

KIEFER LANDFILL

The following provides a brief summary of the background of groundwater contamination at Kiefer Landfill and the status of plume migration. This information is summarized based on the following documents: *Public Hearing Concerning Renewal of Waste Discharge Requirements (NPDES No. CA0083681) and Time Schedule Order for County of Sacramento Public Works Agency Kiefer Landfill Groundwater Extraction and Treatment Plant, Sacramento County*

(California Regional Water Quality Control Board, Central Valley Region, 2007) and *Kiefer Landfill Groundwater Remediation Status* (County of Sacramento, Department of Waste Management and Recycling, 2011).

BACKGROUND

The County of Sacramento owns and operates the Kiefer Landfill, a Class III solid waste disposal facility, which includes an on-site groundwater extraction and treatment system. The landfill is at the intersection of Grant Line Road and Kiefer Boulevard, in the eastern portion of Sacramento County, about 15 miles east of the City of Sacramento. A 1987 Solid Wastewater Quality Assessment Test indicated that disposal operations at the landfill have resulted in contamination of groundwater with volatile organic compounds. The County of Sacramento has been directed to remediate the groundwater under an approved Correction Action Plan required under Cleanup and Abatement Order No. 91-725. The Correction Action Plan called for the extraction and treatment of the contaminated groundwater. Treated groundwater is discharged to Deer Creek, a water of the United States and a tributary to the Cosumnes River. (California Regional Water Quality Control Board, Central Valley Region, 2007)

Groundwater beneath the landfill is divided into three zones with depth: Zone A, Zone B, and Zone C. Groundwater contamination is 90% in Zone A and 0% in Zone C. Regional drinking water is drawn from Zone C. (County of Sacramento, Department of Waste Management and Recycling, 2011).

PLUME MIGRATION

The plume at Kiefer Landfill is contained and under hydraulic control (County of Sacramento, Department of Waste Management and Recycling, 2011).

FORMER MATHER AIR FORCE BASE

The following provides a brief summary of the background of groundwater contamination at the former Mather Air Force Base and the status of plume migration. This information is summarized based on the *Annual and Fourth Quarter 2011 Groundwater Monitoring Report* (URS Group, 2012).

BACKGROUND

Groundwater at the former Mather Air Force Base (Mather) and its vicinity is contaminated by chemicals used during routine operations at Mather between 1918 and 1993.

There are five areas of monitoring for groundwater contamination at Mather:

- AC&W (Aircraft Control and Warning) Site Plume: The AC&W Site Plume reportedly resulted from disposal of solvents in a waste disposal pipe or dry well from 1958 to 1966.
- Site 7 Plume: The source area for the Site 7 Plume was a gravel borrow pit used as a landfill into which waste was disposed from 1953 to approximately 1966. The borrow pit was reportedly used to dispose of petroleum, oil, and lubricant wastes, empty drums, sludge from plating shops, absorbent sand used for cleaning oil and solvent spills, and at least one load of transformer oil that may have contained polychlorinated biphenyls. The Site 7 groundwater extraction and treatment system operation has been interrupted three times since 1998 to accommodate mining and related reclamation activities (from July 1999 to May 2001, from July 2001 to March 2002, and from April 2003 to mid-December 2006). The extraction and groundwater treatment system resumed operation in December 2006 and has operated continually since then.
- Landfills and Northeast Plume: Sources of contamination include landfill disposal.
- MBSA (Main Base/Strategic Air Command Area) Plume: The commingled contaminant plume resulting from sources at several sites in this area is referred to as the MBSA Plume. Multiple source areas of contamination resulted from industrial activities, equipment maintenance, dry cleaning, and fuel storage and delivery.
- Off-base Area: The off-base area is identified as the portion of the MBSA and Site 7 Area plumes that have migrated beyond Mather property boundaries. The monitoring program referred to as "Off Base" is the monitoring of large water supply wells, selected nearby monitoring wells, and generally smaller privately owned supply wells in the vicinity of and downgradient from the plumes. The sampling of large supply wells and nearby monitoring wells is governed by the *Mather AFB Off-base Water Supply Contingency Plan.* (URS Group, 2012)

PLUME MIGRATION

Based on the plume distribution and estimated capture zones developed using potentiometric surface data from the fourth quarter of 2011, the plumes being treated by groundwater extraction are nearly completely captured. Of the 5 plumes being treated by groundwater extraction, 3 are 100 percent contained, one is 96 percent contained, and one is 93 percent contained. (URS Group, 2012)

SECTION 3 DESCRIPTION OF MODEL AND BASELINES

SACRAMENTO AREA INTEGRATED WATER RESOURCES MODEL

The SacIWRM was used to perform hydrologic modeling for this analysis. As an integrated hydrologic model, SacIWRM models both groundwater and surface water resources, including important surface water courses in the SunCreek area: Cosumnes River, Deer Creek, Morrison Creek, Laguna Creek, and the American River.

SacIWRM is a widely accepted integrated hydrologic model for the Sacramento County area. The model is based on the Integrated Groundwater and Surface Water Model (IGSM) and has been updated and enhanced over time. It has been used in numerous studies and investigations, including, among others:

- Sunrise Douglas analysis
- American River Basin Cooperating Agencies studies
- Zone 40 Water Supply Master Plan update
- Rio del Oro impacts study
- Aerojet analyses
- Studies along the Cosumnes River
- Regional contamination studies
- Regional groundwater banking analyses

The most recent recalibration of the SacIWRM in the central Sacramento County area occurred in mid-2008 (WRIME [now RMC], 2008).

In the area near SunCreek, the SacIWRM simulates the groundwater aquifer as three layers, representing shallow, intermediate, and deep groundwater. The layering is used by the model to better simulate the vertical gradients that develop due to low-conductivity beds and other natural causes of anisotropy in the aquifer system that result in greater horizontal groundwater flow than vertical groundwater flow. Near the North Vineyard Wellfield, Layer 1 is closest to the surface and is typically utilized by private wells for irrigation and domestic use. The Cosumnes River is underlain by Layer 1. In much of SunCreek and to the east of SunCreek, Layer 1 is unsaturated and Layer 2 is the only saturated aquifer layer present. Layer 2 is immediately below Layer 1, and is utilized by SCWA for the North Vineyard Wellfield. Schematic cross-sections of these layers are shown in Figure 3-1 and Figure 3-2, with the cross-section locations shown in Figure 3-3.

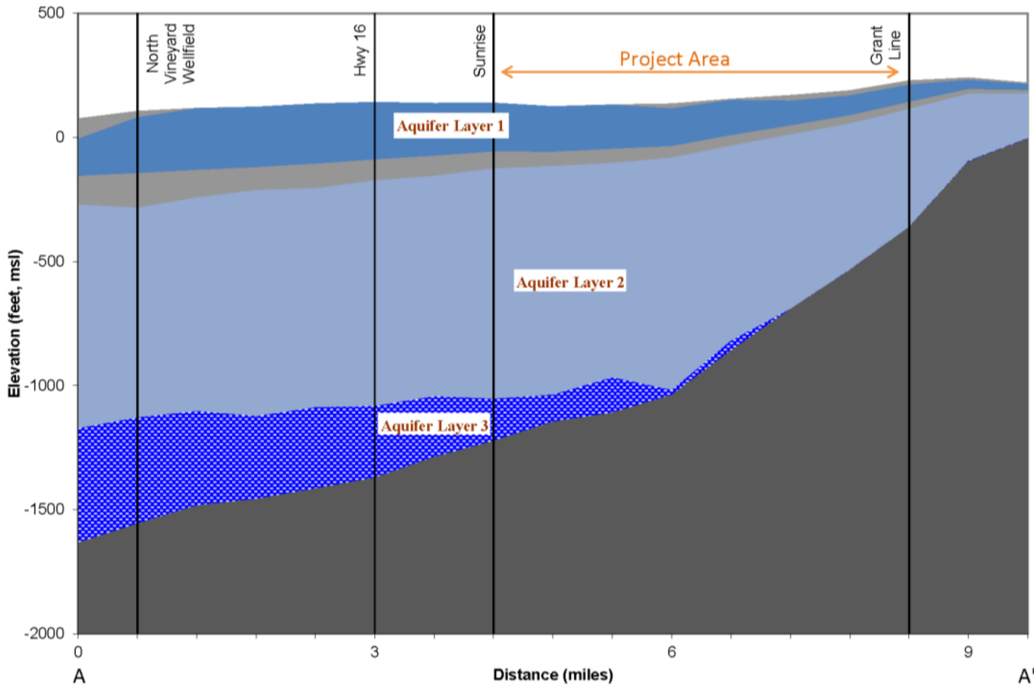


Figure 3-1 Schematic Cross-Section A – A′

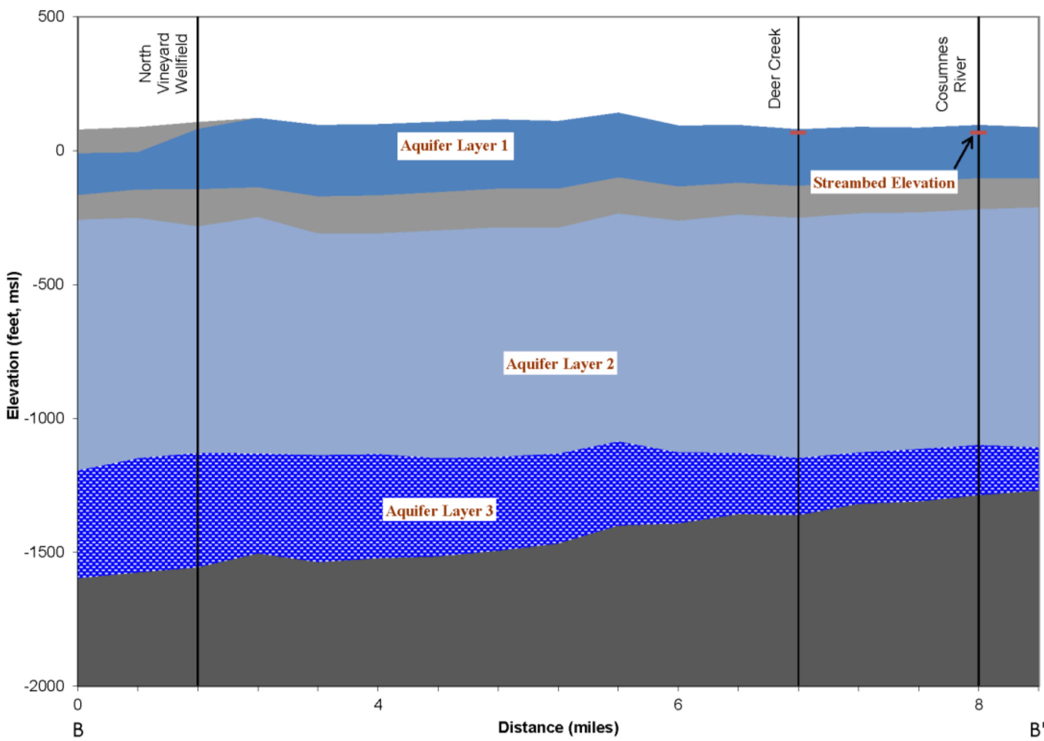
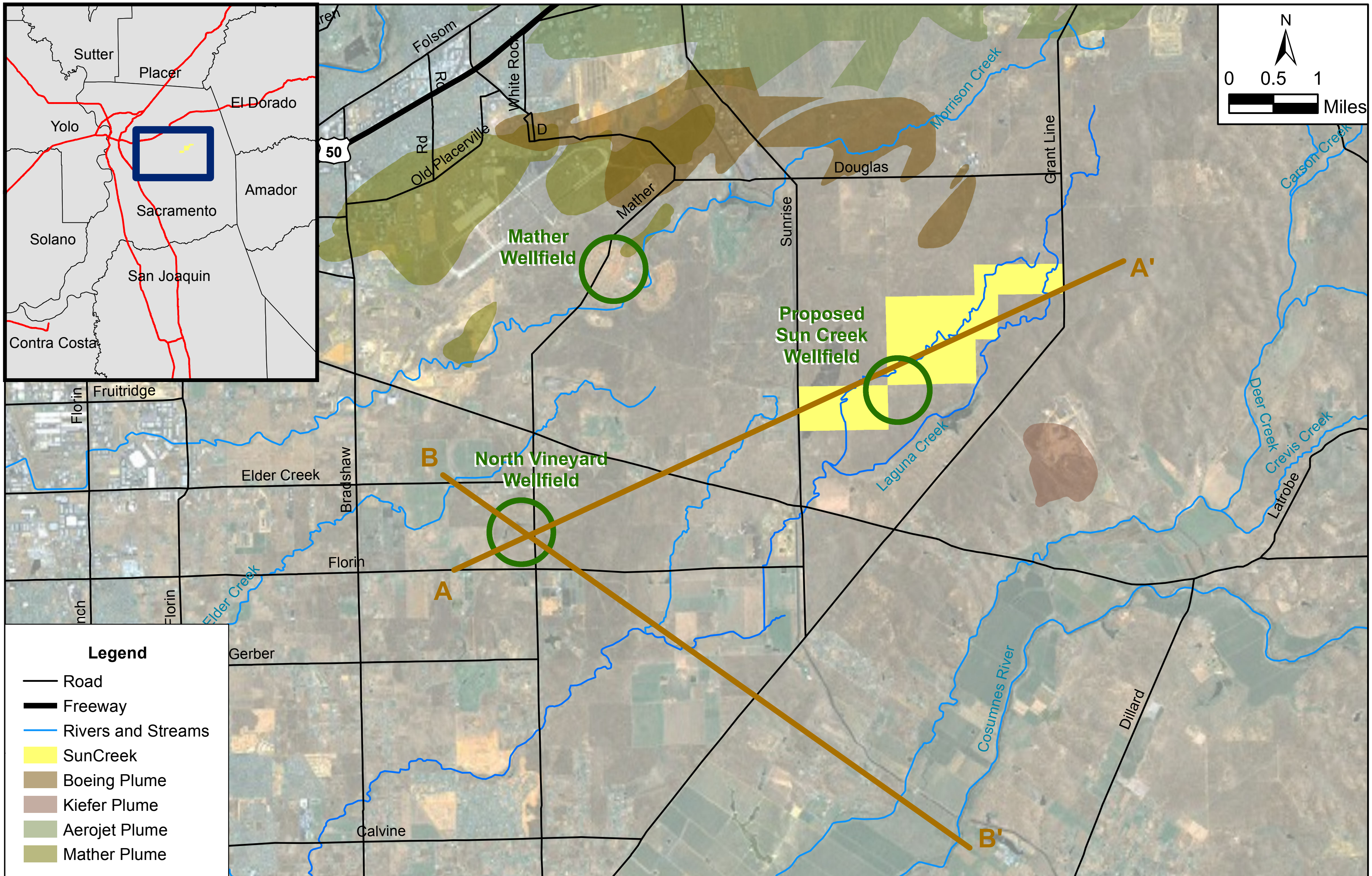


