Appendix 2:
Attachments to Comment Letter Y

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Exhibit A
Gen Plan Initiation Review Draft

FRESNO

2035 General Plan

August 2012

REVIEW
DRAFT
INITIATION
PURPOSES
ONLY

Development and Resource Management Department

City of FRESNO

2035 General Plan Team

Mayor

Ashley Swearingen

City Manager

Mark Scott

Asst. City Manager

Bruce Rudd

City Council

Blong Xiong
Andreas Borgeas
Oliver L. Baines III
Larry Westerlund
Sal Quintero
Lee Brand
Clint Olivier

Planning Commission

Jaime Holt
Serop Torossian
Rama Dawar
Andy Hansen-Smith
Luisa Medina
Rojelio Vasquez
Paul Capriolio

Long Range Planning Team

Keith Bergthold
Darrell Unruh
Franklin Spees
Arnoldo Rodriguez
Michelle Zumwalt
Trai Her
Edward Smith

City Staff

Joseph Oldham
Karana Hattersley-Drayton
Sophia Pagoulatos
Sandra Brock
Jack VanPatten
John Fox
Shannon Chaffin
Allen Smith
Mike Sanchez
Bonique Emerson
Patrick Wiemiller
Martin Querin
Scott Mozier
Steve Hogg
Brock Buche
Scott Tyler
Kevin Norgaard
Jill Gormley
John Downs
John Dugan

Consulting Team

Dyett & Bhatia (Lead Consultant)
MW Steele Group Inc.
Michael Brandman Associates
Calthorpe Associates
Fehr & Peers, Inc.
Economic and Planning Systems

General Plan Citizens Committee

The General Plan Citizens Committee provided guidance and leadership throughout the process. A special thanks to committee members:

Francine Farber, Co-Chair
Eric Payne, Co-Chair
Kris Clarke
Ryan Calvert
Austin Ewell III
Sameh El Kharbawy
Kiel Famellos-Schmidt
Paul Humphrey
Gerard Lozano
William Eric McComas
Ali Nekumanesh
Larry Raven
Michael Renberg
Mike Wells
Louise Yenovkian
Nick Yovino
Melissa White

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Initiation Review Draft
Fresno General Plan Update

This document contains the following:

1. Introduction

- Purpose of the Initiation Review Draft
- Planning Process
- Public Participation Process
- Planning Area
- Plan Buildout

2. Land Use Element

- Land Use Classifications
- Density and Intensity
- Land Use Diagram
- General Plan Zoning Consistency

3. Circulation Element

- Street Typologies
- Circulation Map
- Street Design Standards

4. Goals and Objectives

- Goals
- Objectives

INITIATION REVIEW DRAFT

INTRODUCTION

PURPOSE OF THE INITIATION REVIEW DRAFT

This version of the Draft General Plan Update for the City of Fresno ("the City") is being called the "Initiation Review Draft." The Initiation Review Draft is not the final draft anticipated to be presented to the City Council for adoption, and will continue to be refined prior to release for public review and a final decision by the City Council. Instead, the intent of this draft is to provide information for a high-level review by the City Council to formally initiate the 2035 General Plan update process. The Initiation Review Draft has been based on the modified Alternative "A" model consistent with the direction given by the City Council

on April 19, 2012, to consider the merits of that alternative. The update process will include California Environmental Quality Act (CEQA) review of environmental impacts and project alternatives, including modified Alternative "A," commencing with the creation of a Notice of Preparation (NOP).

The City's Local Planning and Procedures Ordinance (LPPO) has very few informational requirements for formal initiation of general plan update by the City Council. However, as part of the CEQA process the NOP must contain the following minimum information: description of the project, location of the project, and probable environmental effects of the project. While this necessary information might conceivably be supplied by as little as a Land Use Diagram and Circulation Map, the Initiation Review Draft provides additional information to allow for a more in-depth, high-level review. For example, the goals and objectives of the proposed plan may not be "required" for initiation or to prepare the NOP, but will assist in informing the initiation and CEQA processes. However, a projection of future development under the proposed plan is essential for transportation and air quality analysis.

This Initiation Review Draft is anticipated to be presented to the Planning Commission for review and comment prior to consideration by the City Council. The City Council has authority to approve, approve with modifications, or deny the initiation of the General Plan update. If approved or approved as modified for the purpose of initiation, the Initiation Review Draft will provide the basis for subsequent CEQA review. The results of the subsequent CEQA review will be presented in an environmental document to accompany the "Draft General Plan for Public Review," proposed to be released sometime after March 1, 2013. Comments on the draft environmental document and the City's responses to them will be considered by decision-makers prior to any formal action to approve the General Plan Update. These additional refinements can be included in a potential "Hearing Draft General Plan," which will be the subject of public hearings prior to consideration of formal adoption by the City.

PLANNING PROCESS

The planning process for the General Plan update consisted of an initial phase of information gathering through a Map Atlas[1] and service provider correspondence, followed by an in-depth exploration of targeted issues and potential policy initiatives via a series of working papers reviewed with the General Plan Citizen's Advisory Committee (GPCC) and at public workshops. These findings, along with the GPCC's visioning process setting goals for the general plan, culminated in the alternatives phase.

The alternatives process explored four fundamentally different approaches to accommodating projected population and job growth while meeting the proposed vision for Fresno. The Alternatives Report, issued in March 2012, reviewed four options, which differed by the type, density, mix, and location of future growth. The Alternatives Report evaluated the alternative scenarios against one another in terms of their relative (1) ability to meet housing and job demand, (2) provision of parks and open space, (3) impact on transportation and mobility, and (4) adherence to the proposed goals. The Alternatives Report was reviewed by at a community workshop and at public hearings by the GPCC, Planning Commission and City Council.

[1] The Map Atlas, published in September 2011, is an existing conditions report organized as a series of maps with descriptive text.

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The City Council endorsed Alternative A with modifications. Alternative A focused on rebuilding the primary corridors as a series of neighborhood and regional mixed-use centers surrounded by higher density housing, with half of future housing in infill areas and half in growth areas on the urban edge. The Council's modified A shifted more development to single family housing and with more focus on growth west and southwest of Highway 99, but maintained a strong commitment to Downtown and major corridor revitalization, complete neighborhoods, and more compact development, and called for no expansion of the Sphere of Influence (SOI) during the plan horizon of 2035. The Council elected to not expand the SOI in part to fully develop the Southeast Growth Area (SEGA), under the draft specific plan to be incorporated in Part II of this General Plan, which requires its development through sub-area master plan phases that include comprehensive public infrastructure. Portions of SEGA are anticipated to develop by 2035, with full buildout not occurring until 2050 or beyond.[2]

The preservation of the SOI boundary for the 2035 General Plan not only serves SEGA to be developed in the longer term, but is anticipated to increase the value of land in the Downtown, as shown on the General Plan Land Use Diagram insert, and existing neighborhoods, benefitting current home and property owners, and lead to more thoughtfully conceived and higher quality development in growth areas. In addition, a solid SOI boundary that is stable over the planning period allows for more effective strategic investments in and upgrades to the City's surface water treatment and distribution system and sewer system needed to serve the greater densities anticipated in the Downtown and in the corridors.

PUBLIC PARTICIPATION PROCESS

Preparation for the General Plan update began in the summer of 2010. In order for the General Plan to accurately address community needs and values, a comprehensive public process of obtaining the input of residents, businesses, and property owners as well as City officials was commenced by the City. The GPCC provided leadership throughout this process. This involved the sharing of information and ideas between elected and appointed officials, City staff, the planning consultants, and residents. The following methods were used over the course of the General Plan update to ensure the community's full participation:

- *Stakeholder Interviews*. Over 160 interviews were conducted with City officials and staff and representatives of various community stakeholders and organizations.
- *Community Workshops*. 15 public workshops held on various topics including the Map Atlas of existing conditions, Visioning and Guiding Principles, Economic Development, Urban Form, Healthy Communities, Transportation and Resource Conservation, and the Alternatives Report.
- *Neighborhood Meetings, Focus Groups and other agencies*. City staff was invited to make over 100 presentations before neighborhood associations, as well as business, educational, social, and non-profit segments of the community to discuss the General Plan Update and the Alternatives Report.

[2] The official Council minutes state "RESOLVED, Alternative A hereby selected as the Preferred Alternative for the preparation of the 2035 General Plan Update, as amended by Councilmember Brand with his 'Comparative Analysis of Alternatives A, D & A-2", and as amended by Councilmember Baines to (1) study the area near the Wastewater Treatment Plan for industrial and heavy agricultural (with buffers) and (2) study the Bus Rapid Transit (BRT) route for inclusion of a west Fresno corridor…"

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- *General Plan Citizens Advisory Committee*. The GPCC served as a "sounding board" for ideas and alternatives during the update process, working with City staff and the consultant team to formulate a a recommendation to the City Council. The GPCC also heard public comment and participated with invited speakers in discussions on a range of planning topics. GPCC members also attended public workshops to facilitate dialogue and understand community concerns. The GPCC held 24 meetings throughout the process, through May 2012.
- *Planning Commission/City Council meetings*. City staff appeared at seven Planning Commission and City Council meetings for discussion items on the General Plan Update, focusing on specific issues requiring policy direction. These meetings were open to the public.
- *Other City Commissions and Committees*. Other City Commissions and Advisory Committees also met periodically to discuss issues and concerns pertaining to the General Plan Update and provide comments on documents prepared for the General Plan Update.
- *Newsletter and Survey*. The City published a newsletter in English and Spanish to introduce the planning process and provide details on means of participation. The newsletter was distributed in August 2011. The City also conducted a telephone survey on issues and priorities for the new General Plan.
- *General Plan Update Website*. A website was created for the General Plan Update process, linked to the main City website. All meeting agendas, staff reports, workshop summaries, planning documents and maps created during the update process were posted on the site and available for public review.
- *General Plan Update Mailing List*. Those interested in receiving information and notices were placed on the General Plan update email distribution.
- *Availability of Documents*. Copies of the results from GPCC, Planning Commission and City Council meetings, workshops, and presentations were made available on the General Plan Update website and at City Hall.