Figure 3-2 Schematic Cross-Section B – B′



Cross-Section Locations

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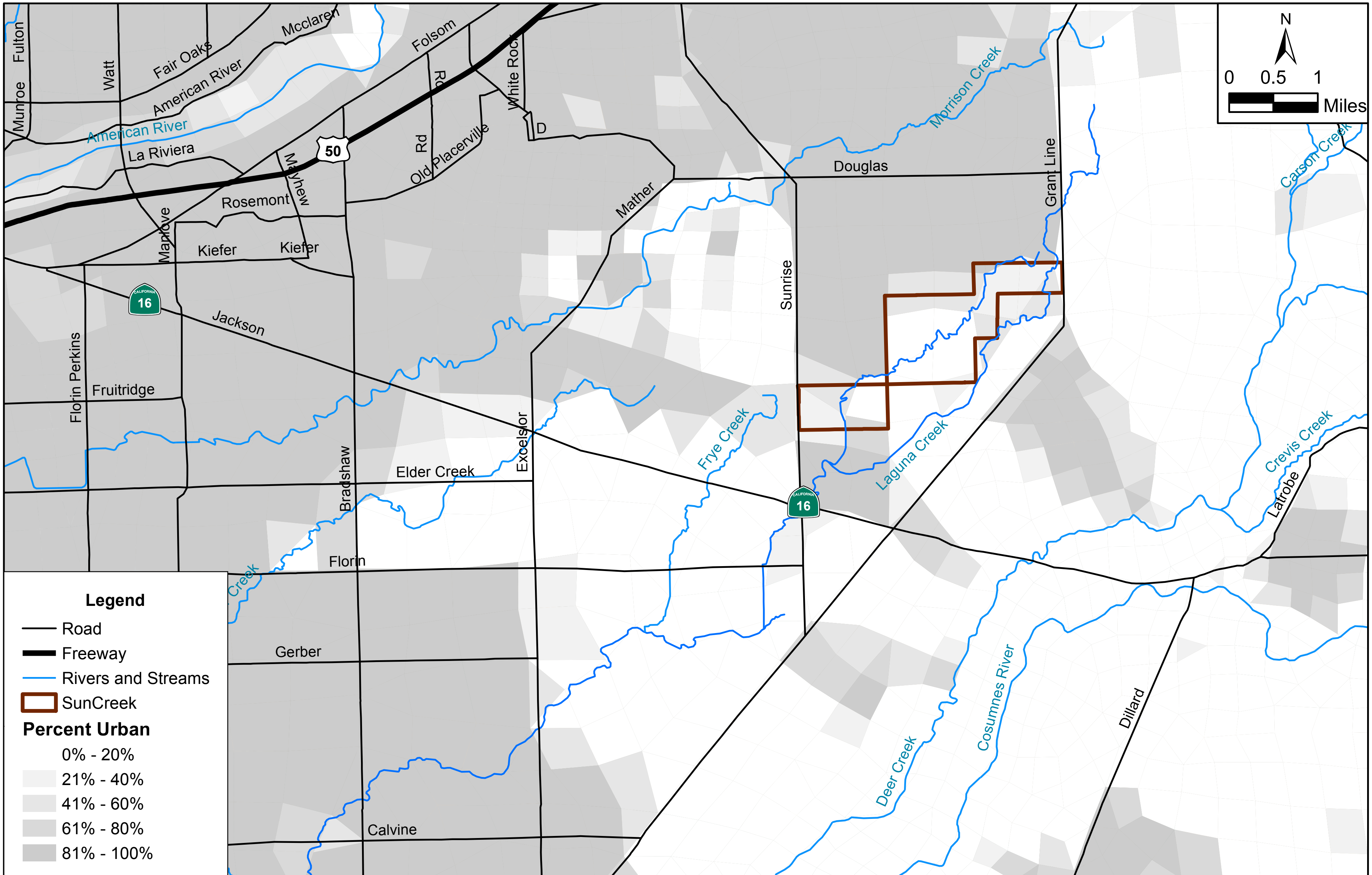
Figure 3-3

BASELINES

To model the project at the point of maximum impact, two development levels were selected: buildout and 2015 conditions. SunCreek buildout is projected by 2031 and represents the largest amount of impervious surfaces, resulting in precipitation being routed to storm sewers rather than to evapotranspiration, runoff, and aquifer recharge. The Future Conditions baseline is used for the analysis of buildout conditions at SunCreek. Year 2015 represents the end of Phase I of the water supply and the largest planned SunCreek demand while solely relying on groundwater (immediately prior to the completion of surface water conveyance infrastructure and the delivery of surface water). The selection of 2015 is considered conservative in that *Technical Memorandum No. 2, Groundwater Specific Demands, Sun Creek Specific Plan* (MacKay & Somps, 2011) (TM2) indicates surface water availability by 2013. Thus, the 2015 modeling includes higher demands and higher groundwater needs than is indicated in TM2. The 2015 baseline is used for the analysis of 2015 conditions at SunCreek. These two baselines are used for comparison to determine the incremental impacts of the project and land use alternatives at these critical stages of development and water supply.

FUTURE CONDITIONS BASELINE

The Future Conditions Baseline for this project is based on the most recent SacIWRM future conditions baseline, which was updated for the central portion of Sacramento County in the winter of 2008/2009. It includes information contained in the *Zone 40 Water Supply Master Plan* (Sacramento County Water Agency, 2005) and in the *Zone 40 Water System Infrastructure Plan* (WSIP) (Sacramento County Water Agency, 2006). The SacIWRM future conditions baseline was analyzed to ensure that the model represents the latest understanding of future conditions in the NSA. The urbanized area and total water demands were altered for use in this project to remove SunCreek, which was already factored into the future conditions baseline. Prior to removing SunCreek development from the future conditions baseline, demands matched the Zone 40 WSIP value of 32,982 acre-feet per year (AFY). After removing SunCreek development, NSA demands were reduced to 29,924 AFY. A map of the simulated urbanized area is shown in Figure 3-4 and a summary of water supply conditions is shown in Table 3-1.



Simulated Urbanized Area, Future Conditions Baseline

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Figure 3-4

Table 3-1
Summary of NSA Water Supply Conditions Under Future Conditions Baseline (AFY)

Item	Zone 40 WSIP		Future Conditions Baseline		Future Conditions Baseline With SunCreek Removed	
Year Type:	*Dry Years*	*Wet Years*	*Dry Years*	*Wet Years*	*Dry Years*	*Wet Years*
NSA Total Water Demand	32,982	32,982	32,982	32,982	29,924	29,924
NSA Total Water Supply	33,750	37,500	32,982	32,982	29,924	29,924
Groundwater for Anatolia WTP	2,215	0	1,447	0	1,161	0
Groundwater for Mather WTP	0	0	0	0	0	0
Groundwater for SunCreek WTP	0	0	0	0	0	0
Surface Water Supplies	31,535	37,500	31,535	32,982	28,763	29,924

WTP = Water Treatment Plant

Confirmation of the future conditions baseline's water supply came from three primary sources:

- WSIP: Zone 40 Water System Infrastructure Plan (Sacramento County Water Agency, 2006)
- MWS: The Water Master Study for the SunCreek Specific Plan (Sacramento County Water Agency, 2008)
- TM2: Technical Memorandum No. 2, Groundwater Specific Demands, Sun Creek Specific Plan (MacKay & Somps, 2011)

NSA water demands are presented in TM2, based on 2009 and 2010 projections from the MWS, 2031 projections from the WSIP, and interpolation between those years. Water supply sources (groundwater and surface water treatment plants) are also developed in TM2 based on the information in the WSIP. These numbers, however, are Maximum Day Demands (developed to allow for the proper design of the water supply infrastructure). To determine Average Day Demands, the demand data may be divided by two. However, the operation of the water supplies to meet demands on an annual basis requires only a portion of the total supplies, which are designed to meet that Maximum Day Demand. The choice of supplies on a day-to-day basis is a function of policy and operational needs.

Section 4 of the WSIP presents the mix of NSA projected buildout surface water and groundwater supplies on an average annual basis for dry years and wet years:

- Dry years
    - 2,215 AFY groundwater
    - 31,535 AFY surface water

- Wet years
    - 0 AFY groundwater
    - 37,500 AFY surface water

Section 3 of the WSIP presents the NSA projected buildout demands on an average annual basis: 32,982 AFY. The Future Conditions Baseline matches this buildout demand, with an average annual demand of 32,982 AFY for the NSA prior to the removal of SunCreek from the baseline.

As total supply exceeds total demand in the WSIP, an assumption is applied that surface water supplies will be used prior to groundwater supplies. Thus, at buildout water demand and water supplies in the Future Conditions Baseline, surface water can provide all water to the NSA during wet years and must be supplemented with less than 2,000 AFY of groundwater in dry years, as shown in Table 3-1.

Although planning documents support a low level of pumping, modeling at buildout includes the planned groundwater facilities pumping at full capacity (Maximum Groundwater Usage Scenarios) to investigate impacts at this higher level of production.

2015 Conditions Baseline

The 2015 Conditions Baseline is based on the most recent SacIWRM existing conditions baseline. As with the future conditions baseline, the existing conditions baseline was most recently updated for the central portion of Sacramento County in the winter of 2008/2009 and includes information contained in the *Zone 40 Water Supply Master Plan* (Sacramento County Water Agency, 2005) and in the *Zone 40 Water System Infrastructure Plan* (Sacramento County Water Agency, 2006).

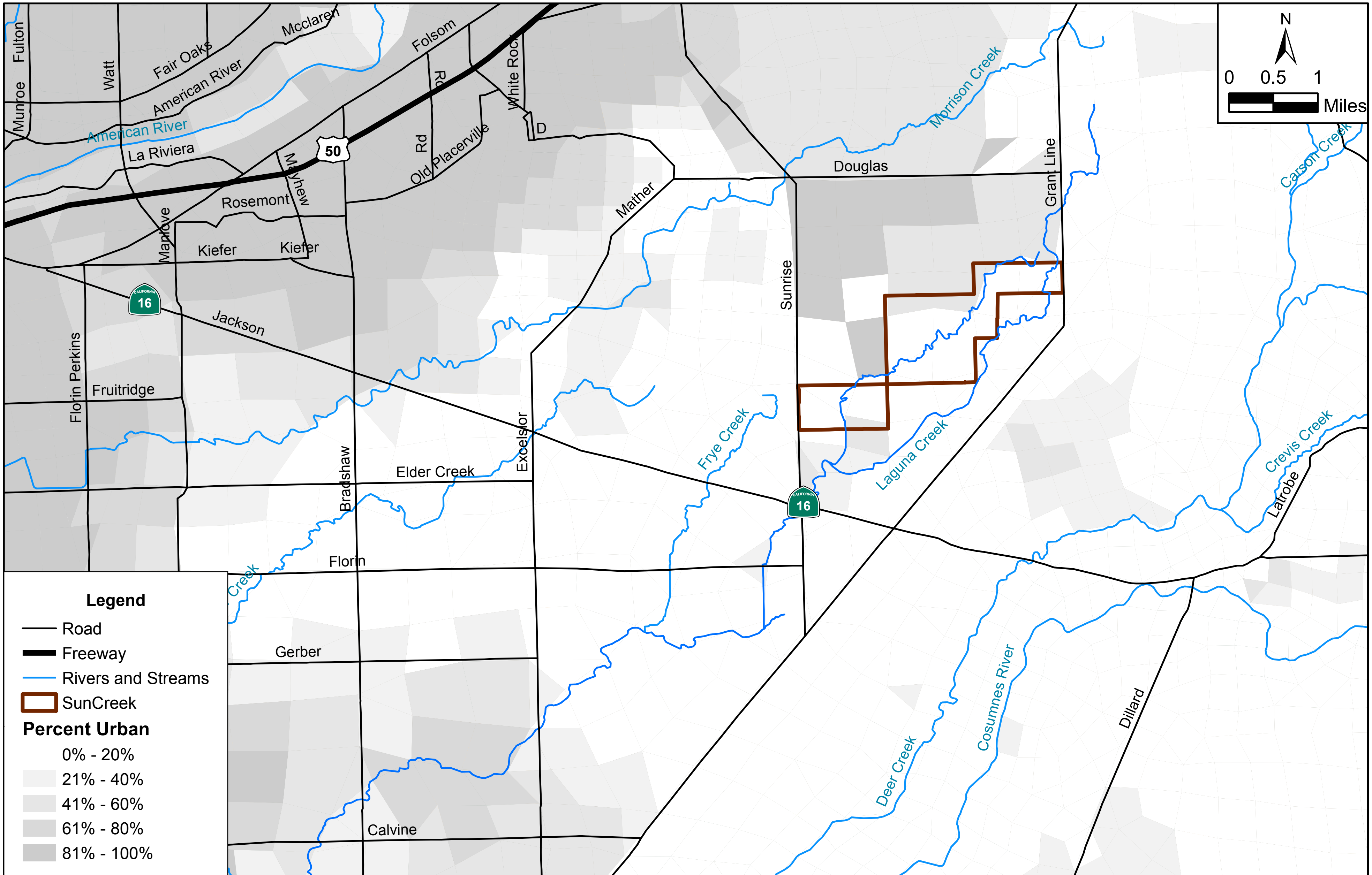
The existing conditions baseline was analyzed to ensure that the model represents the latest understanding of 2015 conditions in the NSA. The urbanized area and total water demands for the most recent existing conditions baseline were altered for use in this project to add projects in the NSA that are likely to be partially developed by 2015 and that would be consistent with the NSA water demands listed in TM2. TM2 shows groundwater meeting all demands in the NSA through 2012; however this analysis takes a conservative approach and utilizes 2015 as the largest all-groundwater demand in the NSA. 2015 was selected as surface water demands shown in TM2 for earlier years are less than the design capacity of the proposed SunCreek Wellfield (4 mgd). Thus, there is the potential for an all groundwater supply to continue through 2015, similar to Scenario 5 discussed in TM2. Beyond 2015, surface water would be required, and the arrival of the large surface water pipeline would dramatically reduce municipal groundwater usage.

Unlike in the Future Conditions Baseline, development in the SunCreek area did not require removal from the existing conditions baseline, as this land is designated as native vegetation in the existing conditions baseline. A summary of water supply conditions is shown in Table 3-2 and a map of the simulated urban area is shown in Figure 3-5. Figure 3-6 shows the simulated urban area under the existing conditions baseline. Total NSA water demand is based on values presented in TM2. It should be noted that the maximum day demand used as the basis for the total demand in 2015, 20.18 mgd, is slightly higher than the value presented in TM2, 20.02 mgd, due to later revisions in TM2. The 20.18 mgd value is slightly higher and thus more conservative. The annual average demand was developed by converting the maximum day demand for the NSA without the proposed SunCreek project at 2015 (i.e., 20.18 mgd reduced by 0.55 mgd) to average day demand by dividing by two and converted from mgd to acre-feet.

The distribution of groundwater production between the different wellfields and groundwater treatment plants is based on focusing pumping in single locations to the extent possible to look at impacts to groundwater resources. The Mather Wellfield is modeled as continuing to pump as modeled in the Existing Conditions Baseline; Mather Wellfield water would not be used to supply SunCreek. All additional groundwater production is focused at the North Vineyard Wellfield and the Anatolia WTP. Concentration of production at the North Vineyard Wellfield is considered more conservative than spreading the supply across the 3 wellfields; no other wellfield has the capacity to meet the additional demand by itself. The SunCreek wellfield was not utilized as the project will only be 10 percent built out by 2015 and the buildout area does not include the well sites. Further, Sacramento County has indicated that reimbursement for these well facilities would be slow as the county focuses on obtaining surface water for the NSA rather than construction of new groundwater facilities. Thus, groundwater production is assumed to continue at current levels from the Mather WTP, with all new water supplied from the North Vineyard Wellfield supplying the Anatolia WTP. It should be noted that the impacts of full operation of the SunCreek Wellfield are explored under the Maximum Groundwater Usage Scenarios.

Table 3-2 Summary of NSA Water Supply Conditions Under 2015 Baseline

Item	Existing Conditions Baseline	2015 Baseline
NSA Water Demand	2,278 AFY	11,002 AFY
Groundwater for Anatolia WTP	952 AFY	9,676 AFY
Groundwater for Mather WTP	1,326 AFY	1,326 AFY
Groundwater for SunCreek WTP	0 AFY	0 AFY
Surface Water Supplies	0 AFY	0 AFY



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Simulated Urbanized Area, 2015 Conditions Baseline

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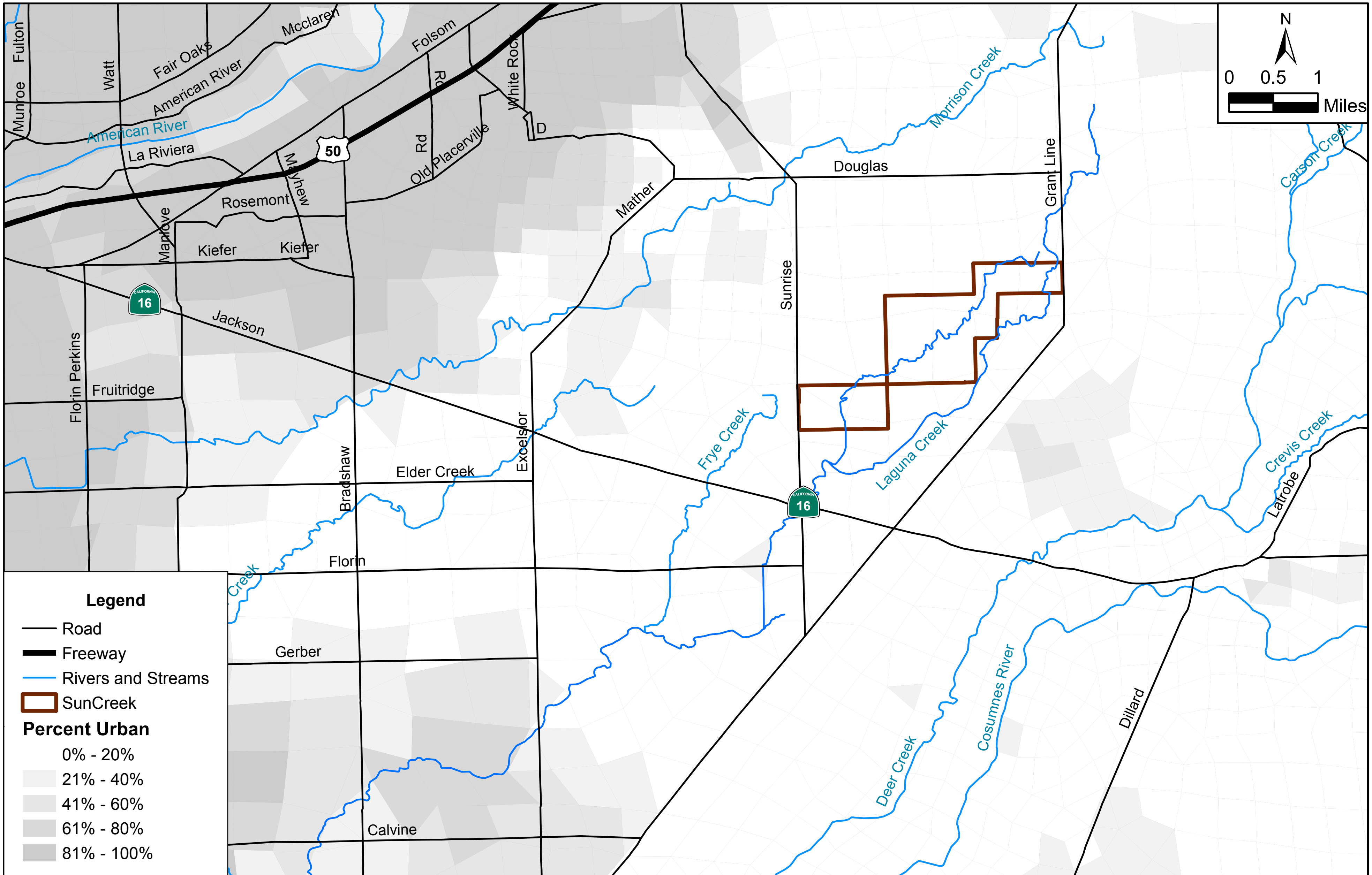
Figure 3-5



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Simulated Urbanized Area, Existing Conditions Baseline

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Figure 3-6

SECTION 4 DEFINITION OF MODEL SCENARIOS

The SunCreek planning documents (MacKay & Somps, 2011; supported by Sacramento County Water Agency, 2008) include five land use alternatives and five water supply scenarios. All five land use scenarios were simulated, but only under the most conservative water supply scenarios.

The five water supply scenarios are based on the development of surface water resources for the NSA. The SunCreek Specific Plan calls for phased development of the area through 2031. The phasing allows for construction and operation of infrastructure to bring surface water to the NSA. Due to uncontrollable uncertainties on the overall development of the NSA, which is needed to fund surface water infrastructure, three different water supply scenarios were developed:

- Accelerated Construction of the NSA Pipeline
    - Initial surface water deliveries in 2012
    - Maximum NSA groundwater production of 10.3 million gallons per day (mgd) (Maximum Day Demand)
- Delayed Construction of the NSA Pipeline
    - Initial surface water deliveries in 2013
    - Maximum NSA groundwater production of 14.92 mgd (Maximum Day Demand)
- Conversion of the Raw Groundwater Transmission Pipeline
    - Initial surface water deliveries in 2012
    - Maximum NSA groundwater production of 10.3 million gallons per day (mgd) (Maximum Day Demand)

The Delayed Construction of the NSA Pipeline water supply scenario has greater impacts to the groundwater and surface water resources than the other scenarios due to the later arrival of surface water and the higher reliance on groundwater. Therefore, of these, only the Delayed Construction scenario was simulated. These were simulated under 2015 conditions to be conservative, as earlier delivery of surface water reduces the impacts on groundwater. The 2015 Conditions Scenarios analyze impacts at this time period for the five land use alternatives:

- Proposed Project 2015 Conditions
- Agency Conceptual Alternative 2015 Conditions
- Biological Impact Minimization Alternative 2015 Conditions
- No USACE Permit Alternative 2015 Conditions

- Increased Development Alternative 2015 Conditions

Additional water supply scenarios were developed with the intent of analyzing the impact of utilizing groundwater production facilities to the fullest extent. Four scenarios are presented, modeled under future conditions:

- Maximum Groundwater Without Project
- Maximum Groundwater With Proposed Project
- Maximum Groundwater With No USACE Permit Alternative
- Maximum Groundwater With Increased Development Alternative

The two remaining land use alternatives, Biological Impact Minimization and Agency Conceptual Alternative, were not modeled as the impacts are bracketed by the Proposed Project, which is larger and has a higher demand and water usage, and the No USACE Permit Alternative, which is smaller and has a lower demand and water usage.

The five land use scenarios share the following common assumptions in the model:

- Urban land use, including residential, commercial, and irrigated parkland and schools, is 60 percent impervious.
- Other land uses are 0 percent impervious and include wetlands, wetland buffers, detention basin, and canals.
- Overall water demand is split between 46 percent indoor use and 54 percent outdoor use, on an annual average. This is variable throughout the year, with higher percent outdoor use in the summer and higher percent indoor use in the winter.
- Storm water is discharged to Laguna Creek, which flows to Morrison Creek and the Sacramento River. Laguna Creek is not tributary to the Cosumnes River.
- Sanitary sewer is discharged to the Sacramento River at the Sacramento Regional Wastewater Treatment Plant.

Additional details relating to the level of development at buildout and at 2015 for the five land use alternatives are provided in the following subsections.

LAND USE ALTERNATIVES

PROPOSED PROJECT

Buildout Conditions

The proposed land use and water demand at buildout for the Proposed Project is shown in Table 4-1, based on data provided in TM2 (MacKay & Somps, 2011). The table organizes land use into categories recognized by the SacIWRM: urban land uses and unirrigated open space (native vegetation). These acreages were incorporated into the SacIWRM by assigning each model element with the percentages of each appropriate land use. The annual average water demand in the SacIWRM for this scenario matches the 3,058 AFY value indicated in Table 4-1.

Table 4-1 Land Use and Water Demand at Buildout for Proposed Project

Land Use	Acres	Annual Average Water Demand (AFY)
Urban Land Uses		
Low Density Residential	*169.4*	*489.6*
Medium Density Residential	*322.7*	*1194.0*
Compact Density Residential	*20.1*	*74.4*
High Density Residential	*34.6*	*142.6*
Commercial Mixed Use	*31.9*	*80.1*
Local Town Center	*59.4*	*149.1*
Public/Quasi-Public	*13.0*	*13.5*
School	*110.9*	*383.7*
Minor Roads	*23.2*	*0*
Major Roads	*79.0*	*0*
Community Park	*43.1*	*149.1*
Neighborhood Park	*44.0*	*152.2*
Neighborhood Green	*4.3*	*14.9*
Parkway, Paseos and Trails	*9.1*	*1.9*
Subtotal Urban Land Uses	964.7	2845.1
Unirrigated Open Space		
Wetland Preserve	*203.7*	*0*
Preserve Buffer	*45.2*	*0*
Detention Basin	*46.9*	*0*
Storm water Canal	*5.0*	*0*
Subtotal Unirrigated Open Space	300.8	0
Total	**1265.5**	**2845.1**
With 7.5 Percent System Loss		**3058.5**

This water demand is met by surface water supplies and groundwater supplies from the Vineyard Wellfield in the same proportions as utilized under the Future Conditions Baseline.

2015 Conditions

Land and water use at 2015 conditions for the Proposed Project are based on the 2015 demand values presented in TM2 (MacKay & Somps, 2011). That document lists a 10 percent buildout of SunCreek by 2015, with a Maximum Daily Demand of 0.55 mgd. The average annual demand is 308 AFY, which meets urban demand focused in a footprint within Phase I of the project, in the southwestern portion of the project area (bounded on the west by Sunrise Blvd. and on the north by Kiefer Blvd.) and in the northwestern section of the middle portion of the project area (near the intersection of Rancho Cordova Parkway and Campus Drive). This water demand is modeled as met by groundwater supplies from the Vineyard Wellfield.

Land use in within SunCreek at 2015 conditions for the Proposed Project was simulated as 9 percent urban.

AGENCY CONCEPTUAL STRATEGY ALTERNATIVE

Buildout Conditions

The Agency Conceptual Strategy Alternative conforms slightly better to the Conceptual Level Strategy for the project than the Proposed Project does (MacKay & Somps, 2011). The proposed land use and water demand at buildout for the Agency Conceptual Strategy Alternative is shown in Table 4-2, based on data provided in MacKay & Somps' TM2 (2011). The table organizes land use into categories recognized by the SacIWRM: urban land uses and unirrigated open space (native vegetation). These acreages were incorporated into the SacIWRM by assigning each model element with the percentages of each appropriate land use. The annual average water demand for this alternative in the SacIWRM is 2,951 AFY, matching the value shown in Table 4-2.

Table 4-2 Land Use and Water Demand for the Agency Conceptual Strategy Alternative

Land Use	Acres	Annual Average Water Demand (AFY)
Urban Land Uses		
Low Density Residential	*141.5*	*408.9*
Medium Density Residential	*410.9*	*1520.3*
Compact Density Residential	*18.5*	*68.5*
High Density Residential	*12.5*	*51.5*
Commercial Mixed Use	*10.9*	*27.4*
Local Town Center	*0*	*0*
Public/Quasi-Public	*7.2*	*7.5*
School	*108.4*	*375.1*
Minor Roads	*0*	*0*
Major Roads	*117.5*	*0*
Community Park	*74.2*	*256.7*
Neighborhood Park	*7.8*	*27.0*
Neighborhood Green	*0*	*0*
Parkway, Paseos and Trails	*11.6*	*2.4*
Subtotal Urban Land Uses	921	2745.3
Unirrigated Open Space		
Wetland Preserve	*310.2*	*0*
Preserve Buffer	*13.0*	*0*
Detention Basin	*14.9*	*0*
Storm water Canal	*6.4*	*0*
Subtotal Unirrigated Open Space	344.5	0
Total	**1265.5**	**2745.3**
With 7.5 Percent System Loss		**2951.2**

This water demand is met by surface water supplies and groundwater supplies from the Vineyard Wellfield in the same proportions as utilized under the Future Conditions Baseline.

2015 Conditions

Land and water use at 2015 conditions for the Agency Conceptual Strategy Alternative are based on the 2015 demand values presented in TM2 (MacKay & Somps, 2011). That document lists a 10 percent buildout of SunCreek by 2015, with a maximum daily demand of 0.53 mgd. The average annual demand is 297 AFY, which meets urban demand focused in a footprint within Phase I of the project, in the southwestern portion of the project area (bounded on the west by Sunrise Blvd. and on the north by Kiefer Blvd.) and in the northwestern section of the middle portion of the project area (near the intersection of Rancho Cordova Parkway and Campus Drive). This water demand is modeled as met by groundwater supplies from the Vineyard Wellfield.

Land use in SunCreek at 2015 conditions for the Agency Conceptual Strategy Alternative was simulated as 9 percent urban.

BIOLOGICAL IMPACT MINIMIZATION ALTERNATIVE

Buildout Conditions

The Biological Impact Minimization Alternative represents a significantly less intense development plan as compared to the Proposed Project (MacKay & Somps, 2011). The proposed land use and water demand at buildout for the Biological Impact Minimization Alternative is shown in Table 4-3, based on data provided in TM2 (MacKay & Somps, 2011). The table organizes land use into categories recognized by the SacIWRM: urban land uses and unirrigated open space (native vegetation). These acreages were incorporated into the SacIWRM by assigning each model element with the percentages of each appropriate land use. The annual average water demand under this scenario in the SacIWRM is 2,670 AFY, matching the value shown in Table 4-3.

Table 4-3 Land Use and Water Demand for the Biological Impact Minimization Alternative

Land Use	Acres	Annual Average Water Demand (AFY)
Urban Land Uses		
Low Density Residential	*166.7*	*481.8*
Medium Density Residential	*391.3*	*1447.8*
Compact Density Residential	*11.6*	*42.9*
High Density Residential	*6.2*	*25.5*
Commercial Mixed Use	*0*	*0*
Local Town Center	*0*	*0*
Public/Quasi-Public	*4.1*	*4.3*
School	*52.0*	*179.9*
Minor Roads	*0*	*0*
Major Roads	*98.8*	*0*
Community Park	*78.3*	*270.9*
Neighborhood Park	*8.3*	*28.7*
Neighborhood Green	*0*	*0*
Parkway, Paseos and Trails	*6.7*	*1.4*
Subtotal Urban Land Uses	824	2483.2
Unirrigated Open Space		
Wetland Preserve	*411.1*	*0*
Preserve Buffer	*14.6*	*0*
Detention Basin	*15.8*	*0*
Storm water Canal	*0*	*0*
Subtotal Unirrigated Open Space	441.5	0
Total	**1265.5**	**2483.2**
With 7.5 Percent System Loss		**2669.4**

This water demand is met by surface water supplies and groundwater supplies from the Vineyard Wellfield in the same proportions as utilized under the Future Conditions Baseline.

2015 Conditions

Land and water use at 2015 conditions for the Biological Impact Minimization Alternative are based on the 2015 demand values presented in TM2 (MacKay & Somps, 2011). That document lists a 10 percent buildout of SunCreek by 2015, with a maximum daily demand of 0.48 mgd. The average annual demand is 269 AFY, which meets urban demand focused in a footprint within Phase I of the project, in the southwestern portion of the project area (bounded on the west by Sunrise Blvd. and on the north by Kiefer Blvd.) and in the northwestern section of the middle portion of the project area (near the intersection of Rancho Cordova Parkway and Campus Drive). This water demand is modeled as met by groundwater supplies from the Vineyard Wellfield.

Land use in SunCreek at 2015 conditions for the Biological Impact Minimization Alternative was simulated as 8 percent urban.

NO USACE PERMIT ALTERNATIVE

Buildout Conditions

The No USACE Permit Alternative is less intense than both the Proposed Project and the Biological Impact Minimization Alternative (MacKay & Somps, 2011). The proposed land use and water demand for the No USACE Permit Alternative at buildout is shown in Table 4-4, based on data in TM2 (MacKay & Somps, 2011). The table organizes land use into categories recognized by the SacIWRM: urban land uses and unirrigated open space (native vegetation). These acreages were incorporated into the SacIWRM by assigning each model element with the percentages of each appropriate land use. The annual average water demand under this alternative in the SacIWRM is 2,034 AFY, matching the value shown in Table 4-4.