PLANNING AREA

The Planning Area is the geographic area for which the General Plan establishes policies about future urban growth, long-term agricultural activity, and natural resource conservation. The boundary of the Planning Area was determined in response to State law requiring each city to include in its General Plan all territory within the boundaries of the incorporated area as well as "any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (California Government Code Section 65300).

The Planning Area is coterminous with the City's Sphere of Influence (SOI). The SOI is a boundary that encompasses lands that are expected to ultimately be annexed into the City, although until annexed it falls under the jurisdiction of the County of Fresno. The Fresno County Local Agency Formation Commission (LAFCO), which is an entity empowered to review and approve proposed boundary changes and annexations by incorporated municipalities, determines the SOI after giving great weight to any agreement between the City and County. The City's SOI comprises all land within the City limits as well as the county islands—unincorporated land entirely surrounded by the city—and land beyond the outer City limits on all sides (see Figure 1). The SOI encompasses 157 square miles in total, of which 44 square miles is unincorporated land.

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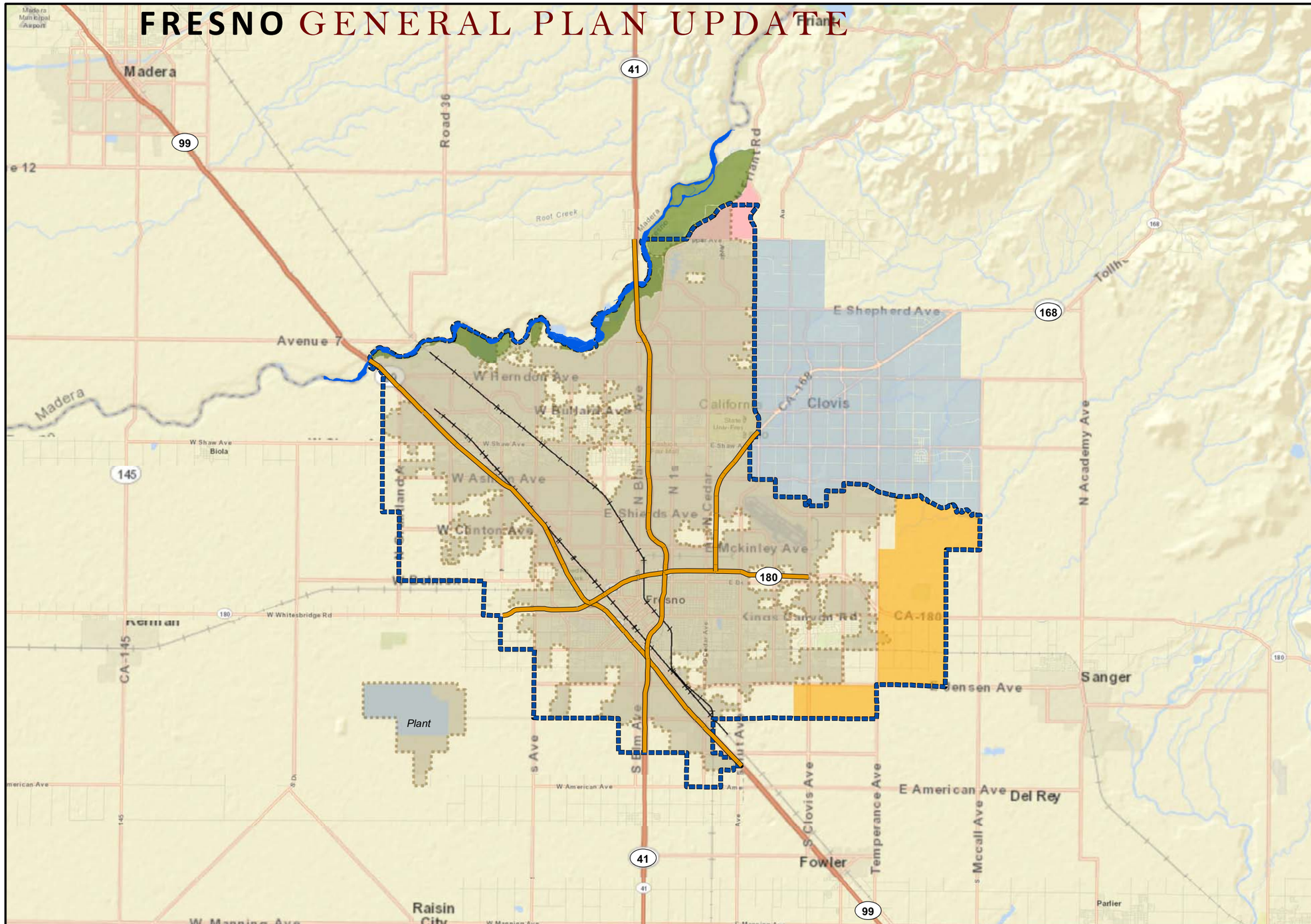
FRESNO GENERAL PLAN UPDATE



Planning Boundaries
Draft Figure 1

Boundaries

- Sphere Of Influence
- City Limits
- North Growth Area
- Multi-Use
- San Joaquin River
- SEGA
- Clovis GP

Circulation

- 99 State Highway
- 41 State Highway
- 168 State Highway
- 180 State Highway
- Rail Lines

0 0.5 1 2 3 Miles

Source: Boundary and circulation information, City of Fresno Development And Resource Management Department, 2010; World Street Map, developed by Esri using DeLorme basemap layers, Automotive Navigation Data, USGS, UNEP-WCMC, Tele Atlas Dynamap, 2009

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PLAN BUILDOUT

Full development under the General Plan is referred to as "buildout." It should be noted that when buildout will actually occur is not specified in or anticipated by the General Plan, and designation of a site for a certain use does not necessarily mean that the site will be built/redeveloped with the designated use by 2035, the horizon year of the General Plan Update.

Residential Development

Table 1 tracks the existing and additional housing units expected under the General Plan buildout. As shown, approximately 171,000 units currently exist in the Planning Area. The General Plan is intended to accommodate an additional 76,000 units, through both infill development and growth area development. In total, General Plan buildout will result in approximately 247,000 housing units in the Planning Area. Around 43,500 of these new units, or 57 percent, would be located in the existing City limits, including the Downtown as defined on the Land Use Diagram inset.

TABLE 1: RESIDENTIAL DEVELOPMENT

Existing Units (2010)	*Additional Units Under General Plan Buildout*	*Total Housing Units at Buildout (2035)*
171,000	76,600	247,000

Source: City of Fresno, Dyett & Bhatia, 2012.

Table 2 lists the initial projections of new housing by type and location. Around half of the new residential units are anticipated to be in single family houses, and half in multi-family and townhome units, which could include small lot and semi-attached houses. The West Area is the portion of the Sphere of Influence that is west of Highway 99 and north of Highway 180. The Southwest Area is south of Highway 180 and west of Highway 99. The North Area is north of Copper Avenue. SEGA is made up of three subareas—the portion of the SOI east of Minnewawa Avenue and south of Jensen Avenue, the area east of Temperance Avenue between Jensen Avenue and McKinley Avenue, and the area north of McKinley Avenue and east of Locan Avenue. Downtown is defined on the Land Use Diagram inset map. Bus Rapid Transit (BRT) corridors and East-Southeast locations are located within the remainder of the Planning Area, generally the existing City limits.[3]

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[3] Bus Rapid Transit (BRT) is a form of bus service that uses design and infrastructure features such as dedicated traffic lanes, pre-paid fares, raised stations, and limit stops. These features create rapid transit service with high speeds and frequency, such as usually seen with subways and light rail, at much lower costs. A first phase BRT system has been approved and funded to run along the Ventura Street/Kings Canyon Boulevard and Blackstone Avenue corridors, meeting in Downtown Fresno. This system is presently in the design stage with implementation anticipated over the next two to three years.

TABLE 2: PROJECTED SUB-REGIONAL RESIDENTIAL BUILDOUT AND DWELLING UNIT MIX[1]

Targeted Area	*Multi-Family and Townhome Units*	*Single-Family - Large Lot and Small Lot*	*Sub-Region - Total Units*
Downtown[2]	8,000	2,000	**10,000**
BRT Corridor Infill (Blackstone, Kings Canyon, Shaw)	8,000	0	**8,000**
West Area			**17,000**
West Shaw BRT Corridor (West of SR99 to Grantland)	4,000	0	
Westlake Transit Village (Grantland between Ashlan and Shields)	2,300	0	
Balance Westlake East & West Area (Garfield, Ashlan, Polk, Clinton Aves.)	2,200	8,500	
Southwest Area			**10,500**
California BRT Corridor (Thorne Ave. to Hughes Ave.)	900	0	
Veteran's Community Transit Village (California – Hughes to Marks)	1,700	0	
Balance of SW Area	2,400	5,500	
East & Southeast			**9,000**
General	3,500	2,500	
Peach-Jensen Neighborhood (Peach, Jensen, Minnewawa and North Aves.)	1,000	0	
Clovis Ave., SR 180-Belmont Ave.	2,000	0	
SEGA			**11,500**
North of McKinley	1,500	4,250	
South of Jensen	1,500	4,250	
Between McKinley & Jensen	0	0	
North Growth Area (North of Copper Ave.)	1,500	1,000	**2,500**
Approved Maps (Undeveloped)		7,500 (others converted or lapse)	**7,500**
TOTALS	**41,000**	**35,000**	**76,000**

Notes:
1. Consistent with City Council Approval of Alternative A – Modified on April 19, 2012 for 2035 GP Update.
2. Downtown reduced from 11,000 to 10,000 units based on Downtown Planning revisions

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Buildout Population

The city's population of 495,000 in 2010 represents a 16 percent increase over its 2000 population of 428,000—an annual growth rate of 1.25 percent. The entire Planning Area had a 2010 population of 545,000, so around 50,000 people live in unincorporated land within the SOI. Buildout of the General Plan will accommodate a population of approximately 226,000 new residents within the Planning Area. This would result in a total population of 771,000 and an average annual growth rate of 1.24 percent. Table 3 shows the current and estimated buildout populations for the Planning Area.