Table 4-4 Land Use and Water Demand for the No USACE Permit Alternative

Land Use	Acres	Annual Average Water Demand (AFY)
Urban Land Uses		
Low Density Residential	*54.3*	*156.9*
Medium Density Residential	*287.1*	*1062.3*
Compact Density Residential	*97.7*	*361.5*
High Density Residential	*18.1*	*74.6*
Commercial Mixed Use	*6.7*	*16.8*
Local Town Center	*0*	*0*
Public/Quasi-Public	*4.8*	*5.0*
School	*29.0*	*100.3*
Minor Roads	*0*	*0*
Major Roads	*108.6*	*0*
Community Park	*32.2*	*111.4*
Neighborhood Park	*1.0*	*3.5*
Neighborhood Green	*0*	*0*
Parkway, Paseos and Trails	*0.6*	*0.1*
Subtotal Urban Land Uses	640.1	1892.4
Unirrigated Open Space		
Wetland Preserve	*607.0*	*0*
Preserve Buffer	*3.3*	*0*
Detention Basin	*14.3*	*0*
Storm water Canal	*0.8*	*0*
Subtotal Unirrigated Open Space	625.4	0
Total	**1265.5**	**1892.4**
With 7.5 Percent System Loss		**2034.3**

This water demand is met by surface water supplies and groundwater supplies from the Vineyard Wellfield in the same proportions as utilized under the Future Conditions Baseline.

2015 Conditions

Land and water use at 2015 conditions for the No USACE Permit Alternative are based on the 2015 demand values presented in TM2 (MacKay & Somps, 2011). That document listed a 10 percent buildout of SunCreek by 2015, with a maximum daily demand of 0.36 mgd. The average annual demand is 202 AFY, which meets urban demand focused in a footprint within Phase I of the project, in the southwestern portion of the project area (bounded on the west by Sunrise Blvd. and on the north by Kiefer Blvd.) and in the northwestern section of the middle portion of the project area (near the intersection of Rancho Cordova Parkway and Campus Drive). This water demand is modeled as met by groundwater supplies from the Vineyard Wellfield.

Land use in SunCreek at 2015 conditions for the No USACE Permit Alternative was simulated as 6 percent urban.

INCREASED DEVELOPMENT ALTERNATIVE

Buildout Conditions

The Increased Development Alternative represents a more intense development plan as compared to the Proposed Project (MacKay & Somps, 2011). The proposed land use and water demand at buildout for the Increased Development Alternative is shown in Table 4-5, based on data provided in TM2 (MacKay & Somps, 2011). The table organizes land use into categories recognized by the SacIWRM: urban land uses and unirrigated open space (native vegetation). These acreages were incorporated into the SacIWRM by assigning each model element with the percentages of each appropriate land use. The annual average water demand for the Increased Development Alternative in the SacIWRM is 3,478 AFY, matching the value shown in Table 4-5.

Table 4-5 Land Use and Water Demand for the Increased Development Alternative

Land Use	Acres	Annual Average Water Demand (AFY)
Urban Land Uses		
Low Density Residential	*609.8*	*1762.3*
Medium Density Residential	*173.0*	*640.1*
Compact Density Residential	*0*	*0*
High Density Residential	*31.4*	*129.4*
Commercial Mixed Use	*17.7*	*44.4*
Local Town Center	*0*	*0*
Public/Quasi-Public	*0*	*0*
School	*94.4*	*326.6*
Minor Roads	*0*	*0*
Major Roads	*145.8*	*0*
Community Park	*96.0*	*332.2*
Neighborhood Park	*0*	*0*
Neighborhood Green	*0*	*0*
Parkway, Paseos and Trails	*0*	*0*
Subtotal Urban Land Uses	1168.1	3235
Unirrigated Open Space		
Wetland Preserve	*97.4*	*0*
Preserve Buffer (WB)	*0*	*0*
Detention Basin (DB)	*0*	*0*
Storm water Canal	*0*	*0*
Subtotal Unirrigated Open Space	97.4	0
Total	**1,265.5**	**3,235.0**
With 7.5 Percent System Loss		**3,477.6**

This water demand is met by surface water supplies and groundwater supplies from the Vineyard Wellfield in the same proportions as utilized under the Future Conditions Baseline.

2015 Conditions

Land and water use at 2015 conditions for the Increased Development Alternative are based on the 2015 demand values presented in TM2 (MacKay & Somps, 2011). That document lists a 10 percent buildout of SunCreek by 2015, with a maximum daily demand of 0.62 mgd. The average annual demand is 347 AFY, which meets urban demand focused in a footprint within Phase I of the project, in the southwestern portion of the project area (bounded on the west by Sunrise Blvd. and on the north by Kiefer Blvd.) and in the northwestern section of the middle portion of the project area (near the intersection of Rancho Cordova Parkway and Campus Drive). This water demand is modeled as met by groundwater supplies from the Vineyard Wellfield.

Land use in SunCreek at 2015 conditions for the Increased Development Alternative was simulated as 10 percent urban.

2015 CONDITIONS SCENARIOS

As discussed in Section 3, 2015 represents the end of Phase I of the water supply and the largest planned SunCreek demand while solely relying on groundwater (immediately prior to the completion of surface water conveyance infrastructure and the delivery of surface water). The 2015 Conditions Scenarios analyze impacts at this time period for the five land use alternatives:

- Proposed Project 2015 Conditions
- Agency Conceptual Alternative 2015 Conditions
- Biological Impact Minimization Alternative 2015 Conditions
- No USACE Permit Alternative 2015 Conditions
- Increased Development Alternative 2015 Conditions

All scenarios are based on the 2015 Conditions Baseline. The modeled NSA water supply for this baseline and five land use alternatives are shown in Table 4-6.

Table 4-6
Summary of NSA Water Supply Conditions Under
2015 Conditions Scenarios (AFY)

Item	2015 Conditions Baseline	Proposed Project 2015 Conditions	Agency Conceptual Alternative 2015 Conditions	Biological Impact Minimization Alternative 2015 Conditions	No USACE Permit Alternative 2015 Conditions	Increased Development Alternative 2015 Conditions
NSA Total Water Demand	11,002	11,310	11,299	11,271	11,204	11,349
NSA Total Water Supply	11,002	11,310	11,299	11,271	11,204	11,349
Groundwater for Anatolia WTP	9,676	9,984	9,973	9,945	9,878	10,023
Groundwater for Mather WTP	1,326	1,326	1,326	1,326	1,326	1,326
Groundwater for SunCreek WTP	0	0	0	0	0	0
Surface Water Supplies	0	0	0	0	0	0

MAXIMUM GROUNDWATER USAGE SCENARIOS

Well facilities are anticipated to be constructed with a capacity that exceeds the average annual demand on these facilities. Extra capacity is required to allow for peaking and for redundancy in the event of a loss of a portion of the overall water supply. While not anticipated, the following scenarios explore the impact of these groundwater facilities operating at full capacity at buildout conditions, with peaking and redundancy provided by surface water. Four scenarios are developed:

- Maximum Groundwater Without Project
- Maximum Groundwater With Proposed Project
- Maximum Groundwater With No USACE Permit Alternative
- Maximum Groundwater With Increased Development Alternative

All scenarios are based on the Future Conditions Baseline as the NSA under the 2015 Baseline has insufficient demand for the full groundwater supply. The two remaining land use alternatives, Biological Impact Minimization and Agency Conceptual Alternative, were not modeled as the impacts are bracketed by the Proposed Project, which is larger and has a higher demand and water usage, and the No USACE Permit Alternative, which is smaller and has a lower demand and water usage.

The Maximum Groundwater scenario simulates maximum groundwater usage for the project area. All scenarios include the Vineyard Wellfield pumping at the full 8.92 mgd (10,000 AFY) and the Mather Wellfield pumping at the full 6 mgd (6,726 AFY). The SunCreek Wellfield pumps at the full 4 mgd (4,484 AFY) for all scenarios except Maximum Groundwater Without Project. Surface water meets any remaining demand. Demands are based on the land use alternative, as discussed previously in this section. The modeled NSA water supply for the Future Conditions Baseline, without-project scenario, and five land use alternatives are shown in Table 4-7.

Table 4-7
Summary of NSA Water Supply Conditions Under
Maximum Groundwater Usage Scenarios (AFY)

Item	**Future Conditions Baseline**		**Maximum Groundwater without Project**	**Maximum Groundwater with Proposed Project**	**Maximum Groundwater with Agency Conceptual Alternative**	**Maximum Groundwater with Biological Impact Minimization Alternative**	**Maximum Groundwater with No USACE Permit Alternative**	**Maximum Groundwater with Increased Development Alternative**
Year Type:	*Dry Years*	*Wet Years*	*All Years*	*All Years*	*All Years*	*All Years*	*All Years*	*All Years*
NSA Total Water Demand	29,924	29,924	29,924	32,982	32,875	32,594	31,958	33,402
NSA Total Water Supply	29,924	29,924	29,924	32,982	32,875	32,982	31,958	33,402
Groundwater for Anatolia WTP	1,161	0	10,000	10,000	10,000	10,000	10,000	10,000
Groundwater for Mather WTP	0	0	6,726	6,726	6,726	6,726	6,726	6,726
Groundwater for SunCreek WTP	0	0	0	4,484	4,484	4,484	4,484	4,484
Surface Water Supplies	28,763	29,924	13,198	11,772	11,665	11,772	10,748	12,192

NSA: North Service Area
WTP: Water Treatment Plant

Model scenarios were developed by adding the proposed land use alternatives at the appropriate level of development to the corresponding baseline. This section describes the simulated impacts to groundwater flow direction and groundwater flow gradient through text and tables. No groundwater quality modeling was performed as part of this analysis. Instead, groundwater flow directions and groundwater gradients were identified. The velocity of groundwater flow varies linearly with the groundwater gradient through the equation:

$$v = \frac{K\left(\frac{dh}{dl}\right)}{n_e}$$

where:

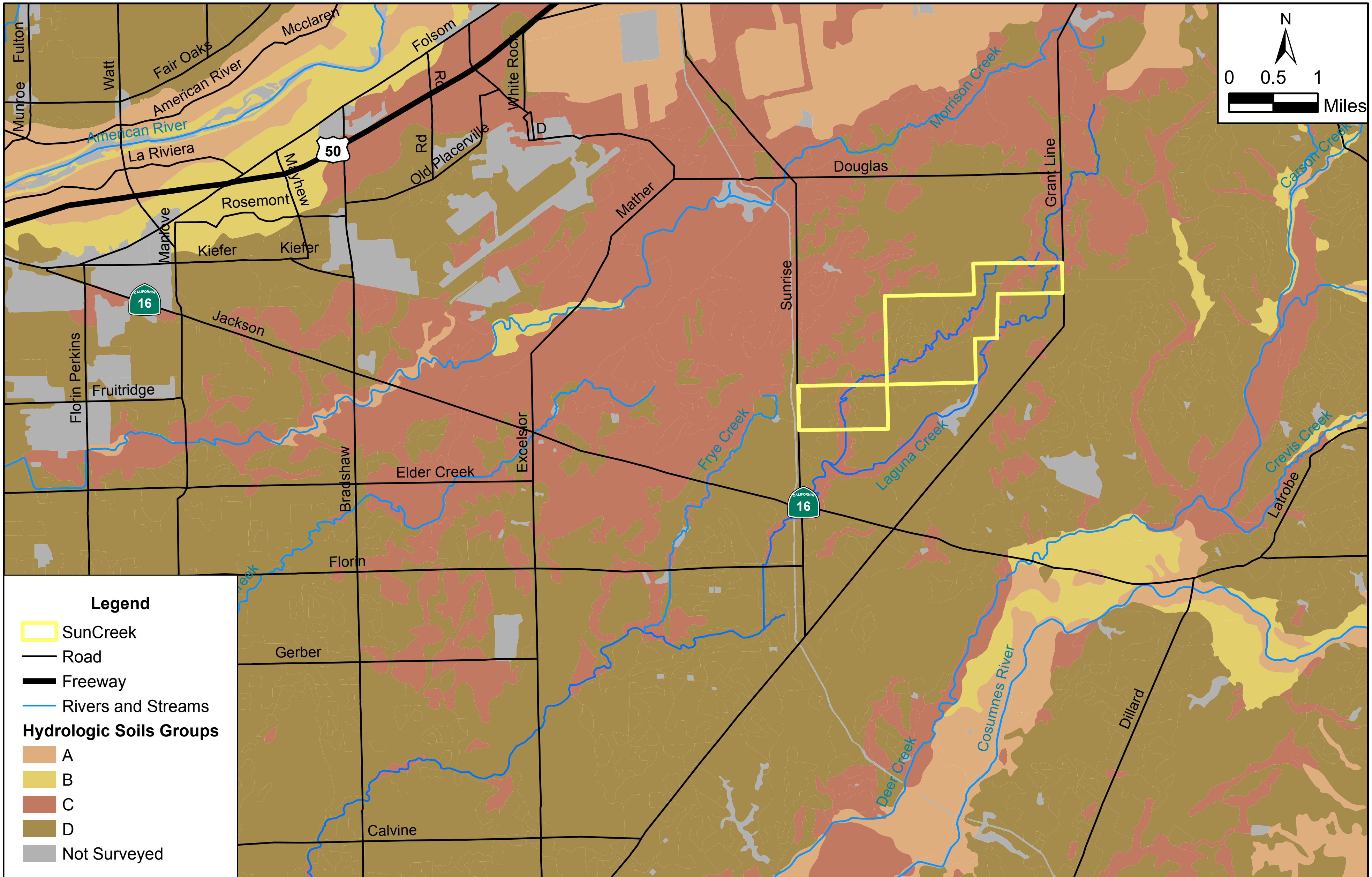
- v is the groundwater velocity
- K is the hydraulic conductivity
- $\frac{dh}{dl}$ is the groundwater gradient
- n_e is the effective porosity.

These simulated impacts are caused by the change to the amount of impervious surfaces as well as by the change to water supplies and water usage.

Impervious Surface Impacts

By itself, an increase in impervious surfaces decreases groundwater levels. However, existing soil conditions at SunCreek do not allow significant infiltration to groundwater, even in undeveloped conditions. Figure 5-1 shows soils conditions as represented by the U.S. Department of Agriculture's hydrologic soil groups in the *Soil Survey of Sacramento County, California* (Tugel, 1993). The hydrologic soil groups were developed from water intake estimates during the latter part of a storm of long duration, after the soil profile is wet and has an opportunity to swell, without the protective effect of any vegetation. Also considered in the classification are depths to the seasonal high water table and to a low permeability layer. Under the hydrologic soil group classification system, soils are grouped A to D with A having the lowest runoff potential (highest infiltration rates) and D having the highest runoff potential (lowest infiltration rates). Figure 5-1 indicates that Type D soils cover most of the SunCreek site. Some Type C soils are along creeks in areas that generally will remain undeveloped.

The SacIWRM estimates that only 0.4 inches of precipitation per year infiltrate to the groundwater under undeveloped conditions, with the remaining water running off (4.4 inches per year) or consumed through evapotranspiration (15.3 inches per year). Thus, impacts from increased impervious surfaces due to development at the SunCreek site will be smaller than would be expected in areas with higher permeability soils.



Hydrologic Soil Groups

January 2013

Figure 5-1

Water Use Impact

Urban land uses result in application of water, in addition to precipitation, for outdoor use. A portion of this water (reduced by the soils conditions described above), reaches the aquifer. This increases groundwater levels in the vicinity of the project. Indoor use does not impact local groundwater or surface water as this water is simulated as discharged to the Sacramento River at the Sacramento Regional Wastewater Treatment Plant.

BASELINES

Two baselines were used for comparison of project impacts on groundwater and surface water, as described in Section 3: Future Conditions Baseline and 2015 Conditions Baseline. The Future Conditions Baseline and 2015 Conditions Baseline are compared to the existing condition baseline to show the impact of changes in development, water supply, and water use to groundwater flow direction and groundwater flow gradients.

Comparison shows that changes in groundwater flow direction and gradients are small and unlikely to impact containment of regional contaminant plumes. Changes in flow direction and gradients at selected regional contaminant plumes are shown in Table 5-1, based simulated fall 2004 conditions. Note that conditions vary across these large plumes, including localized groundwater capture, and the information presented are generalized regional-level estimates.