TABLE 3: POPULATION

Existing Population (2010)	*Additional Population From Additional Units Under General Plan Buildout*	*Buildout Population (2035)*
545,000	226,000	771,000

Source: City of Fresno Map Atlas, 2011. Projections: Dyett & Bhatia, 2012.

Non-Residential Development

Table 4 summarizes the additional non-residential floor area expected under the General Plan buildout. The General Plan is intended to accommodate an additional 54 million square feet of non-residential space of the types listed. This new space is fairly evenly split between retail, office, and other uses (industrial, research and development, flexible space, etc.).

TABLE 4: NON-RESIDENTIAL FLOOR AREA

Type	*Additional Floor Area (in thousands of square feet) Under General Plan Buildout*
Retail	16,167,000
Office	17,535,000
Other	20,370,000
Total	**54,072,000**

Source: Dyett & Bhatia, 2012.

Buildout Employment and Jobs/Resident Balance

At buildout, the Planning Area could accommodate approximately 108,000 new jobs. These new jobs would be roughly broken down into:

- Retail = 50,000 new jobs
- Office = 32,500 new jobs
- Other = 25,500 new jobs

A city's ratio of jobs/employed residents would be 1:1 if the number of jobs in the city equaled the number of employed residents. In theory, such a balance would eliminate the need for commuting. More realistically, a balance means that in-commuting and out-commuting are matched, leading to efficient use of the transportation system, particularly during peak hours. At buildout, the General Plan would add 0.48 jobs per new resident, roughly equivalent to the current percent of the City's population in the labor force (46 percent according to the 2010 US Census).

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LAND USE ELEMENT

LAND USE CLASSIFICATIONS: GENERALLY

These land uses cover the entire Planning Area, including SEGA, with the exception of the areas in the Downtown.

Residential

Residential land use provide for a wide range of neighborhoods and housing types, anywhere from larger lot single family residential (SFR) development to neighborhoods with a mix of houses and townhouse/duplexes, to high density apartment communities.

- Single-family residential development is typically arranged as stand-alone detached units, or attached as duplexes or triplexes. They may range in density from one to 12 units per acre. Garages may be accessed from the front or from alleys.
- Townhomes or row homes are typically clustered in groups of four to six units. They range from two to three stories in height and from seven to 16 units per acre. Where possible, garage access should be from the rear of the site.
- Multi-family residential buildings may be multiple stories while garage spaces should be integrated into the ground level of the development or below grade, in individually secured garages.

Residential land uses also allow for neighborhood-serving community facilities such as parks, churches, schools, family day care, libraries, community gardens and farmers markets. Residential uses are designated by density.

Low Density

This designation is intended to provide for large lot residential development. Low Density residential allows one to up to 3.5 units per acre. The resulting land use pattern is large lot residential in nature, such as rural residential, ranchettes, or estate homes.

Medium Low Density

The Medium Low Density designation is intended to provide for single family detached housing with densities of 3.5 to 6 units per acre.

Medium Density

Medium Density residential covers developments of 5 to 12 units per acre and is intended for areas with predominantly single-family residential development, but can also accommodate a mix of housing types, from small-lot starter homes, zero-lot-line developments, and duplexes, to townhouses. Much of the city's existing neighborhoods fall within this designation.

Medium High

Medium High Density residential is intended for neighborhoods with a mix of single-family residences, townhomes, garden apartments, and multi-family units intended to support a fine-grain, pedestrian scale. This land use accommodates densities from 12 to 16 units per acre overall—individual parcels may have densities outside of that range so long as a master planned neighborhood has a density that conforms.

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Urban Neighborhood

Urban Neighborhood residential covers densities from 16 to 30 units per acre, which will require multi-family dwellings but still allows for a mix of housing types including single-family houses. This land use is intended to provide for a compact community that includes community facilities, walkable access to parkland and commercial services, and supports efficient, frequent transit service. Urban Neighborhood is designated for targeted areas with complementary land uses adjacent.

High Density

High Density residential is intended to accommodate attached homes, two- to four-plexes, and apartment buildings, supported by walkable access to frequent transit, retail and services, and community facilities such as parks and schools. High Density allows for 30 to 45 units per acre.

Commercial

Commercial land use designations allow a wide range of retail and service establishments intended to serve local and regional needs. Some designations allow residential mixed use, but must include a commercial component.

Main Street

Main Street commercial encourages a traditional "Main Street" character with active storefronts, outdoor seating and pedestrian-oriented design. This designation promotes primarily one to two story retail uses, with moderate office and minimal multi-family as supportive uses. It also preserves small-scale, fine-grain character in neighborhoods where single-family residential and townhomes are predominant. The maximum Floor Area Ratio (FAR)[4] is 1.0.

Community

Community commercial is intended for pedestrian-oriented commercial development that primarily serves local needs such as convenience shopping and offices. Many of the city's current commercial districts fall into this designation. Specific uses allowed include medium-scale retail, office, civic and entertainment uses, supermarkets, drug stores and supporting uses. The maximum FAR is 1.0.

Recreation

The commercial recreation designation is intended for areas of private commercial recreation uses such as bowling alleys, family entertainment centers, and golf driving ranges. The maximum FAR is 0.5.

General

This designation is intended for a range of retail and service uses that are not appropriate in other areas because of higher volumes of vehicle traffic and potential adverse impacts on other uses. Development such as strip malls would fall into this designation. Examples of allowable uses include: building materials, storage facilities with active storefronts, equipment

[4] FAR is defined as the permitted ratio of gross floor area to site area. It is further defined in the Density and Intensity section below.

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rental, wholesale businesses, and specialized retail not normally found in shopping centers. The maximum FAR is 2.0.

Highway & Auto

The Highway & Auto land use designation is intended for limited areas near the freeway to accommodate uses that depend on or are supported by freeway access but do not generate a large volume of traffic. Hotels, restaurants, and auto malls are typical land uses. The maximum FAR is 0.75.

Regional

This land use designation is intended to meet local and regional retail demand, such as large-scale retail, office, civic and entertainment uses, shopping malls, with large format or "big-box" retail, are allowed, as are supporting uses such as gas stations, and hotels. Buildings are typically larger-footprint and urban-scaled. Development and design standards will create a pedestrian orientation within centers and along major corridors, with parking generally on the side or rear of major buildings, but automobile-oriented uses also will be accommodated on identified streets and frontages. The maximum FAR is 1.0.

Employment

Office

The Office land use designation is intended for administrative, financial, business, professional, medical, and public offices. This designation is mainly intended to apply to existing office uses on smaller lots, generally located on arterial roadways, and is also considered to be compatible with existing residential neighborhoods given the smaller level of noise and traffic generation than commercial uses. Retail uses would be limited to business services and food service and convenience goods for those who work in the area. The maximum FAR is 2.0.

Business Park

The Business Park designation provides for office/business parks in campus-like setting that is well suited for large offices or multi-tenant buildings. This designation is intended to accommodate and allow for the expansion of small businesses with limited outdoor storage proximate to residential uses, thus adequate landscaping is imperative. Typical land uses include research and development, laboratories, administrative and general offices, medical offices and clinics, professional offices, prototype manufacturing, testing, repairing, packaging, and printing. No free-standing retail is permitted, except for small uses serving businesses and employees. The maximum FAR is 1.0.

Regional Business Park

The Regional Business Park land use designation is intended for large or campus-like office and technology development that includes office, research and development, manufacturing, and other large-scale, professional uses, with limited and properly screened outdoor storage. Permitted uses include incubator-research facilities prototype manufacturing, testing, repairing, packaging, and printing as well as offices and research facilities. Small-scale retail and service uses serving local employees and visitors are permitted as secondary uses. The maximum FAR is 1.0.

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Light Industrial

The Light Industrial designation accommodates a diverse range of light industrial uses, including limited manufacturing and processing, research and development, fabrication, utility equipment and service yards, wholesaling, warehousing, and distribution activities. Small-scale retail and ancillary office uses are also permitted. Light Industrial areas may serve as buffers between Heavy Industrial and other land uses and otherwise are generally located in areas with good transportation access, such as along railroads and freeways. The maximum FAR is 1.5.

Heavy Industrial

The Heavy Industrial designation accommodates the broadest range of industrial uses including manufacturing, assembly, wholesaling, distribution, and storage activities that are essential to the development of a balanced economic base. Small-scale commercial services and ancillary office uses are also permitted. The maximum FAR is 1.5.

Mixed Use

Mixed-use land use designations are based on commercial uses and also require a residential component.

Corridor/Center Mixed Use

The Corridor/Center Mixed Use designation is higher intensity than Neighborhood Mixed Use, and is intended to allow for either horizontal or vertical mixed-use development in multiple story buildings along key circulation corridors in the city where height and density can be easily accommodated. Ground-floor retail and upper-floor residential or offices are the primary uses, with personal and business services and public and institutional space as supportive uses. Development will facilitate the transformation of existing transportation corridors into vibrant, highly walkable areas with broad, pedestrian-friendly sidewalks, trees, landscaping, and local-serving uses with new buildings that step down in relationship to the scale and character of adjacent neighborhoods. This designation will largely apply along arterial streets, at targeted locations between regional activity centers. Residential densities range between 16 and 30 units per acre with a maximum 40 percent residential uses and the maximum FAR is 1.5.

Regional Mixed Use

This land use designation is intended to accommodate mixed use development in urban-scale buildings and retail establishments that serve residents and businesses of the region at large. Medium-scale retail, housing, office, civic and entertainment uses, and shopping malls, with large format or "big-box" retail, are allowed, as are supporting uses such as gas stations and hotels and residential in mixed use or single use buildings. Design standards will support a pedestrian orientation within centers and along major corridors, with parking on the side or rear in general, but automobile-oriented uses also will be accommodated on identified streets and frontages. Residential densities range between 30 and 45 units per acre with a maximum 30 percent residential uses and the maximum FAR is 2.0. Additional residential density may be allowed with a Master Plan.

Neighborhood Mixed Use

The Neighborhood Mixed Use designation is similar to the Main Street and Community commercial land use designations, however it allows up to 50 percent residential uses, whereas the commercial districts do not allow residential uses. This designation provides for

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mixed use districts of local-serving, pedestrian-oriented commercial development, such as convenience shopping and professional offices in two- to three-story buildings. Development is expected to include ground-floor neighborhood retails uses and upper-level housing or offices, with a mix of small lot single family houses, townhomes, and multi-family dwelling units on side streets, in a horizontal or vertical mixed-use orientation. The built form will have a scale and character that is consistent with pedestrian-orientation, to attract and promote a walk-in clientele, with small lots and frequent roadway and pedestrian connections permitting convenient access from residences to commercial space. Automobile-oriented uses are not permitted. Residential densities range between 12 and 16 units per acre and the maximum FAR is 1.5.

Open Space

These designations apply to public and private recreational sites and facilities, including neighborhood, community and regional parks, recreational centers, golf courses and other open space areas. It also applies to multi-purpose trails that serve both regional and neighborhood level needs, some of which are paved while others, in particular those found along the San Joaquin River Bluff Environs, may be unpaved. Please see Figure 4. – Multi-Purpose Trails Map below. Moreover, these designations cover open space areas that are not parks or trails, such as riparian corridors, the clear zone around Fresno-Yosemite International Airport, and the San Joaquin riverbottom which is primarily designated as open space even though it includes a limited number of existing homes.

Public Facilities

These designations apply to lands owned by public entities, including City Hall and other City buildings, county buildings, schools, the municipal airport and hospitals. They also include public facilities such as fire and police stations, City-operated recycling centers and sewage treatment.

Buffer

This designation is intended to separate urban uses from commercial agricultural uses in order to preserve long-term viable agricultural areas and intensive farming operations adjoining but outside the Planning Area, which is coterminous with the SOI established by LAFCO. The buffer will serve to prevent urban residential and related uses from developing near agricultural operations, and thereby infringing on full operation of farmland of importance. A variety of uses are compatible with the purpose of the buffer that will be defined in detail in the Development Code update. General categories include environmental, habitat, water conveyance, retention and recharge, preservation and preparation of gravel resources for beneficial uses related to permanent water resource facilities, limited agriculture and necessary supportive uses, such as agricultural processing, sans animal processing or uses that have the potential to create obnoxious noise, odor, etc., and residential uses with 20 acres of land required per residence. The one-quarter mile wide Buffer designated along the eastern Planning Area Boundary (in SEGA) may be modified and reduced to a narrower band of appropriate Buffer uses if designed as an integrated part of a sub-area master plan required for SEGA development, and if the narrower Buffer design clearly achieves the goal of the Buffer classification to separate urban uses from commercial agricultural uses in order to preserve long-term viable agricultural areas and intensive farming operations adjoining but outside the Planning Area.

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LAND USE CLASSIFICATIONS: THE DOWNTOWN

These land use classifications are specific to just the Downtown portion of the Planning Area. It is anticipated the land use classifications may be further refined in community or specific plans such as the proposed Downtown Neighborhoods Community Plan and Fulton Corridor Specific Plan, which may be adopted by the City.

Central Business District (CBD)

The CBD is the cultural, civic, shopping, and transit center of Fresno and the region. This designation is applied to areas of the Downtown Core bounded by Stanislaus Street, the Union Pacific tracks, Inyo Street and the alley between Van Ness Avenue and L Street. New buildings will be block-scale, at least two stories and up to 15 stories in height and located at or near the sidewalk to promote vibrant streets of active ground floor commercial activity. Most upper stories will be expressed in a single volume to generate a consistent streetwall with upper most volumes massed for an interesting skyline. Buildings will be occupied with ground floor commercial, retail, and office activity to support active streetscapes and walking. Upper floors and the floor area behind shop fronts will accommodate a wide variety of office, civic, lodging, housing, or additional commercial uses.

Civic Center

The Civic Center is intended for civic and office uses, including numerous public buildings containing City, County, State, and Federal uses. This designation is applied to properties currently fronting Mariposa Street and the south side of Fresno Street and the north side of Tulare Street between Van Ness and Q. New buildings will be block-scale, up to 10 stories in height and set back from the sidewalk along a continuous build-to line to maintain a formal alignment and arrangement of building frontages. Upper stories will be expressed in volumes that enhance and support the civic presence of buildings along these streets. A full range of civic and office uses, including ground floor retail, are envisioned to support active streetscapes and walking. Upper floors will have office and civic uses.

Chinatown

The Chinatown designation is applied to the areas bounded by the Union Pacific Railroad tracks, Highway 99, Stanislaus Street and Inyo Street. Its close proximity to Highway 99 and the Downtown Core create the unique opportunity to introduce buildings and uses that serve both the region and the surrounding neighborhoods. F Street is preserved and developed as Chinatown's "main street." New buildings will be block-scale, up to 3 stories in height and located at the sidewalk to activate the sidewalk with pedestrian-oriented commercial activity. Most upper stories will be expressed in single volumes to enhance the small scale of this urban neighborhood and historic main street. Ground floor uses will include commercial, retail, civic or office uses to support active streetscapes and walking. Upper floors and the space behind shop fronts will have offices, housing or additional commercial uses.

Cultural Arts

This designation is applied to the area immediately north of the Central Business District which is undergoing transformation into a thriving artist community. This designation is intended to encourage the area's transformation by encouraging mixed-use buildings comprised primarily of small-scale retail, office, industrial, and multi-family housing. New buildings will be block scale, up to five stories tall that will be located at or near the sidewalk to generate an active public realm. Most upper stories will be expressed in single volumes

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with multiple volumes moderating larger buildings. Buildings will have ground floor retail uses, live-work, and uses such as art galleries on key streets to support active streetscapes and walking.

South Stadium/South Van Ness

This designation is applied to the areas immediately to south of the Central Business District, including the Monterrey and Los Angeles Street areas, and is intended for small-scale retail, office, industrial and multi-family housing. New buildings will be block-scale, with non-industrial buildings up to five stories in height located at or near the sidewalk to generate an active public realm. Secondary streets and upper floors will have residential and office uses. Industrial buildings may have larger footprints and may be up to two stories tall.

Town Center

The Town Center designation is applied to nodes at major intersections along corridors and is intended for medium-scale retail, housing, office, civic, and entertainment uses that serve several neighborhoods. New buildings will be block-scale, up to five stories in height and located at or near the sidewalk to generate focused and active, commercial activity along corridors. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Ground floor uses will include commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind shop fronts will have office, civic, residential or additional commercial uses.

Neighborhood Center

The Neighborhood Center designation is applied to nodes at secondary intersections along corridors and is comprised of primarily small-scale neighborhood uses such as retail, office, civic, and entertainment, including housing. New buildings will be block and house-scale, up to three stories in height, completely compatible in scale with adjacent single-family houses, and located at or near the sidewalk to generate pedestrian activity. Upper stories will be expressed in volumes compatible with adjacent houses. Buildings will have ground floor commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind shop fronts will have office, civic, residential or additional commercial uses.

Corridor General

This designation is applied to areas fronting on corridors including Belmont Avenue, East Kings Canyon Road, Blackstone Avenue, Abby Street, and North Fresno Street. It is intended for moderate intensity housing and neighborhood services, while also accommodating automobile-oriented commercial uses. New buildings will be block-scale and house-scale, up to three stories in height located at or near the sidewalk to generate more pedestrian activity. Buildings will vary in size and type, but be compatible in massing and scale with adjacent buildings. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Living rooms, dining rooms, and other formal rooms will face the street. Ground floor uses will include housing as well as commercial, retail and office uses. Upper floors will be for housing, office, or additional commercial uses.

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Downtown Neighborhoods

This designation is applied to areas outside of the Downtown Core, including the Lowell neighborhood, much of the Southwest and Southeast neighborhoods, the "L" Street area and to Huntington Boulevard area east of Downtown, the Jefferson Neighborhood, areas south of Elm and B Streets in Southwest, several Southeast neighborhoods adjacent to Highway 180, and areas west of Highway 99 including the Jane Addams area. New buildings will be house-scale up to 2 stories in height and some buildings may be up to two and one-half stories. All buildings will set back from the sidewalk to provide a buffer between the sidewalk and the dwellings. Living rooms, dining rooms, and other formal rooms will face and activate the street. Other house-scale buildings are compatible in these neighborhoods when scaled and massed in relation to the predominant single-family houses. Buildings will be occupied with residential uses, limited live/work uses and home occupation activity.