Table 5-1
Flow Direction and Gradient near Regional Contaminant Plumes, Normal Conditions, Future Conditions, 2015 Conditions, and Existing Conditions Baseline, Layer 1

	Flow Direction			Gradient (-)		
Plume	Existing Conditions Baseline	Future Conditions Baseline	2015 Conditions Baseline	Existing Conditions Baseline	Future Conditions Baseline	2015 Conditions Baseline
Aerojet	SW	SW	SW	0.0015	0.0015	0.0016
Boeing	SW	SW	SW	0.0022	0.0017	0.0009
Kiefer Landfill	*	*	*	*	*	*
Mather Field	SSW	SW	SW	0.0005	0.0012	0.0006

* Layer 1 is unsaturated at Kiefer Landfill

2015 CONDITIONS SCENARIOS

Five model scenarios were developed based on SunCreek 2015 conditions using the 2015 baseline described in Section 3. The scenarios represent the impacts of five potential land use scenarios under the Delayed Construction of the NSA Pipeline water supply scenario at 2015. The scenarios are summarized in Section 4. The simulated impacts to groundwater flow direction and groundwater flow gradients are developed through the comparison of the Proposed Project at 2015 to no-project (2015 baseline) conditions.

Comparison shows only small changes in groundwater flow direction or gradient. Changes in flow direction and gradients at selected regional contaminant plumes are shown in Table 5-2, based on the simulated fall 2004 conditions. Note that, given the similarity of results for all project scenarios, only the Proposed Project is shown in Table 5-2. Also note that conditions vary across these large plumes, including localized groundwater capture, and the information presented in Table 5-2 are generalized regional-level estimates. Given the similar gradients and flow directions between baseline and proposed project conditions, as well as the current level of capture of existing treatment systems, any migration of plumes at Aerojet, Boeing, Kiefer Landfill, or Mather Field is unlikely to be altered as a result of the Proposed Project.

Table 5-2
Flow Direction and Gradient near Regional Contaminant Plumes, Normal Conditions, Proposed Project at 2015 Conditions Compared to 2015 Baseline, Layer 1

Plume	Flow Direction		Gradient (-)	
	2015 Conditions Baseline	Proposed Project at 2015 Conditions	2015 Conditions Baseline	Proposed Project at 2015 Conditions
Aerojet	SW	SW	0.0016	0.0016
Boeing	SW	SW	0.0009	0.0009
Kiefer Landfill	*	*	*	*
Mather Field	SW	SW	0.0006	0.0006

* Layer 1 is unsaturated at Kiefer Landfill

MAXIMUM GROUNDWATER USAGE SCENARIOS

Model scenarios were developed to simulate the impacts of utilizing groundwater to the fullest ability of the existing and proposed infrastructure. These scenarios are based on the Future Conditions Baseline, adjusted to pump the North Vineyard Wellfield and the Mather Wellfield at full capacity, reducing the amount of surface water delivered to the North Service Area. This new scenario is the Maximum Groundwater Without Project scenario.

Incremental impacts from the addition of the project and the project wellfield are simulated with the SunCreek wells pumping at the full capacity. Water is supplied to the North Service Area, reducing the need for surface water. Three land use alternatives are modeled: Proposed Project, No USACE Permit, and Increased Development. All alternatives utilize the full groundwater supply; variability in demand between the land use scenarios is reflected in variability in surface water supplies to meet the total demand above the available groundwater supply.

The simulated impacts to groundwater flow direction and groundwater flow gradients are developed through the comparison of the project conditions to no-project (Maximum Groundwater Without Project) conditions.

Comparison shows only small changes in groundwater flow direction or gradient. Changes in flow direction and gradients at selected regional contaminant plumes are shown in Table 5-3, based simulated fall 2004 conditions. Note that conditions vary across these large plumes, including localized groundwater capture, and the information presented are generalized regional-level estimates. Given the similar gradients and flow directions between baseline and proposed project conditions, as well as the current level of capture of existing treatment systems, any migration of plumes at Aerojet, Boeing, Kiefer Landfill, or Mather Field is unlikely to be altered as a result of the Proposed Project.

Table 5-3
Flow Direction and Gradient near Regional Contaminant Plumes, Normal Conditions, Maximum Groundwater Usage Scenarios, Layer 1

Plume	Flow Direction					Gradient (-)				
	Future Conditions Baseline	Max GW Without Project	Max GW With Proposed Project	Max GW With No USACE Permit Alternative	Max GW With Increased Development Alternative	Future Conditions Baseline	Max GW Without Project	Max GW With Proposed Project	Max GW With No USACE Permit Alternative	Max GW With Increased Development Alternative
Aerojet	SW	SW	SW	SW	SW	0.0015	0.0021	0.0022	0.0022	0.0022
Boeing	SW	SW	SW	SW	SW	0.0017	0.0021	0.0022	0.0022	0.0022
Kiefer Landfill	*	*	*	*	*	*	*	*	*	*
Mather Field	SW	S	S	S	S	0.0012	0.0013	0.0013	0.0013	0.0014

* Layer 1 is unsaturated at Kiefer Landfill

Max GW = Maximum Groundwater

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APPENDIX B

Materials Submitted by SCAS

SACRAMENTO COUNTY AIRPORT SYSTEM

Memorandum

January 9, 2013

TO: Bret Samson, Planning Department – City of Rancho Cordova
Lauren Hocker, Associate Environmental Analyst –County of Sacramento

FROM: Greg Rowe, Senior Environmental Analyst – Planning and Environment
Sacramento County Airport System

SUBJECT: **FAA Regulations and Policies Relative to Local Land Use Decisions Near Public Use Airports With Respect to Proposed Projects Near Mather Airport (MHR)**

This memo summarizes current and pending Federal Aviation Administration (FAA) regulations, policies and guidance for local land use decisions having the potential to effect safe airport operations.[1] It also summarizes noise and hazardous wildlife concerns specific to Mather Airport (MHR). A list of current Federal Aviation Administration (FAA) land use and hazardous wildlife documents is at the end of this memo. The information provided herein is intended to inform the review and analysis of the Specific Plan and General Plan Amendment processes for a number of proposed development projects near MHR, including but not limited to NewBridge, Jackson Township and SunCreek.

In summary, the FAA and the Sacramento County Airport System (County Airport System or SCAS) are generally concerned about the following aspects of proposed development projects near the four airports comprising the County Airport System, and McClellan Airport (which SCAS manages for another County agency). As a standard procedure, we request that the CEQA and NEPA analyses of such projects examine these factors in detail.

- <u>Open Space, Wildlife Habitat Preserves and Wetlands:</u> New development often includes open space dedicated to preserving and enhancing existing wildlife habitat, and creation of new habitat as a required compensatory mitigation measure. Depending on the design parameters, such features could potentially attract wildlife hazardous to civil and military aircraft operations at airports owned and operated by the County of Sacramento (County).

- <u>Detention Basins</u>: Due the County's general flat topography, many new development projects include stormwater facilities to collect and store stormwater runoff. The FAA regards detention and retention basins as potential hazardous wildlife attractants. The

[1] This is an updated version of a memo initially provided to County Planning and DERA staff in July 2011.

"Drainage Master Plan" section for such projects often provide for on-site storage of stormwater for extended periods coupled with habitat enhancement. Storage facilities are often termed "detention basins" when in fact they match the FAA's definition of "retention basins." The FAA criteria for detention basins require complete drainage within 48 hours after a storm event ends. If drainage takes longer, the facility is more accurately defined as a "retention" basin and is therefore a potential hazardous wildlife attractant.

- Aviation Activity: Project descriptions and environmental documents often fail to take into account the actual type and frequency of aircraft activity at airports. We have found this to occasionally be case with respect to MHR. In such cases we request that the environmental documentation include an analysis of current and projected military, cargo, flight training ("touch-and-go") and flight test operations.

Overview of Incompatible Land Use Near Airports

Noise and building height restrictions near airports have traditionally been the most common land use compatibility considerations addressed in urban and regional planning. Land uses that can induce hazardous wildlife activity near airports are a relatively new but growing public safety concern. Airports and the land surrounding them are highly sensitive and valuable resources in which the FAA and local governments such as the County of Sacramento have made considerable investments. Incompatible land uses around an airport, however, can affect the efficient operation of aircraft. Local land use decisions having aviation noise and hazardous wildlife implications can result in permanent incompatibility with continued airport operations.

One of the greatest challenges confronting public-use airports[2] in California is continued encroachment pressure by incompatible and land uses. Individual incompatible land uses near an airport may appear to have a negligible influence on air navigation and airport utility, but collectively over time, land use decisions made without adequate consideration of aircraft operating requirements can not only restrict airport activity or expansion, but also result in undesired repercussions on residents and wildlife.

Policies promulgated by the FAA place significant expectations upon local land use authorities for careful evaluation of proposed changes in land use near airports. The FAA's 2009 revised guidance for FAA personnel on compatible land use and air space protection points out that "The legal structure of airport ownership will determine its power to regulate or influence land uses around the airport. Municipalities or counties with this regulatory authority need to be aware of existing and long-term airport development plans and the importance of using that

[2] Defined by the FAA as an airport used or intended to be used for public purposes, and of which the area used for landing, taking off, or surface maneuvering of aircraft may be under the control of a public agency or privately owned and used for public purposes (49 USC, Section 47102[21]).

authority to minimize development of incompatible land uses."[3] As noted below, recently issued FAA documents further emphasize the expectation that local land use agencies devote attention to potentially incompatible land uses near airports, particularly features that can attract hazardous wildlife.

Noise effects associated with aircraft operations and prevention of the growth or establishment of obstructions in an airport's approach and departure airspace have been the traditional focus of land use planning near airports. It is now well recognized, however, that certain land uses and activities near airports can have unintended consequences such as inducing higher populations of wildlife species, thereby increasing the hazards to aircraft operations in an airport's approach and departure airspace and air operations area (AOA).[4] As stated in a report to the U.S. House of Representatives in early 2009 following the forced landing of US Airways Flight 1549 in the Hudson River, "As aircraft traffic has increased, so too have wildlife 'strikes,' or collisions. Populations of many large bird species have also increased."[5]

The FAA has determined that the risk of wildlife strikes to aircraft has increased in recent years. A "Cert Alert" issued by the FAA on June 11, 2009[6] stated that many populations of wildlife species commonly involved in strikes have increased markedly in the past three decades and have adapted to living in urban environments, including near airports. Other factors contributing to the bird-aircraft strike hazard (BASH) include:

- Thirteen of the 14 North America bird species with average body mass greater than eight pounds showed significant population increases from 1970 to the early 1990s.[7] For example, from 1980 to 2009, the non-migratory Canada goose population in the USA and Canada increased at a mean rate of 13.3 percent per year.[8]
- Commercial air traffic increased from 17.8 million aircraft movements (landings or takeoffs) in 1980 to over 25.2 million in 2011, and is projected to continue growing at an annual rate of 1.2 percent to 37 million movements by 2030.[9]

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[3] *FAA Airport Compliance Manual*. Order 5190.6B. September 30, 2009, page 20-4. The *Airport Compliance Manual* is a handbook that provides guidance to FAA personnel on interpreting and administering the various continuing commitments that airport sponsors made to the United States government when they accept grants of federal funds or federal property for airport purposes.

[4] The FAA defines hazardous wildlife as species of wildlife (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard.

[5] "US Airways Flight 1549 Accident." Report to the House of Representatives Committee on Transportation and Infrastructure, February 23, 2009, p. 5.

[6] FAA Safety and Operations Division. Cert Alert No. 09-10, June 11, 2009. "Wildlife Hazard Assessments in Accordance with Part 139 Requirements," page 1. As an example, from 1980 to 2006, the non-migratory Canada goose population in the United States and Canada increased at an average (mean) rate of 7.3 percent annually.

[7] *Wildlife Strikes to Civil Aircraft in the United States, 1990-2011*. Federal Aviation Administration and United States Department of Agriculture, Animal and Plant Health Inspection Service – Wildlife Services (APHIS-WS). July 2012, page 2 (hereinafter "Wildlife Strikes, 2012").

[8] "Clarification of Wildlife Hazard Management Requirements for Non-Certificated Federally Obligated Airports in the National Plan of Integrated Airport Systems (NPIAS)." Federal Aviation Administration. *Federal Register*, Vol. 77, No. 237, December 10, 2012, page 73514 (hereinafter "Clarification of Wildlife Hazard Management Requirements").

[9] Wildlife Strikes, 2012, page 2.

- Wetland clean-up and creation efforts under the federal Clean Water Act have resulted in an expansion of wetland habitat supportive of growing bird populations.
- Bans on some pesticides have enabled bird populations to grow.
- Commercial air carriers have replaced older 3-and-4 engine fleets with quieter, more fuel-efficient 2-engine aircraft, making the loss of even one engine more critical when a bird strike occurs. In 1965 about 90 percent of the 2,100 passenger aircraft in the United States had 3 or 4 engines. By 2005 the passenger fleet had grown to about 8,200 aircraft, but only about 10 percent had 3 or 4 engines.[10]
- Birds are less able to detect and avoid modern turbofan-powered aircraft compared to aircraft equipped with older and noisier engine technology.[11]

<u>The Sacramento County Airport System (SCAS)</u>

The County operates five airports, which have a collective economic impact in excess of $3 billion annually (2008 dollars) and over 5,000 on-site jobs. Four airports comprise the County Airport System: Sacramento International, Sacramento Executive, Sacramento Mather, and Franklin Field. A fifth County airport, McClellan Field (MCC), is operated by the County Airport System on behalf of the County's Department of Economic Development.

All five County airports are operated in accordance with FAA regulations, orders, standards and grant assurance obligations as well as California Public Utilities Code (PUC) section 21670, the State Aeronautics Act. The primary federal requirements applicable to public-use airports holding an Airport Operating Certificate are embodied in the Code of Federal Regulations, Title 14 – Aeronautics and Space, Part 139 – Certification of Airports (14 CFR, Part 139). Airports that support regularly scheduled air carrier passenger flights (i.e. airline operations) are regulated by Part 139, Certification of Airports, Subpart D, and are therefore often referred to as "Part 139 airports" or Part 139 Certificated airports." Sacramento International is the County's only Part 139 airport.

The Sacramento County Airport System Policy Plan assigns complementary roles for each airport to optimize system-wide efficiency and serve the regional demand for aviation services. Sacramento International (SMF) is the region's primary air carrier passenger service airport, accommodating almost 5.38 million enplaned passengers in 2007 (although this number declined to 4.47 million in 2011). Sacramento Executive Airport (SAC) is a general aviation airport that also serves as a reliever airport for Sacramento International. SAC is owned by the City of Sacramento and operated by the County Airport System under an annually renewing 25-year lease. Sacramento Mather Airport (MHR), formally Mather Air Force Base, serves as the region's primary air cargo airport. Located in the southern County, Franklin Field (F72) is a small, non-staffed general aviation airport frequently used for flight training. With the exception of MCC,

[10] Wildlife Strikes, 2012, page 2.
[11] "Increasing Trend of Damaging Bird Strikes with Aircraft Outside the Airport Boundary: Implications for Mitigation Measures." Richard A. Dolbeer, *Human-Wildlife Interactions*, Fall 2011, p. 235 (hereinafter "Dolbeer, 2011").

the County's non-certificated airports are part of the FAA's National Plan of Integrated Airport Systems (NPIAS).[12]

Aviation Activity at Mather Airport

A number of large development projects proposed in recent years near MHR are within the "downwind" flight path for aircraft that often fly at relatively low altitude. In commenting on such projects and draft environmental documentation, the County Airport System's Aircraft Noise Information Office will usually provide a flight track analysis. The analysis involves placing a "penetration gate" centered over the project location, from which the distance of the proposed project from MHR is calculated. Flight tracks over and near proposed project sites are described using the factors described below. It is evident from this information that aircraft using MHR often fly at relatively low altitudes above the development projects currently being proposed to the south and east of MHR. Please note that the proposed NewBridge project is located west of Sunrise Boulevard in the County of Sacramento, and is contiguous to the east boundary of the proposed SunCreek project area.