Special Districts

The Special Districts designation is applied to areas that are best suited for a variety of moderate to intense industrial and manufacturing activity. These areas are comprised primarily of large and varied building sizes with substantial activity from large cargo vehicles. New buildings will be block-scale, up to three stories in height and located with a portion or all of their frontage at or near or the sidewalk. Ground floor activity will range from industrial and manufacturing uses and outdoor assembly to offices. Included in the Special Districts designation are (1) the Chandler Airport area between Kearney Boulevard, and Thorne and Whitesbridge Avenues and (2) Downtown Hospital district, including the hospital campus as well as on surrounding streets such as Fresno, Illinois, Clark, and Divisadero.

DENSITY AND INTENSITY

The General Plan calculates density on **net acreage**, defined as the land area of a lot remaining after dedication of all areas for major streets, schools, or regional trails. Infill development already served by such infrastructure may have the same gross and net density, as a result.

For residential uses, the density/intensity standards are expressed as the number of housing units per net acre. For non-residential uses, a measure known as Floor Area Ratio (FAR) is specified. In design terms, FAR is defined as the permitted ratio of gross floor area to site area. It is a measure of building bulk that controls both visual prominence and traffic generation. See the accompanying image for a graphic example of how FAR is calculated.

The City-wide density and intensity standards, established in Table 5, are intended to establish minimum and maximum densities and intensities per net acre allowed in each General Plan land use category in the Planning Area exclusive of the Downtown. Minimum and maximum densities, intensities and required land use mixes are more precisely defined within the Development Code for purposes of determining the consistency of a proposed zone district and a property development entitlement with an applicable planned land use designation. The Development Code may also provide a process and criteria to allow exceptions to be granted for qualified small projects, special situations or single users offering community benefits and otherwise meeting the overall objectives of the General Plan. Minimum lot/parcel sizes (and corresponding lot frontage minimums and other lot design requirements) will be further

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defined in the Development Code for each zone district. The Development Code may also provide procedures and criteria for preparing and implementing a precise development plan for a given area to allow for limited reconfiguration of the planned land uses for a specific area while maintaining the equivalent densities, intensities and mix of uses. Finally, the General Plan land use designations may provide overlap in the defined densities, intensities and land uses described for various land uses.

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TABLE 5: CITYWIDE STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY[1]

Land Use Classification	*Minimum to Maximum Residential Density (du/net acre)*	*Maximum Floor Area Ratio (FAR)*
Residential		
Low-Density	Min = 1 unit per 5 acres Max = 3.5 units per acre	-
Medium Low Density	Min = 3.5 units per acre Max = 6 units per acre	-
Medium Density	Min = 5 units per acre Max = 12 units per acre	-
Medium High Density	Min = 12 units per acre Max = 16 units per acre	-
Urban Neighborhood Density	Min = 16 units per acre Max = 30 units per acre	-
High Density	Min = 30 units per acre Max = 45 units per acre	-
Commercial		
Main Street		1.0
Community		1.0
Recreation		0.5
General		2.0
Highway & Auto		0.75
Regional		1.0
Employment		
Office		2.0
Business Park		1.0
Regional Business Park		1.0
Light Industrial		1.5
Heavy Industrial		1.5
Mixed Use		
Corridor/Center Mixed Use	Min = 16 units per acre Max = 30 units per acre 40% Res. / 60% Non-res.	1.5

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TABLE 5: CITYWIDE STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY[1]

Land Use Classification	*Minimum to Maximum Residential Density (du/net acre)*	*Maximum Floor Area Ratio (FAR)*
Regional Mixed Use	Min = 30 units per acre Max = 45+ units per acre (higher with Master Plan) 30% Res. / 70% Non-res.	2.0
Neighborhood Mixed Use	Min = 12 units per acre Max = 16 units per acre 50% Res. / 50% Non-res.	1.5
Buffer	Max = 0.05 (1 unit per 20 acres)	-

Notes:
1. The dwelling unit standard also is a population density standard, and can be converted using a city-wide average of 3.23 persons per unit. The Hearing Draft of the General Plan Update will include a column with population density ranges. The population density standard is for general planning purposes and not intended to limit occupancy of individual units.

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Table 6 provides density and intensity standards specific to the Downtown portion of the Planning Area. More specific parameters as to the design and form of development will be further defined in the Development Code specific to the Downtown portion of the Planning Area.

TABLE 6: DOWNTOWN STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY

Land Use	*Maximum Residential Density (du/net acre)*[1]	*Maximum Floor Area Ratio*
Central Business District	60 units per acre	7.5
Civic Center	-	5.0
Chinatown	45 units per acre	3.0
South Stadium / South Van Ness	60 units per acre	5.0
Town Center	45 units per acre	4.0
Neighborhood Center	30 units per acre	2.0
Corridor General	30 units per acre	2.5
Downtown Neighborhoods	16 units per acre	-
Special Districts[2]	-	2.5

Notes:
1. Additional density may be allowed for affordable housing or provision of community benefits.
2. Additional FAR may be granted for hospitals and related uses, up to 5.0 total.

LAND USE DIAGRAM

Consistent with the Local Planning and Procedures Ordinance, the Land Use Diagram is the City's master designation of land uses for Fresno including the Sphere of Influence. The Land Use Diagram includes the Downtown area, anticipated to be further implemented through specific and community plans such as proposed the Fulton Corridor Specific Plan and Downtown Neighborhoods Community Plan, as identified in an inset. Land use descriptions in this area are generalized to facilitate implementation by providing some flexibility for detailed plans.

The Land Use Diagram is labeled as **Figure 2** and is provided above and in a separate fold-out map, attached to the hard copies of the Initiation Review Draft. All new parks, open space, and public facilities (such as school sites), carry dual land use designations, so that if that facility is not needed, private and public development consistent with zoning and development standards may be approved. These dual land use designations are shown on Figure 5. Dual Designations – Alternative Land Uses for Proposed Parks, Open Space, Schools, and Other Public Facilities.

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City of Fresno
2035 Fresno General Plan
Land Use Diagram

DRAFT FIGURE 2

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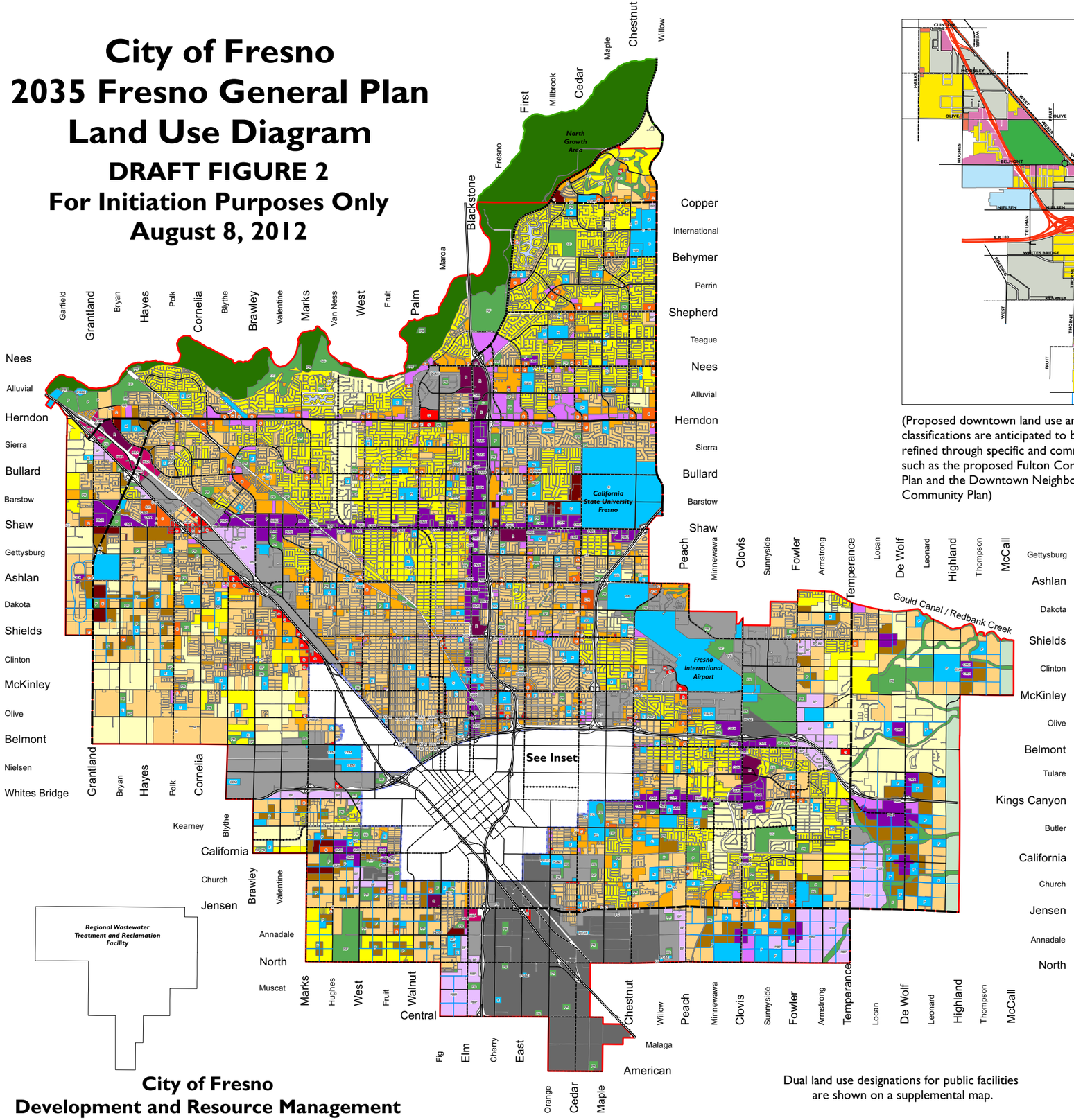

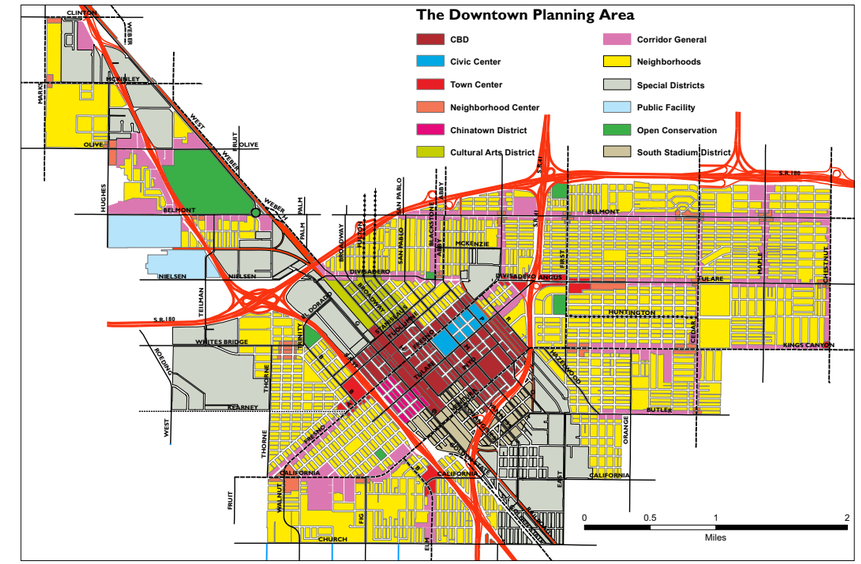

(Proposed downtown land use and circulation classifications are anticipated to be further refined through specific and community plans such as the proposed Fulton Corridor Specific Plan and the Downtown Neighbohoods Community Plan)

LEGEND

RESIDENTIAL
- Low Density (1-3 D.U./acre)
- Medium Low Density (3.5-6 D.U./acre)
- Medium Density (5.0-12 D.U./acre)
- Medium High Density (12-16 D.U./acre)
- Urban Neighborhood (16-30 D.U./acre)
- High Density (30-45 D.U./acre)

COMMERCIAL
- Main Street
- Community
- Recreation
- General
- Highway & Auto
- Regional

EMPLOYMENT
- Office
- Business Park
- Regional Business Park
- Light Industrial
- Heavy Industrial

MIXED USE
- Corridor/Center Mixed Use
- Regional Mixed Use
- Neighborhood Mixed Use

OPEN SPACE
- Clear Zone
- Commercial-Recreational
- Community Park
- Flood Control Project
- Golf Course
- Lake, Pond
- Multi-Use
- Neighborhood Park
- Outdoor Environmental education area
- Open Space
- Park
- Ponding Basin
- Ponding Basin (Park use)
- Regional Park

PUBLIC FACILITIES
- Public/Quasi-public Facility
- Special School
- Elementary School
- Elementary & Middle School
- Elementary, Middle & High School
- Middle School
- High School
- College
- Airport
- Cemetery
- Church
- Community Activity Center
- Convalescent Hospital
- Fairgrounds
- Fire Station
- Government Offices
- Hospital
- Medical Center
- Neighborhood Center
- PG & E Substation
- Police Dressing Station
- Water Recharge Basin
- Waste Water Treatment Facility

BUFFER
- Buffer

BOUNDARIES
- Existing Fresno Sphere of Influence
- Growth Areas
- Downtown Neighborhoods

Circulation Legend
- Freeway
- Expressway
- Scenic Expressway
- Connector
- Super Arterial
- Arterial
- Scenic Arterial
- Ramp
- Scenic Drive
- Collector
- Scenic Collector

Dual land use designations for public facilities are shown on a supplemental map.

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GENERAL PLAN AND ZONING CONSISTENCY

TABLE 7: GENERAL PLAN LAND USE DESIGNATIONS AND ZONE DISTRICTS

Land Use Designation	*Zone District*	
Residential		
Low Density	RE	Residential Estate
	RS-36	Single Family
	RS-20	
	RS-12	
Medium Low Density	RS-12	Single Family
	RS-9	
	RS-5	
Medium Density	RS-5	Single Family
	RS-2.5	
Medium High Density	RS-2.5	Single Family
	RM-2.5	Multi-Family
Urban Neighborhood Density	RM-1.5	Multi-Family
High Density	RM-1	Multi-Family
Commercial		
Main Street	MSC	Main Street Commercial
Community	CC	Community Commercial
Recreation	CR	Commercial Recreation
General	GC	General Commercial
Highway and Auto	HAC	Highway and Auto Commercial
Regional	RC	Regional Commercial
Employment		
Office	O	Office
Business Park	BP	Business Park
Regional Business Park	RBP	Small Business Park
Light Industrial	IL	Light Industrial
Heavy Industrial	IH	Heavy Industrial
Mixed-Use		
Corridor/Center Mixed Use	CMX	Corridor/Center Mixed Use
Regional Mixed Use	RMX	Regional Mixed Use
Neighborhood Mixed Use	NMX	Neighborhood Mixed-Use
Other		
Open Space	OS	Open Space
	PK	Park
Public Facilities	PI	Public and Institutional
Buffer	B	Buffer

Note: Specific zoned districts associated with Downtown land uses will be provided in a subsequent draft.

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CIRCULATION ELEMENT

Figure 3, the Circulation Map, illustrates the planned roadway network of the General Plan. For some roadways, especially in areas that are not yet developed with urban uses, the map indicates the future and not the present character of the road. The construction of planned major streets occurs during the course of a general plan's implementation through the execution of the City's capital improvements program utilizing funds from a variety of sources. In addition, portions of major streets are constructed by private property owners and developers in accordance with applicable property development standards.

STREET TYPOLOGIES

This General Plan update establishes a refined street classification system to categorize roadways and other transportation facilities, as shown in Figure 3. Each classification reflects the character of the facility as well as its function within the context of the entire transportation system. Each classification has standards considering a facility's relation to surrounding land uses, existing right-of-way, accessibility via other roadways, and appropriate travel speeds. It prioritizes travel modes for each road, but also how to accommodate multiple travel modes.

This classification system will be used for engineering design and traffic operation standards; these classifications may be modified for the growth areas described in the Urban Form, Land Use, and Design Element (e.g., SEGA or the Westside Growth Area) based on specific master planning, if approved by the City in the development review process.

Freeway: Multiple-lane divided roadways on adopted state route alignments servicing through and crosstown traffic, with no access to abutting property and no at-grade intersections.

Expressway – Suburban: Four- to six-lane divided roadways primarily serving through and crosstown vehicle traffic, with at-grade major street intersections located at approximately one-half mile intervals and no driveways for direct motor vehicle access to abutting property.

Superarterial – Activity Center and Suburban: Four- to six-lane divided roadways with a primary purpose of moving multiple modes of travel traffic to and from major traffic generators and between community plan areas. A select number of motor vehicle access points to adjacent properties or local streets between the major street intersections may be approved by the city. Access points will typically be limited to right-turn entrance and exit vehicular movements. Special circumstances may justify a median island opening between intersections to allow left-turn movement from the superarterial street to an adjoining property or local street.

Arterial – Activity Center and Suburban: Four- to six-lane divided roadways, with somewhat limited motor vehicle access to abutting properties, and with the primary purpose of moving traffic within and between neighborhoods and to and from freeways and expressways. In addition to major street intersections, appropriately designed and spaced local street intersections may allow left-turn movements to and from the arterial streets.

Collector – Activity Center and Suburban: Two- to four-lane, typically undivided roadways, with the primary function of connecting local streets and arterials and neighborhood traffic generators and providing access to abutting properties. Local street

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intersections and motor vehicle access points from abutting properties are allowed consistent with the city's engineering standards and accepted traffic engineering practices.

Quarter-mile and Connector: Two- to three-lane, typically undivided roadways planned to provide access to larger well integrated neighborhoods typically 40 to 160 acres in size and having a range of residential densities and one or more supporting uses, such neighborhood serving recreational open space, school, civic, quasi-public and shopping.

Local – Activity Center and Suburban: Two- to three-lane roadways designed to provide direct access to properties, while discouraging excessive speeds and volumes of motor vehicle travel incompatible with neighborhoods being served through the implementation of multiple well connected routes and traffic calming measures. Local street alignments are typically not designated by the General Plan, but existing local streets may be depicted for informational purposes. In specific circumstances local streets are designated where necessary to assure adequate access and implementation of complete neighborhoods with well-connected routes for motor vehicle, bicycle and pedestrian travel.

STREET DESIGN STANDARDS

The General Plan expands the roadway classification descriptions to include specific characteristics, such as pedestrian realm, on-street parking, number of vehicle lanes, bike lanes, and landscaped median, as shown in Table 8. Activity centers represent areas of greater land use intensity as well as places for walking and biking. The Suburban standards represent the city's current roadway system.