- Arrivals: Arriving flights typically passing over or near a site are graphically depicted. In recent years it has been shown that a significant number of flights will occur above or near proposed development sites, such as NewBridge and Jackson Township, at altitudes between 500 and 4,000 feet above Mean Sea Level (MSL). For example, a NewBridge flight track analysis prepared in July 2011 for the month of April 2011 showed that 110 arriving flights passed within a one-mile radius of the site, of which 83 passed through the "gate" spanning the location. These flights occurred at elevations between 1,000 and 3,500 feet above Mean Sea Level (MSL).

- Departures: The flight track analyses also shows departures. The April 2011 NewBridge flight track analysis showed that 155 departures flew within a one-mile radius of the NewBridge site, and 121 penetrated the gate at elevations between 500 and 6,000 feet MSL.

- Cargo Aircraft Operations: Cargo aircraft operations typically occur at MHR during nighttime hours. Many will fly within a one-to-two mile radius of proposed project sites, typically at altitudes between 3,000 and 6,000 feet MSL. The aircraft conducting these operations are typically Boeing 757-200, Boeing 767-300 and Airbus 300F4-600, which are relatively large models compared to the most commonly used aircraft at SMF, the Boeing 737. Typical departure hours for these cargo aircraft are between 5:00 and 7:00 AM and between 7:00 and 11:00 PM.

[12] The 2013-17 NPIAS report to Congress classifies SAC and MHR as Reliever Airports and F72 as a General Aviation airport.

- Touch-and-Go (T&G) Analysis: MHR is used daily by the United States Air Force (USAF) for T&G flight training, typically using T38 high performance (capable of supersonic flight) jet aircraft and other aircraft [13] that usually originate at Beale Air Force Base.[14] MHR is particularly attractive for military flight training because its long runway (11,301 feet) accommodates a variety of aircraft. Such military aircraft do not have the same noise and emissions requirements as commercial aircraft. (Commercial aircraft standards are set by the International Civil Aviation Organization [ICAO], an affiliate of the United Nations.) During April of 2012, a total of 322 T&G flight tracks were recorded at MHR, of which 69 flew within a one-mile radius of the proposed NewBridge project site. (Note that one T&G flight track may in fact comprise multiple operations.) The recorded April 2011 flights typically passed over the NewBridge site at altitudes between 1,500 and 3,500 MSL.

- Other considerations:
    - Flight Testing: MHR is also used for flight testing of new aircraft models. For instance, the new Boeing 787 (B787) conducted flight testing operations at MHR during 2010, and during early July 2011 Boeing conducted flight tests of the new 747-8F freighter aircraft at MHR. (The B747-8 is an updated version of the aircraft first put into use in the 1970s, but with new technology, substantially larger dimensions and quieter engines.) Boeing is now selling both passenger and freighter (F) versions of the 747-8.

    - Other Military Use: During the summer of 2011 a KC-10 aerial refueler temporarily relocated from Travis Air Force Base to MHR for two weeks while runway repairs were made at Travis. Such temporary operations may occur at any time as deemed necessary by the military. The KC-10 is a large air-to-air tanker (i.e. it refuels other aircraft while flying) powered by three turbine (jet) engines. Because it is an older aircraft (manufactured 1979 – 1987), it is quite loud at takeoff. Over a two-week period, the KC-10 departed MHR as early as 5:00 AM to conduct refueling operations with military aircraft operating from Barkdale Air Force Base in Louisiana. The NewBridge, Jackson Township, SunCreek and other proposed developments near MHR could be subject to similar temporary military overflights in the future.

    - SMF Continuity of Operations Plan: in November 2008 the Sacramento County Board of Supervisors approved a Continuity of Operations Contingency Plan for Sacramento International Airport (SMF). The plan specifies that a limited volume of operations would be temporarily moved to Mather Airport (MHR) if a flood disrupted SMF operations. The County Airport System therefore typically re-

[13] Including MC-12 single engine turboprops, Kingair 250 turboprops, and an occasional U-2 “spy plane.”
[14] FAA Grant Assurance 27, “Use by Government Aircraft,” requires airports to make available to federal government aircraft all facilities developed with federal financial assistance and all those airport facilities usable for takeoff and landing.

quests that the environmental analysis of proposed development projects near MHR consider the potential noise, traffic and related associated with temporarily relocating commercial air service operations to MHR.

Airport Land Use Compatibility Plan (ALUCP)

In 1967, the California legislature authorized creation of Airport Land Use Commissions (ALUCs), for the purpose of protecting public health, safety, and welfare. ALUCs encourage orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public-use airports, to the extent that such areas are not already devoted to incompatible land uses. The law requires each County's ALUC to prepare an Airport Land Use Compatibility Plan (ALUCP) with a twenty-year planning horizon. Project proponents and Planning Commissions should likewise consult adopted ALUCPs when considering proposed projects near airports.

After an airport master plan is adopted, the Sacramento Area Council of Governments (SACOG), the region's ALUC, will initiate an update to the ALUCP as required by PUC section 21670. Such plans identify compatible and incompatible land uses arising from noise, safety, and height considerations, as recommended per the State of California's *Airport Land Use Planning Handbook* (revised October 2011). Once adopted, airport land use compatibility plans are incorporated into local (city or county) general plans.

The ALUCP adoption process is not always straightforward. In a 2006 report to the State Senate, the California Research Bureau noted that ALUCs and airport operators are confronted with two opposing forces that significantly influence airport operations and expansion[15]:

(1) pressure for communities to expand by developing open land near airports for residential and other high-density development; and
(2) the continuous need to make airport improvements and to expand airport capacity.

On April 19, 2006, the County Board of Supervisors adopted Airport Planning Policy Areas (APPAs) for Sacramento International, Sacramento Mather, and McClellan [16] as an interim effort to ensure airport land use compatibility during a period of rapid development that was outpacing the rate at which airport master plans, environmental documentation, and Airport Land Use Compatibility Plans could be updated. The Board directed that the APPAs be incorporated into the General Plan. The APPAs will continue to be used by SCAS in evaluating and commenting on proposed land use projects and activities near SMF, MCC and MHR.[17]

[15] California Research Bureau. *Growing Pains: Airport Expansion and Land Use Compatibility Planning in California.* September 2006.
[16] Resolution numbers 2006-0490, 2006-1378 and 2006-1379, adopted April 19, 2006
[17] An APPA is an area beyond the 60 Community Noise Exposure Level (CNEL) noise contour inside the County's jurisdiction, where residential development would be allowed but would require a disclosure notice to homebuyers and granting of an avigation easement to the County. The APPA does not restrict residential development, but ap-

FAA Requirements for Compatible Land Use and Airspace Protection

Although the FAA does not regulate or otherwise control local land use decisions, it does promulgate and monitor compliance with a number of Federal Aviation Regulations (FARs), Orders, Advisory Circulars and Certification Alerts (Cert Alerts) concerning land use compatibility on and near airports.[18] Perhaps most important, as an airport grant sponsor, the County of Sacramento is required to adhere to an extensive list of Grant Assurances to ensure continued FAA grant funding eligibility. (The City of Rancho Cordova is not bound by airport grant assurance requirements, but the FAA does expect airports operated by grant sponsors to review and comment on proposed developments near airports that may have the potential to impact airport operations, regardless of the political jurisdiction in which the proposed development is located. See details below.)

The FAA's expectations regarding local land use decisions focus on public use airports operated by public and private owners that receive federal grant-n-aid funds for airport capital improvements. Airport operators receiving such funds are defined by the FAA as "airport grant sponsors,"[19] and the associated airports are regarded by the FAA as "federally obligated airports." All four County Airport System airports, including MHR, are federally obligated. In effect since 1964, Grant Assurance 21, *Compatible Land Use*, requires in part that an airport grant sponsor "…take appropriate action, to the extent reasonable, including the adoption of zoning laws, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft."[20]

Although highly unlikely, the FAA may revoke a Part 139 airport's operating certificate if it determines the airport has created or failed to vigorously oppose the creation of hazard wildlife attractants on or near the airport. FAA safety certification personnel conduct periodic airport inspections to ascertain compliance with FAA regulations, policies and guidance. The FAA may periodically request documentation of airport comments on proposed projects, including draft CEQA and NEPA documents. (Recently released draft FAA guidance states that such documentation may be requested by FAA as part of an airport certification inspection, and that airport operators shall maintain a log of projects on which they have commented.)

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plies State guidance to address aircraft overflight and related noise beyond the normally mapped noise exposure contours by providing disclosure to potential homebuyers.

[18] An example is 14 CFR Part 77 – Objects Affecting Navigable Airspace.

[19] FAA Order 5190.6B became effective September 30, 2009, and replaced Order 5190.6A (October 1989). The Order further defines an "Airport Sponsor" as a public agency or tax-supported organization such as an airport authority, that is authorized to own and operate the airport, to obtain property interests, to obtain funds, and to be able to meet all applicable requirements of current laws and regulations both legally and financially (page 315). Hence, the County of Sacramento is the "Airport Sponsor" for federal grant-in-aid funds provided for capital improvements to any of the five airports operated by the County Airport System.

[20] Grant Assurance 21 is codified in Title 49 of the United States Code (U.S.C.), section 47107(a) (10).

Other FAA Grant Assurance Requirements

- Grant Assurance 19 – Operation and Maintenance. This requirement of grant sponsors (i.e. County of Sacramento) is particularly relevant to hazardous wildlife management. It states, in part, that "The airport and all facilities which are necessary to serve the aeronautical users of the airport...shall be operated at all times in accordance with the minimum standards as may be prescribed by applicable federal, state and local agencies. It will not cause or permit any activity thereon which would interfere with its use for airport purposes."
    - Proposed Revision of Grant Assurance 19: In its *Federal Register* notice of December 10, 2012, the FAA announced its intent to modify Grant Assurance 19, as it applies to non-Part 139 airports such as MHR, to include hazardous wildlife considerations as follows: "[The sponsor] will suitably operate and maintain the airport and all facilities or connected therewith, with due regard to issues including, but not limited to, climatic and flood conditions, and wildlife hazards."[21]

- Grant Assurance 27 – Use by Government Aircraft. As noted above, a significant number of military aircraft continue using MHR, primarily for training purposes. This activity occurs because Grant Assurance 27 requires, in part, that an airport recipient of federal financial assistance make the airport available in common use with other aircraft at all times for without charge by aircraft owned by the United States.

The role of airport sponsors such as the County of Sacramento in ensuring that land adjacent to or in the immediate vicinity of a federally obligated airport is consistent with safe airport operations is clearly articulated in the *FAA Airport Compliance Manual* (guidance for FAA personnel)*:* "Ensuring compatible land use near federally obligated airports is an important responsibility and an issue of federal interest," because airports in which the FAA has invested federal grant-in-aid funds are important components of the national aviation system.

FAA Order 5190.6B makes other important points regarding the responsibilities of an airport sponsor to protect airports from encroachment by incompatible land uses, including:

- "…to accommodate air traffic demand, maximum utility must be achieved from existing airports. For this to happen, the land use in the vicinity of airports must be reserved for compatible uses."
- Although residential housing has historically been regarded as among the most incompatible land uses near an airport, the FAA now recognizes that "Additional concerns include the airport's proximity to landfills and wetlands that may result in hazards to air navigation created by flocks of birds attracted to the landfills or wetlands."
- Airport sponsors are expected to take appropriate actions to zone and control existing and planned land uses to make them compatible with aircraft operations at the airport.
- "In all cases, the FAA expects a sponsor to take appropriate actions to the extent reasonably possible to minimize incompatible land."

[21] "Clarification of Wildlife Hazard Management Requirements," *Federal Register*, Vol. 77, No. 237, page 73513.

Hazardous Wildlife Considerations

Among the most stringent FAA regulations and policies governing airports providing regularly scheduled commercial airline service are those intended to minimize the impacts of hazardous wildlife. Collisions between wildlife and aircraft (strikes) have resulted in the loss of hundreds of lives worldwide, as well as billions of dollars in aircraft damage. According to the FAA National Wildlife Database (Wildlife Database), 119,917 reported wildlife strikes occurred in the United States during from 1990 through 2011, with 10,083 in 2011 alone.[22] Birds account for more than 97 percent of reported wildlife strikes.

More Strikes Are Occurring at Higher Elevations: Most bird strikes have historically occurred fairly close to the ground and near airports, but this dynamic has changed in recent years, partly due to successful efforts by airport operators in better managing property under airport control.[23] The percentage of strikes involving commercial air carriers operating at or above 500 feet above ground level (AGL) increased from about 25 percent in 1990 to 30 percent in 2009. The percentage of damaging strikes that occurred more than 500 feet AGL increased at a greater rate, from about 37 percent in the early 1990s, to 45 percent between 2005 and 2009.[24] This data means a higher percentage of reported bird strikes and damaging bird strikes are occurring at further distances from airport boundaries. In response to this data, the most recent annual FAA strike report stated, "To address this trend in strikes above 500 feet, the general public and aviation community must first widen its view of wildlife management to consider habitats and land uses within five miles of airports. Wetlands, dredge-spoil containment areas, municipal solid waste landfills, and wildlife refuges can attract hazardous wildlife. Such land uses…are often incompatible with aviation safety and should either be prohibited near airports or designed and operated in a manner that minimizes the attraction of hazardous wildlife."[25]

Reported Strikes Do Not Reflect Actual Strikes: The wildlife strike problem is more significant than the national data indicate because the FAA has historically estimated that only about 20 percent of wildlife strikes involving civil aircraft are reported to the Wildlife Database, and only about 44 percent of reported strikes identify the responsible wildlife species group.[26] The FAA estimates that wildlife strikes cost the civil aviation industry in the United States at least $500 million annually in direct damage and associated costs and over 500,000 hours of aircraft down time. Although the economic costs of wildlife strikes are extreme, the cost in human lives lost when airplanes crash as a result of wildlife strikes illustrates the need for comprehensive management of the wildlife strike problem, starting with appropriate local public policy decisions regarding land use activities and practices near airports.

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[22] Wildlife Strikes, 2012, page xii.
[23] Dolbeer, 2011, pages 235 and 240.
[24] Wildlife Strikes, 2012, pages 12-13.
[25] Wildlife Strikes, 2012, page 13.
[26] The FAA has estimated that the number of strikes reported has increased from 20 percent during the period from 1990-1994 to 39 percent from 2004-2008. "FAA Fact Sheet – FAA Wildlife Hazard Mitigation Program." January 14, 2010, page 2.

Land Uses Capable of Attracting Hazardous Wildlife: The requirements and recommendations of FAA Advisory Circular 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports"[27] (*Wildlife Hazards Advisory Circular*) has significant land use implications associated with the critical need to minimize risks caused by wildlife (particularly avian species) known to pose hazards to aircraft operations on or near airports.

Land uses cited by the FAA as likely to attract birds hazardous to aircraft include:

- wetlands and habitat preserves
- stormwater retention basins ("detention" facilities are defined by FAA as draining within 48 hours a storm event)
- sanitary landfills
- golf courses
- surface mining and dredging
- sewage treatment plants and settling ponds
- drinking water intake and treatment facilities
- agriculture (most crops can attract hazardous wildlife during some phase of production)

Synergistic Effects of Multiple Wildlife Attractants: All of the land use activities cited above can provide hazardous wildlife with ideal locations for feeding, resting, reproduction and escape from predators. Any one of these land uses in isolation may not necessarily attract sufficient numbers of hazardous wildlife to endanger aircraft operations. The risk to aviation can become acute, however, when one or more hazardous wildlife-inducing land uses near an airport are collectively aligned to create a wildlife movement corridor directly through the airport and/or surrounding airspace. (An example would be wetland habitat on one side of an airport and a food source such as agriculture on the opposite side of the airport.) Local land use planning decisions within the hazardous wildlife separation criteria specified by the FAA should therefore devote particular attention to the potential synergistic effects of multiple wildlife attractants surrounding airports.

Wildlife Hazard Management Plans: If an airport regulated by 14 CFR, Part 139 experiences one or more of the hazardous wildlife events or conditions specified in Part 139.337, the FAA may require the airport operator to adopt a Wildlife Hazard Management Plan (WHMP) in compliance with FAA guidelines. Such a plan must specify those measures the airport operator will implement to minimize hazardous wildlife threats. Sacramento International has had an FAA-approved WHMP since 1994 and is now revising the WHMP based on the results of a year-long Wildlife Hazard Assessment (WHA) completed in 2011 and accepted by the FAA in March 2012. The resulting new Wildlife Hazard Management Plan (WHMP) will be submitted to the FAA in early 2013.