TABLE 8: ROADWAY CHARACTERISTIC MATRIX

Roadway Type	*Number of Lanes*	*Pedestrian Facilities*	*On-Street Bike Lanes*	*On-Street Parking*	*Median*
ACTIVITY CENTERS					
Superarterial	4 to 6	Sidewalks	Yes	n/a	n/a
Arterial	2 to 4	Sidewalks	Yes	Yes	Possible
Collector	2	Sidewalks	Yes	Yes	Possible
Local	2	Sidewalks	Possible	Yes	Possible
SUBURBAN					
Expressway	4 to 6	No	No	No	Yes
Superarterial	4 to 6	Possible	Yes	No	Possible
Arterial	4 to 6	Sidewalks	Yes	Possible	Typical
Collector	2 to 4	Sidewalks	Yes	Yes	Possible
Quarter-Mile & Connector	2 to 3	Sidewalks	Possible (not typical)	Yes	Possible (traffic calming)
Local	2	Sidewalks	Possible (not typical)	Yes	n/a

Source: Fehr & Peers, 2011

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City of Fresno
2035 Fresno General Plan
Circulation
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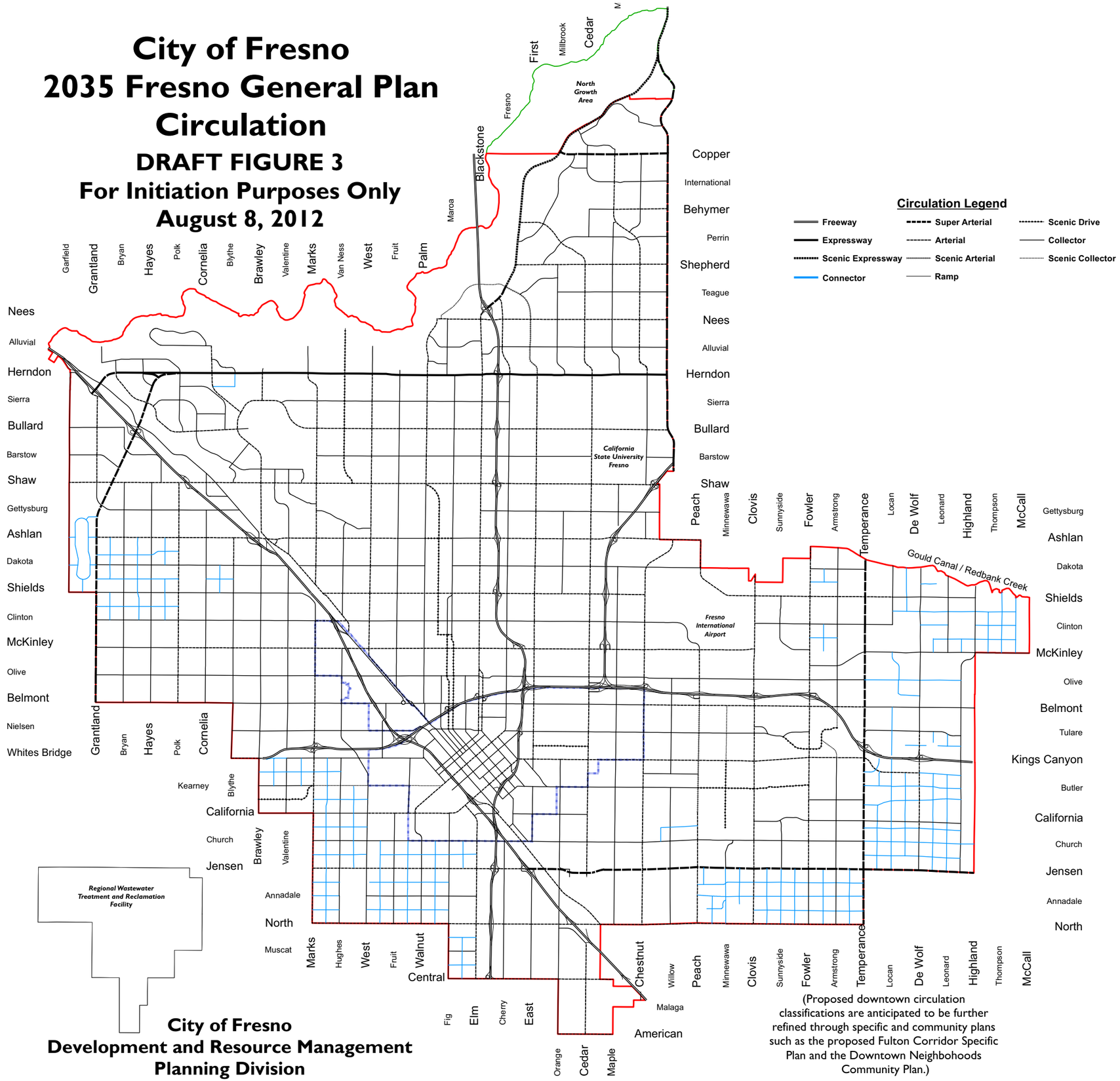
August 8, 2012



(Proposed downtown circulation classifications are anticipated to be further refined through specific and community plans such as the proposed Fulton Corridor Specific Plan and the Downtown Neighbohoods Community Plan.)

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GOALS AND OBJECTIVES

The City's Housing Element has already been approved and is not being comprehensively updated at this time as this work is scheduled to occur after adoption of the Regional Transportation Plan update and the Sustainable Communities Plan as specified under new State regulations set by SB 375. The approved Housing Element's goals and polices are incorporated by reference for the purposes of this Initiation Review Draft. However, technical amendments to the Housing Element needed for General Plan consistency may be proposed in the Hearing Draft of the General Plan as needed. If so, the Housing Element's goals, objectives, policies and programs will be included in the Hearing Draft of the General Plan, with any proposed amendments clearly indicated, so the City Council will be able to consider and act on a proposed General Plan that is complete and internally consistent. Goals and policies developed for the General Plan update are consistent with the approved and current Housing Element.

GOALS OF THE GENERAL PLAN

As explained by the OPR's General Plan Guidelines: "A goal is a general direction-setter. It is an ideal future end related to the public health, safety or general welfare. A goal is a general expression of community values and, therefore, may be abstract in nature. Consequently, a goal is generally not quantifiable or time-dependent…Goals should be expressed as ends, not actions."

The Goals for the General Plan were identified and considered by the GPCC, based on input by the public and from key stakeholders, and endorsed by the City Council and Planning Commission along with Alternative A. These Goals have since undergone minor edits for clarity, grammar, and consolidation, but are otherwise intact.

The commentary in italics following certain goals is mean to further discuss and clarify the goal to help guide the Objectives, which follow.

1. Increase opportunity, economic development, business and job creation.

   Use urban form, land use, and Development Code policies to streamline permit approval, promote local educational excellence and workforce relevance, significantly increase business development and expansion, attract and retain talented people, create jobs and sustained economic growth, strategically locate employment lands and facilities, and avoid of over-saturation of a single type of housing, retail or employment.

2. Support a successful and competitive Downtown.

   Emphasize infill development and a revitalized central core area as the primary activity center for Fresno and the region by locating substantial growth near the Downtown core and along the corridors leading to the Downtown. Use vision-based policies in a Development Code specific to the Downtown, when adopted, to ensure the creation of a unique sense of place in the central core.

3. Emphasize conservation, successful adaptation to climate and changing resource conditions, and performance effectiveness in the use of energy, water, land, buildings, natural resources, and fiscal resources required for the long-term sustainability of Fresno.

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4. Emphasize achieving healthy air quality and reduced greenhouse gas emissions.
5. Support agriculture as an integral industry and sustainable food production system.

   Emphasize the economic and cultural role of Fresno as a center of agriculture and food production systems by conserving farmland through a focus on developing vacant and underutilized land within the established Sphere of Influence of the City, limiting any further urban boundary expansion, and developing urban agriculture within the city and designated growth areas.

6. Protect, preserve, and enhance natural, historic, and cultural resources.

   Emphasize the continued protection of important natural, historic and cultural resources in the future development of Fresno. This includes both designated historic structures and neighborhoods, but also "urban artifacts" and neighborhoods that create the character of Fresno.

7. Provide for a diversity of districts, neighborhoods, housing types (including affordable housing), residential densities, job opportunities, recreation, open space, and educational venues that appeal to a broad range of people throughout the City.
8. Develop "complete neighborhoods" and districts with a compact and diverse mix of residential densities, building types, and affordability which are designed to be healthy, attractive, and centered by schools, parks, public and commercial services to provide a sense of place and that meet daily needs within walking distance.

   Intentionally plan for complete neighborhoods as an outcome, and not a collection of subdivisions which do not result in complete neighborhoods.

9. Promote a city of healthy communities and improve quality of life in existing neighborhoods.

   Emphasize supporting existing neighborhoods in Fresno with safe, well maintained, and accessible streets, public utilities, education and job training, proximity to jobs, retail services, and health care, affordable housing, youth development opportunities, open space and parks, transportation options, and opportunities for home grown businesses.

10. Emphasize increased land use intensity and mixed-use development at densities supportive of greater use of transit in Fresno.

    Greater densities can be achieved through encouragement, infrastructure, and incentives for infill and revitalization along major corridors and in activity centers.

11. Emphasize and plan for all modes of travel on local and major streets in Fresno.

    Facilitate travel by walking, biking, transit, and motor vehicle with interconnected and linked neighborhoods, districts, major campuses and public facilities, shopping centers and other service centers, and regional transportation such as air, rail, bus and highways.

12. Resolve existing public infrastructure and service deficiencies, make full use of existing infrastructure, and invest in improvements to increase competitiveness and promote economic growth.

    Emphasize the fair and necessary costs of maintaining sustainable water, sewer, streets, and other public infrastructure and service systems in rates, fees, financing and public investments to implement the General Plan. Adequately address accumulated deferred maintenance, aging

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infrastructure, risks to service continuity, desired standards of service to meet quality-of-life goals, and required infrastructure to support growth, economic competitiveness and business development.

13. Emphasize the City as a role model for growth management planning, regional cooperation, collaborative planning, efficient processing and permit streamlining, public-private partnerships and shared financing, sustainable urban development policies, environmental quality, and a strong economy, and work with other jurisdictions and institutions to further these values throughout the region.

    Positively influence the same attributes in other jurisdictions of the San Joaquin Valley—and thus the potential for regional sustainability—and improve the standing and credibility of the City to pursue appropriate State, LAFCO, and other regional policies that would curb sprawl and prevent new unincorporated community development which compete with and threaten the success of sustainable policies and development practices in Fresno.