[27] This FAA Advisory Circular is periodically updated, most recently on August 28, 2007. Analysis of proposed projects and land uses should rely upon the most recent version of the *Wildlife Hazards Advisory Circular*.

FAA is Strengthening Airport Hazardous Wildlife Management Requirements

On November 30, 2012 the FAA Office of Airport Safety and Standards released proposed revisions to several advisory circulars that address hazardous wildlife. The most important changes appear in revisions to Advisory Circular (AC) 150-5200-33C, *Hazardous Wildlife Attractants on or Near Airports*, and a new AC titled *Protocol for the Conduct and Review of Wildlife Hazard Site Visits, Wildlife Hazard Assessments, and Wildlife Hazard Management Plans*.[28] If adopted as proposed, these ACs will greatly expand the applicability of FAA's wildlife hazard management requirements to include many general aviation and reliever airports such as MHR and SAC.

These documents also reiterated the FAA's expectation that the sponsors of federal airport grants (such as the County of Sacramento) do more to reduce wildlife strikes. As recently stated in the *Federal Register,* "The FAA believes sponsors who accept new grants at Subject Airports need to be more proactive in the future and take steps to understand and alleviate the risks of wildlife strikes."[29] The FAA also recently clarified its interpretation of the phrase "farthest edge of the airport's Air Operations Area (AOA) in Advisory Circular 150/5200-33 ("Hazardous Wildlife on or Near Airports") to mean to the edge of the AOA closest to the wildlife attractant.[30] Such attractants could include any new stormwater management basins and habitat mitigation preserves within the new development projects proposed near MHR.

General Separation Criteria for Hazardous Wildlife Attractants on or Near Part 139 Airports

The FAA recommends the minimum separation criteria summarized below for private and public land-use practices that attract hazardous wildlife to the vicinity of airports, and states that hazardous wildlife attractants should be avoided, eliminated or mitigated[31] within these separation distances. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across an airport's approach or departure airspace or air operations area (AOA). The separation criteria are based on FAA regulations, but are generally related to the elevation at which aircraft commonly fly near airports and at which most strikes occur.

The FAA separation distances are based on: (1)flight patterns of piston-powered and turbine-powered aircraft; (2) the relatively low altitude at which most bird strikes occur (78 percent below 1,000 feet and 90 percent under 3,000 feet); and (3) recommendations of the National Transportation Safety Board. The County is the grant sponsor for FAA grant-in-aid funds to facilitate airport capital projects at the airports operated by the County Airport System. The County is therefore responsible for ensuring that land uses in and around airports within its jurisdiction comply with the hazardous wildlife exclusion areas specified in the FAA *Wildlife Haz-*

[28] The deadline for these and other draft recently released FAA documents is January 31, 2013.
[29] "Clarification of Wildlife Hazard Management Requirements," *Federal Register*, Vol. 77, No. 237, page 73513.
[30] "Clarification of Wildlife Hazard Management Requirements," page 73513.
[31] In FAA hazardous wildlife terminology, "mitigation" means as alleviating or reducing the hazardous wildlife attractant. It does not have the same meaning as "mitigation" for compensation for habitat impacts under the State or federal endangered species acts.

ards Advisory Circular, summarized below, and the revisions to this AC expected to be approved by the FAA later in 2013.

Paragraph 2 ("Applicability") of this AC states "Airports that have received Federal grant-in-aid assistance must use these standards." In its *Federal Register* notice of December 10, 2012, the FAA clarified this statement as follows: "The word 'standards' in this section of the AC refers to the separation criteria for proposed land use practices…The FAA considers the grant assurances to require federally funded airports to adhere to the separation criteria."[32]

- Perimeter A: The FAA recommends that airports (Part 139 airports or those subject to federal grant assurances) and/or airports serving piston-powered (propeller) aircraft maintain a minimum distance of 5,000 feet between the farthest edge of the Airport Operations Area (AOA)[33] and the nearest hazardous wildlife attractant.

- Perimeter B: The FAA recommends that airports (Part 139 airports or those subject to federal grant assurances) that serve turbine-powered (jet) aircraft maintain a minimum separation distance of 10,000 feet between the AOA and the nearest hazardous wildlife attractant. This area, sometimes referred to as the "Critical Zone," is generally the distance where aircraft in approach descend to an elevation below 500 feet AGL, where most bird strikes have historically occurred.[34]

- Perimeter C – Protection of Approach, Departure and Circling Airspace: For all airports (Part 139 airports or those subject to federal grant assurances), the FAA recommends a distance of five statute miles between the farthest edge of the AOA and hazardous wildlife attractants if the attractant could cause hazardous wildlife movement into or across approach or departure or circling airspace. Perimeter C is sometimes referred to as the "General Zone." The County Airport System is therefore required to review and prepare comments on proposed development plans, CEQA and NEPA scoping documents and draft environmental documents for proposed projects within five miles of the airports owned or operated by the County.

(FAA Regulations and Requirements Pertaining to Hazardous Wildlife

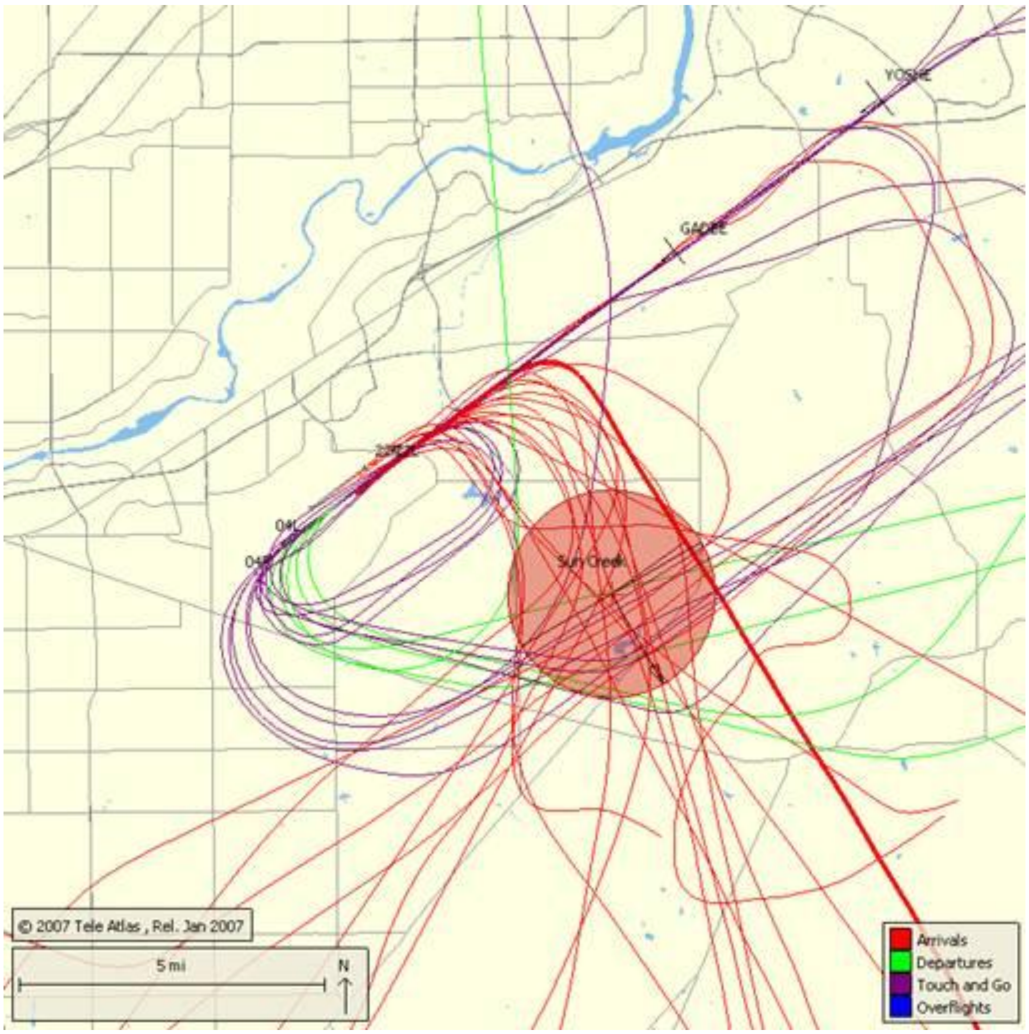
The FAA has developed numerous regulations, policies and guidance documents on minimizing bird strike hazards and habitat on or near airport lands. These documents include the following which should be considered in the environmental analysis (both CEQA and NEPA) for the various specific plans and General Plan amendments under consideration near MHR, and in the environmental analyses conducted pursuant to CEQA and NEPA.

[32] "Clarification of Wildlife Hazard Management Requirements," *Federal Register*, Vol.77, No. 237 page 73513.
[33] The FAA defines the AOA as any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An AOA includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, ramps or apron.
[34] Dolbeer, 2011, page 236.

- Code of Federal Regulations, Title 14, Part 139 – Certification of Airports (14 CFR Part 139, as amended February 2004. In particular, see Part 139.337 *Wildlife Hazard Management*.
- Advisory Circular 50/5200-33B, *Hazardous Wildlife Attractants on or Near Airports*, August 28, 2007 (replaces 33A published July 27, 2004, and all previous versions). Revision 33C was released for comment on November 30, 2012.
- FAA Certification Alert 06-07, *Requests by State Wildlife Agencies to Facilitate and Encourage Habitat for State-Listed Threatened and Endangered Species and Species of Special Concern on Airports,* November 21, 2006.
- FAA Advisory Circular 150/5200-32A, *Reporting Wildlife Aircraft Strikes*, December 22, 2004. Please note that version 32B was released for public comment on November 30, 2012.
- FAA Advisory Circular 150/5200-36A, *Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculum for Airport Personnel in Controlling Wildlife Hazards at Airports*. January 31, 2012).
- *Wildlife Hazard Management at Airports – A Handbook for Airport Personnel.* FAA Office of Airport Safety and Standards and United States Department of Agriculture (USDA), Animal and Plant Health Inspection Services (APHIS) - Wildlife Services, 2nd Edition July 2005.
- FAA Advisory Circular 150/5200-34 *Construction or Establishment of Landfills Near Public Airports*, August 26, 2000.
- FAA Advisory Circular 150/5300-13 *Airport Design*, Appendix 17, "Minimum Distances Between Certain Airport Features and Any On-Airport Agriculture Crops."
- FAA Order 5050.4B*, National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions*, April 28, 2006. Section 209.a – Wildlife Hazard Management Plans (WHMP) specifies that when the FAA Administrator determines that an airport must prepare a WHMP to address wildlife hazards, the airport must submit the WHMP to the FAA for approval prior to implementation.
- FAA Order 5190.6B (National Policy). *FAA Airport Compliance Manual*, September 30, 2009. Chapter 20 – "Compatible Land Use and Airspace Protection," describes local land use agency requirements.
- *Memorandum of Agreement Between the FAA, U.S. Air Force, U.S. Army, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture to Address Aircraft-Wildlife Strikes.* Signed by the agencies December 2002 - July 2003.
- Animal Damage Control Act, 7 USC, Section 426-426c, enacted in 1931 and amended in 1937 and 1991; grants the Secretary of Agriculture broad authority to investigate and control certain predatory and wild animals and nuisance mammals and birds.
- FAA Office of Airport Safety and Standards – Program Policies and Guidance, Airport Certification – 14 CFR 130; Policies 77, 78,79 and 82 specify procedures with regard to wildlife hazard management, waste disposal, and coordination with regard to the federal Endangered Species Act. These policies comprise Appendix D of the 2005 FAA-USDA Hazard Wildlife Management handbook referenced above.

Exhibit 1

Flight Tracks of 34 Flights Occurring Within 1.7-mile Radius of the Center of the Proposed SunCreek Project Area – May 1, 2007



Note: Overflights are aircraft flying through the airspace surrounding Mather Airport (MHR) but which did not land or takeoff from MHR.

Table 1

Proposed SunCreek Specific Plan Project

Aircraft Operations Within 1.7 mile radius of Center of Penetration Gate - May 1, 2007

Note: PCA in the last two columns stands for point-of-closest approach.

Actual Date/Time	Flight No	Runway N	Operation	Aircraft Ty	Operator (	AC Categ.	PCA Alt (ft)	PCA Timestamp
5/1/2007 3:47	UPS954	22L	A	B752	CAR	J	1,555	5/1/2007 3:44
5/1/2007 4:06	ABX1927	22L	A	B762	CAR	J	1,516	5/1/2007 4:03
5/1/2007 5:55	UPS2959	22L	D	B752	CAR	J	3,806	5/1/2007 5:57
5/1/2007 5:58	ABX1655	22L	D	B762	CAR	J	4,055	5/1/2007 6:00
5/1/2007 6:17	TN800MU	22L	A	H25B	GA	B	1,660	5/1/2007 6:15
5/1/2007 6:28	UPS2957	22L	D	A306	CAR	J	4,242	5/1/2007 6:30
5/1/2007 6:47	ABX806	22L	D	B762	CAR	J	4,744	5/1/2007 6:49
5/1/2007 7:14	-	22R	A	-	UNK	U	1,444	5/1/2007 7:11
5/1/2007 8:11	DNJ323	22L	A	E135	COM	R	2,185	5/1/2007 8:09
5/1/2007 8:39	-	22L	A	BE9L	GA	T	2,562	5/1/2007 8:37
5/1/2007 9:05	DNJ623	22L	A	E135	COM	R	1,841	5/1/2007 9:02
5/1/2007 13:02	-	22L	A	-	UNK	U	1,053	5/1/2007 12:59
5/1/2007 13:29	ROPER28	22L	T	T38	MIL	M	4,613	5/1/2007 13:41
5/1/2007 14:15	-	22L	A	PA-28R-20	GA	P	2,546	5/1/2007 14:05
5/1/2007 14:16	-	22L	T	PA-28R-20	GA	P	2,533	5/1/2007 14:21
5/1/2007 14:26	-	22L	A	BE35	GA	P	3,632	5/1/2007 14:24
5/1/2007 14:32	-	22L	T	PA-28R-20	GA	P	2,461	5/1/2007 14:36
5/1/2007 15:04	-	22L	A	C550	GA	B	1,604	5/1/2007 15:02
5/1/2007 15:24	-	22L	T	BE58	GA	P	3,005	5/1/2007 15:27
5/1/2007 15:32	-	22R	A	-	UNK	U	1,250	5/1/2007 15:29
5/1/2007 16:09	DNJ243	22L	A	E135	COM	R	2,126	5/1/2007 16:07
5/1/2007 17:13	-	22L	A	PA44	GA	P	5,013	5/1/2007 17:02
5/1/2007 17:44	MRA850	22R	A	C208	COM	T	2,457	5/1/2007 17:42
5/1/2007 18:06	SNC1026	22L	A	SH36	COM	T	2,418	5/1/2007 18:03
5/1/2007 18:06	MRA853	22L	A	C208	COM	T	2,438	5/1/2007 18:05
5/1/2007 18:17	DNJ263	22L	A	E135	COM	R	2,785	5/1/2007 18:13
5/1/2007 18:28	AMF1441	22L	A	BE99	COM	T	1,732	5/1/2007 18:25
5/1/2007 18:37	TAHOE43	22L	T	K35R	MIL	M	2,933	5/1/2007 18:40
5/1/2007 18:49	TAHOE43	22L	T	K35R	MIL	M	2,949	5/1/2007 18:51
5/1/2007 19:01	TAHOE43	22L	T	K35R	MIL	M	2,858	5/1/2007 19:03
5/1/2007 19:14	TAHOE43	22L	T	K35R	MIL	M	2,972	5/1/2007 19:16
5/1/2007 19:27	-	22L	A	LJ45	GA	B	3,481	5/1/2007 19:25
5/1/2007 19:33	-	22L	D	PRM1	GA	B	5,495	5/1/2007 19:34
5/1/2007 20:20	DNJ363	22L	A	E135	COM	R	1,867	5/1/2007 20:18

APPENDIX C

Fehr & Peers Memorandum

MEMORANDUM

Date: August 27, 2013

To: Bret Sampson, City of Rancho Cordova

From: David B. Robinson, Fehr & Peers

Subject: SunCreek Specific Plan DEIR/DEIS Sensitivity Analysis

RS10-2795

Fehr & Peers completed a sensitivity analysis of the SunCreek Specific Plan DEIR/DEIS to determine if traffic from additional residential development would trigger new transportation impacts. This memorandum presents the following:

- Potential Specific Plan Changes
- Analysis Methodology
- Findings

Potential Specific Plan Changes

We understand that there are two separate changes to the SunCreek Specific Plan being considered that could result in increased residential development in the project. The first change would increase the allowable density range for high-density residential land uses, which could result in about 203 additional high-density dwelling units. The second change would shift park acreage to residential land use, which could result in about 35 additional single family dwelling units.

Analysis Methodology

We used the transportation analysis documented in the SunCreek Specific Plan Draft EIR/EIS as the basis of our sensitivity analysis and were conducted using the following steps:

Step 1 Estimated daily trip generation for potential new multi-family residential dwelling units, based on trip generation rates published in *Trip Generation, 8th Edition* (Institute of Transportation Engineers, 2008) and assuming 203 multi-family and 35 single family dwelling units. The additional dwellings would generate about 1,671 trips per day.

Step 2 Calculated the project's share of daily traffic on study area roadways under baseline and cumulative conditions.

Step 3 Assigned trip generation from Step 1 to the study roadway facilities to develop daily traffic volume forecasts for the Proposed Project alternative with increased development.

Step 4 Calculated the roadway segment volume-to-capacity ratio and level of service. Tables 1 and 2 show the roadway segment traffic operations analysis with the Proposed Project alternative with increased traffic from Step 1 under Baseline and Cumulative conditions, respectively.

Step 5 Compared the updated roadway segment analysis to the analysis in the Draft EIR/EIS to determine if the additional traffic would result in new impacts.

Step 6 Developed an estimate of added peak hour traffic on study area roadways.

Step 7 Reviewed peak hour intersection operations analysis to determine potential for new peak hour intersection impacts.

Findings

Based on the analysis presented in Tables 1 and 2, the addition of traffic from 203 multi-family and 35 single family dwelling units, which would result in about 1,671 trips per day, would not cause additional roadway impacts beyond those already disclosed in the SunCreek Draft EIR/EIS.

Table 1
Roadway Segment Levels of Service—Baseline Conditions

Roadway Segment	Lanes	No Project			Proposed Project			Proposed Project With Increased Development		
		ADT	LOS	V/C	ADT	V/C	LOS	ADT	V/C	LOS
1. SR 16—Excelsior Road to Eagles Nest Road	2	12,900	0.65	B	18,800	0.94	E	18,900	0.95	E
2. SR 16—Sunrise Boulevard to Grant Line Road	2	15,400	0.77	C	17,000	0.85	D	17,000	0.85	D
3. Kiefer Boulevard—Grant Line Road to north of SR 16	2	1,800	0.1	A	2,200	0.12	A	2,200	0.12	A
4. Mather Boulevard—Femoyer Street to Douglas Road	2	12,900	0.72	C	**17,200**	**0.96**	**E**	**17,300**	**0.96**	**E**
5. Douglas Road—Mather Boulevard to Sunrise Boulevard	2	11,700	0.65	B	**16,600**	**0.92**	**E**	**16,700**	**0.93**	**E**
6. International Drive—South White Rock Road to Zinfandel Drive	4	12,000	0.33	A	12,300	0.34	A	12,300	0.34	A
7. International Drive—Zinfandel Drive to Kilgore Road	4	6,800	0.19	A	7,300	0.2	A	7,300	0.20	A
8. White Rock Road—Zinfandel Drive to Sunrise Boulevard	6	24,000	0.44	A	26,500	0.49	A	26,600	0.49	A
9. White Rock Road—Sunrise Boulevard to Grant Line Road	2	7,600	0.38	A	7,700	0.39	A	7,700	0.39	A
10. Folsom Boulevard—Zinfandel Drive to Sunrise Boulevard	4	20,300	0.56	A	20,500	0.57	A	20,500	0.57	A
11. Folsom Boulevard—Sunrise Boulevard to Hazel Avenue	4	13,300	0.37	A	13,400	0.37	A	13,400	0.37	A
12. Mather Field Road—Folsom Boulevard to U.S. 50 westbound ramps	4	26,900	0.75	C	27,600	0.77	C	27,600	0.77	C
13. Mather Field Road—U.S. 50 eastbound ramps to International Drive	6	38,200	0.71	C	41,700	0.77	C	41,800	0.77	C
14. Zinfandel Drive—Folsom Boulevard to U.S. 50 westbound ramps	4	23,100	0.64	B	23,500	0.65	B	23,500	0.65	B
15. Zinfandel Drive—U.S. 50 eastbound ramps to White Rock Road	6	42,100	0.78	C	43,200	0.8	C	43,200	0.80	C
16. Zinfandel Drive—White Rock Road to International Drive	4	19,700	0.55	A	19,700	0.55	A	19,700	0.55	A
17. Sunrise Boulevard—Gold Country Boulevard to Coloma Road	6	74,700	1.38	F	**78,600**	**1.46**	**F**	**78,700**	**1.46**	**F**
18. Sunrise Boulevard—Coloma Road to U.S. 50 westbound ramps	6	72,400	1.34	F	**76,900**	**1.42**	**F**	**77,000**	**1.43**	**F**
19. Sunrise Boulevard—U.S. 50 eastbound ramps to Folsom Boulevard	6	55,200	1.02	F	**60,900**	**1.13**	**F**	**61,000**	**1.13**	**F**
20. Sunrise Boulevard—Folsom Boulevard to White Rock Road	6	43,200	0.8	C	**50,100**	**0.93**	**E**	**50,200**	**0.93**	**E**
21. Sunrise Boulevard—White Rock Road to Douglas Road	6	30,200	0.56	A	41,800	0.77	C	42,100	0.78	C
22. Sunrise Boulevard—SR 16 to Grant Line Road	2	11,400	0.57	A	15,800	0.79	C	15,900	0.80	C
23. Hazel Avenue—Winding Way to U.S. 50 westbound ramps[1]	4	54,200	1.51	F	54,800	1.52	F	54,800	1.52	F
24. Grant Line Road—White Rock Road to Douglas Road	2	8,000	0.4	A	11,600	0.58	A	11,700	0.59	A
25. Grant Line Road—Douglas Road to SR 16	2	6,700	0.34	A	10,100	0.51	A	10,200	0.51	A
26. Grant Line Road—SR 16 to Sunrise Boulevard	2	5,600	0.28	A	7,000	0.35	A	7,000	0.35	A
27. Douglas Road—Sunrise Boulevard to Rancho Cordova Parkway	4	13,500	0.38	A	20,700	0.58	A	20,900	0.58	A
28. Douglas Road—Americanos Boulevard to Grant Line Road	4	4,500	0.13	A	4,500	0.13	A	4,500	0.13	A
29. Sunrise Boulevard—Douglas Road to Kiefer Boulevard	4	27,700	0.77	C	**36,600**	**1.02**	**F**	**36,800**	**1.02**	**F**
30. Sunrise Boulevard—Kiefer Boulevard to SR 16	4	23,000	0.64	B	**33,200**	**0.92**	**E**	**33,400**	**0.93**	**E**

Notes: ADT= Average Daily Traffic (Two-way); LOS = level of service; SR = State Route; U.S. 50 = U.S. Highway 50; V/C = volume-to-capacity

[1] Assumed to have high access control.

Shaded areas indicate deficiency. **Bold** indicates impact.

Source: Data Compiled by Fehr & Peers in 2010

Table 2
Roadway Segment Levels of Service—Cumulative Conditions

Roadway Segment	Lanes	No Project			Proposed Project			Proposed Project With Increased Development		
		ADT	V/C	LOS	ADT	V/C	LOS	ADT	V/C	LOS
1. SR 16—Excelsior Road to Eagles Nest Road	2	21,900	1.22	F	**25,500**	**1.42**	**F**	**25,600**	**1.42**	**F**
2. SR 16—Sunrise Boulevard to Grant Line Road	2	26,140	1.45	F	**28,340**	**1.57**	**F**	**28,400**	**1.58**	**F**
3. Kiefer Boulevard—Grant Line Road to north of SR 16	2	6,300	0.35	A	7,200	0.4	A	7,200	0.40	A
4. Mather Boulevard—Femoyer Street to Douglas Road	4	22,300	0.62	B	26,100	0.73	C	26,200	0.73	C
5. Douglas Road—Mather Boulevard to Sunrise Boulevard	4	26,000	0.72	C	30,700	0.85	D	30,800	0.86	D
6. International Drive—South White Rock Road to Zinfandel Drive	6	60,800	1.13	F	61,700	1.14	F	61,700	1.14	F
7. International Drive—Zinfandel Drive to Kilgore Road	6	65,600	1.21	F	67,600	1.25	F	67,600	1.25	F
8. White Rock Road—Zinfandel Drive to Sunrise Boulevard	6	42,400	0.79	C	42,500	0.79	C	42,500	0.79	C
9. White Rock Road—Sunrise Boulevard to Grant Line Road	6x[1]	52,790	0.65	C	52,990	0.65	C	53,000	0.65	C
10. Folsom Boulevard—Zinfandel Drive to Sunrise Boulevard	4	28,600	0.79	C	28,700	0.8	C	28,700	0.80	C
11. Folsom Boulevard—Sunrise Boulevard to Hazel Avenue	4	27,900	0.78	C	28,000	0.78	C	28,000	0.78	C
12. Mather Field Road—Folsom Boulevard to U.S. 50 westbound ramps	4	41,200	1.14	F	41,600	1.16	F	41,600	1.16	F
13. Mather Field Road—U.S. 50 eastbound ramps to International Drive	6	67,800	1.26	F	69,900	1.29	F	69,900	1.29	F
14. Zinfandel Drive—Folsom Boulevard to U.S. 50 westbound ramps	4	30,800	0.86	D	31,200	0.87	D	31,200	0.87	D
15. Zinfandel Drive—U.S. 50 eastbound ramps to White Rock Road	6	78,000	1.44	F	79,000	1.46	F	79,000	1.46	F
16. Zinfandel Drive—White Rock Road to International Drive	6	42,200	0.78	C	43,100	0.8	C	43,100	0.80	C
17. Sunrise Boulevard—Gold Country Boulevard to Coloma Road	6	97,400	1.8	F	**100,000**	**1.85**	**F**	**100,100**	**1.85**	**F**
18. Sunrise Boulevard—Coloma Road to U.S. 50 westbound ramps	6	97,900	1.81	F	**101,000**	**1.87**	**F**	**101,100**	**1.87**	**F**
19. Sunrise Boulevard—U.S. 50 eastbound ramps to Folsom Boulevard	6	60,400	1.12	F	**63,500**	**1.18**	**F**	**63,600**	**1.18**	**F**
20. Sunrise Boulevard—Folsom Boulevard to White Rock Road	6	55,700	1.03	F	**59,100**	**1.09**	**F**	**59,200**	**1.10**	**F**
21. Sunrise Boulevard—White Rock Road to Douglas Road	6	41,300	0.76	C	47,500	0.88	D	47,600	0.88	D
22. Sunrise Boulevard—SR 16 to Grant Line Road	6	26,400	0.49	A	30,100	0.56	A	30,200	0.56	A
23. Hazel Avenue—Winding Way to U.S. 50 westbound ramps	6	121,100	2.24	F	122,600	2.27	F	122,600	2.27	F
24. Grant Line Road—White Rock Road to Douglas Road	4h[2]	52,520	1.31	F	**59,220**	**1.48**	**F**	**59,400**	**1.49**	**F**
25. Grant Line Road—Douglas Road to SR 16	4h	35,390	0.88	D	**42,990**	**1.07**	**F**	**43,200**	**1.08**	**F**
26. Grant Line Road—SR 16 to Sunrise Boulevard	4h	28,810	0.72	C	32,610	0.82	D	32,700	0.82	D
27. Douglas Road—Sunrise Boulevard to Rancho Cordova Parkway	4	26,930	0.75	C	**36,530**	**1.01**	**F**	**36,700**	**1.02**	**F**
28. Douglas Road—Americanos Boulevard to Grant Line Road	4	18,230	0.51	A	19,030	0.53	A	19,000	0.53	A
29. Sunrise Boulevard—Kiefer Boulevard to SR 16	6	35,900	0.66	B	42,400	0.79	C	42,500	0.79	C
30. Douglas Road—Rancho Cordova Parkway to Americanos Boulevard	4	15,430	0.43	A	15,730	0.44	A	15,700	0.44	A
31. Chrysanthy Boulevard—Sunrise Boulevard to Rancho Cordova Parkway	4	6,800	0.19	A	7,200	0.2	A	7,200	0.20	A
32. Chrysanthy Boulevard—Rancho Cordova Parkway to Americanos Boulevard	4	9,200	0.26	A	10,700	0.3	A	10,700	0.30	A
33. Kiefer Boulevard—Zinfandel Drive to Sunrise Boulevard	4	3,900	0.11	A	9,400	0.26	A	9,500	0.26	A
34. Kiefer Boulevard—Sunrise Boulevard to Rancho Cordova Parkway	4	5,600	0.16	A	16,000	0.44	A	16,200	0.45	A
35. Zinfandel Drive—Mather Boulevard to Douglas Road	6	29,300	0.52	A	32,700	0.61	B	32,800	0.61	B
36. Zinfandel Drive—Douglas Road to Kiefer Boulevard	2	5,600	0.31	A	5,800	0.32	A	5,800	0.32	A
37. Zinfandel Drive—Kiefer Boulevard to SR 16	2	6,300	0.35	A	6,400	0.36	A	6,400	0.36	A
38. Sunrise Boulevard—Douglas Road to Chrysanthy Boulevard	6	53,900	1	E	**58,500**	**1.08**	**F**	**58,600**	**1.09**	**F**
39. Sunrise Boulevard—Chrysanthy Boulevard to Kiefer Boulevard	6	37,800	0.7	B	43,100	0.8	C	43,200	0.80	C
40. Rancho Cordova Parkway—U.S. 50 to Easton Valley Parkway	6x	60,700	0.75	D	62,600	0.77	D	62,600	0.77	D
41. Rancho Cordova Parkway—Easton Valley Parkway to White Rock Road	6x	55,800	0.69	C	57,600	0.71	D	57,600	0.71	D
42. Rancho Cordova Parkway—White Rock Road to Douglas Road	6	18,800	0.35	A	21,100	0.39	A	21,100	0.39	A
43. Rancho Cordova Parkway—Douglas Road to Chrysanthy Boulevard	4	26,700	0.74	C	**41,300**	**1.15**	**F**	**41,600**	**1.16**	**F**
44. Rancho Cordova Parkway—Chrysanthy Boulevard to Kiefer Boulevard	4	28,900	0.8	D	**34,600**	**0.96**	**E**	**34,700**	**0.96**	**E**
45. Americanos Boulevard—Rancho Cordova Parkway to White Rock Road	6	28,400	0.53	A	31,900	0.59	A	32,000	0.59	A
46. Americanos Boulevard—White Rock Road to Douglas Road	4	24,300	0.68	B	29,100	0.81	D	29,200	0.81	D
47. Americanos Boulevard—Douglas Road to Chrysanthy Boulevard	4	17,100	0.48	A	25,500	0.71	C	25,700	0.71	C

Notes: ADT= Average Daily Traffic (Two-way); LOS = level of service; SR = State Route; U.S. 50 = U.S. Highway 50; V/C = volume-to-capacity

[1] h = Assumed to be a limited-access expressway.

[2] h = Assumed to have high access control.

Shaded areas indicate deficiency. **Bold** indicates impact.

Source: Data Compiled by Fehr & Peers in 2010 and 2011.