14. Provide a network of well-maintained parks, open spaces, athletic facilities, and walking and biking trails connecting the city's districts and neighborhoods to attract and retain a broad range of individuals, benefit the health of residents, and provide the level of public amenities required to encourage and support development of higher density urban living and transit use.
15. Improve Fresno's visual image and enhance its form and function through urban design strategies and effective maintenance.
16. Protect and improve public health and safety.
17. Recognize, respect, and plan for Fresno's cultural, social, and ethnic diversity, and foster an informed and engaged citizenry.

    Emphasize shared community values and genuine engagement with and across different neighborhoods, communities, institutions, businesses and sectors to solve difficult problems and achieve shared goals for the success of Fresno and all its residents

OBJECTIVES

Objectives are the City's statements of how it plans to address existing and future issues and support the General Plan Goals. Every objective relates to at least one Goal and may support multiple goals.

The proposed objectives are organized by their intended General Plan Element, appearing in the order anticipated in the full General Plan Update. Objectives are labeled according to the element or section title, combined with a number that increases consecutively. In the full General Plan Update, each objective will be accompanied by one or more Implementing Policies, as done in the 2025 General Plan.

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Economic Development and Fiscal Sustainability Element (ED)

ED-1 Support economic development by maintaining a strong working relationship with the business community and improving the business climate for current and future businesses.

ED-2 Support local business start-ups and encourage innovation by improving access to resources and capital and help overcome obstacles hampering economic development.

ED-3 Attract and recruit businesses and offer incentives for economic development.

ED-4 Cultivate a skilled, educated, and well-trained workforce by increasing educational attainment and the relevant job skill levels in order to appeal to local and non-local businesses.

ED-5 Achieve fiscal sustainability.

Urban Form, Land Use, and Design Element

NOTE: Objectives UF-2 through UF-11 are currently major goals of the draft Downtown Neighborhoods Community Plan and Fulton Corridor Specific Plan, and are incorporated as objectives here to ensure appropriate representation of Downtown planning efforts supported by the General Plan update. The objectives are consistent with the draft Downtown Neighborhoods Community Plan and Fulton Corridor Specific Plans and will allow for the implementation of the updated General Plan.

Urban Form (UF)

UF-1 Emphasize the opportunity for a diversity of districts, neighborhoods, and housing types.

UF-2 Enhance the unique sense of character and identity of the different sub-areas of the Downtown neighborhoods.

UF-3 Revitalize the Downtown to be the government center and economic and cultural heart of the city and the region.

UF-4 Support and encourage arts and culture in the Downtown neighborhoods.

UF-5 Promote a greater concentration of buildings and people in the Downtown.

UF-6 Support new development in the Downtown through investment in public infrastructure.

UF-7 Promote a diverse mix of uses in the Downtown in order to create a community with a 24 hour per day life.

UF-8 Develop each of the Downtown's neighborhoods and districts, according to its unique character.

UF-9 Capitalize on the High Speed Train system to help revitalize the Downtown neighborhoods.

INITIATION REVIEW DRAFT

UF-10 Calibrate parking according to the Downtown's parking needs and make it efficient and easy to find.

UF-11 Revitalize the Fulton Mall.

UF-12 Locate roughly one-half of future residential development in infill areas—defined as being within the 2012 City limits—including the Downtown core area and surrounding neighborhoods, mixed use centers and transit-oriented development along major transit corridors, and other non-corridor infill areas and vacant land.

UF-13 Locate roughly one-half of future residential development in the growth areas—defined as unincorporated land in the 2012 Sphere of Influence—developed within complete neighborhoods that include housing, services, and recreation; mixed-use centers; or along future Bus Rapid Transit corridors.

UF-14 Create an urban form that facilitates multi-modal connectivity.

Land Use (LU)

LU-1 Establish a comprehensive citywide land use planning strategy to meet economic development objectives, achieve efficient and equitable use of resources and infrastructure, and create an attractive living environment.

LU-2 Plan for infill development that includes a range of housing types, building forms, and land uses to meet the needs of both current and future residents.

LU-3 Support the successful fulfillment of plan(s) adopted for the Downtown.

LU-4 Enhance existing residential neighborhoods through regulations, code enforcement, and compatible infill development.

LU-5 Plan for a diverse housing stock that will support balanced urban growth, and make efficient use of resources and public facilities.

LU-6 Retain and enhance existing commercial areas to strengthen Fresno's economic base and site new office, retail, and lodging uses districts to serve neighborhoods and regional visitors.

LU-7 Plan and support industrial development to promote job growth.

LU-8 Provide for the development of civic and institutional land uses to meet the educational, medical, social, economic, cultural, and religious needs of the community.

LU-9 Plan land uses, design, and development intensities to supplement and support, and not compete with, the Downtown.

LU-10 Promote regional cooperation and coordination on land use and planning issues among local jurisdictions.

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LU-11 Encourage coordination with adjacent jurisdictions in providing public services, infrastructure and cooperative economic development.

Design (D)

D-1 Provide and maintain an urban image that creates a "sense of place" throughout Fresno.

D-2 Enhance the visual image of all "gateway" routes entering the Fresno Planning Area.

D-3 Create unified plans for "green streets," using distinctive features reflecting Fresno's landscape heritage.

D-4 Preserve and strengthen Fresno's overall image through design review and create a safe, walkable and attractive urban environment for the current and future generations of residents.

D-5 Maintain and improve community appearance through programs that prevent and abate blighting influences.

D-6 Encourage design that celebrates and supports the cultural and ethnic diversity of Fresno.

D-7 Continue applying local urban form, land use, and design policies to specific neighborhoods and locations.

Mobility and Transportation Element (MT)

MT-1 Create and maintain a transportation system that is safe, efficient, provides access in an equitable manner, and optimizes travel by all modes.

MT-2 Make efficient use of the City's existing and proposed transportation system and strive to ensure the planning and provision of adequate resources to operate and maintain it.

MT-3 Identify, promote and preserve scenic or aesthetically unique corridors by application of appropriate policies and regulations.

MT-4 To establish and maintain a continuous, safe, and easily accessible bikeways system throughout the metropolitan area to reduce vehicle use, improve air quality and the quality of life, and provide public health benefits.

MT-5 Establish a well-integrated network of pedestrian facilities to accommodate safe, convenient, practical and inviting travel by walking including those with physical mobility and vision impairments.

MT-6 Establish a network of multi-purpose pedestrian and bicycle paths, as well as limited access trails, to serve areas and to link residential areas to local and regional open spaces and recreation areas and urban activity centers in order to enhance Fresno's recreational amenities and alternative transportation options.

INITIATION REVIEW DRAFT

MT-7 Pursue a variety of funding sources to maximize implementation and development of the City's path and trail system.

MT-8 Provide public transit options that serve existing and future concentrations of residences, employment, recreation and civic uses and are feasible, efficient, safe, and minimize environmental impacts.

MT-9 Provide public transit opportunities to the maximum number and diversity of people practicable in balance with providing service that is high in quality, convenient, frequent, reliable, and cost- effective.

MT-10 Establish parking standards that are strategically tuned to support neighborhoods, shopping districts and employment centers well served by a complete range of transportation choices.

MT-11 Achieve necessary capacity increasing and inter-modal connectivity enhancing improvements to the goods movement transportation system to support the growth in critical farm product and value added industries.

MT-12 Operate the City's municipal airport facilities to meet present and anticipated demands in a manner that maintains compliance with federal regulations, enhances safety to the public, minimizes the adverse effects of aircraft operations on people, and promotes the economic health of the community.

MT-13 Improve the competitiveness of domestic and international air carrier service, and air cargo operations to and from Fresno Yosemite International Airport.

Parks, Open Space, and Schools Element (POSS)

POSS-1 Provide an expanded, high quality and diversified park system, allowing for varied recreational opportunities for the entire Fresno community.

POSS-2 Ensure that adequate land, in appropriate locations, is designated and acquired for park and recreation uses in infill and growth areas.

POSS-3 Ensure that park and recreational facilities make the most efficient use of land; that they are designed and managed to provide for the entire Fresno community; and that they represent positive examples of design and energy conservation.

POSS-4 Pursue sufficient and dedicated funding for the parks acquisition, operations, and maintenance.

POSS-5 Provide for long-term preservation, enhancement, and enjoyment of plant, wildlife, and aquatic habitat.

POSS-6 Maintain and restore, where feasible, the ecological values of the San Joaquin River corridor.

POSS-7 Support the San Joaquin River Conservancy in its efforts to develop a river parkway.

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POSS-8 Work cooperatively with school districts to find appropriate locations for schools to meet the needs of students and neighborhoods.

POSS-9 Work with California State University, Fresno, and other institutions of higher learning, to enhance the city's workforce, job creation, and economic development, as well as its image and desirability as a place to live.

Public Utilities and Services Element (PU)

PU-1 Provide the level of law enforcement and crime prevention services necessary to maintain a safe, secure, and stable urban living environment through a Police Department that is dedicated to providing professional, ethical, efficient and innovative service with integrity, consistency and pride.

PU-2 Ensure that the Fire Department's staffing and equipment resources are sufficient to meet all fire and emergency service level objectives and are provided in an efficient and cost effective manner.

PU-3 Enhance the level of fire protection to meet the increasing demand for services from an increasing population.

PU-4 Ensure provision of adequate trunk sewer and collector main capacities to serve existing and planned urban development, consistent with the Wastewater Master Plan.

PU-5 Preserve groundwater quality and ensure that the health and safety of the entire Fresno community is not impaired by use of private on-site disposal systems.

PU-6 Ensure the provision of adequate sewage treatment and disposal by utilizing the Fresno-Clovis Regional Wastewater Treatment and Reclamation Facility as the primary facility, when economically feasible, for all existing and new development within the metropolitan area.

PU-7 Promote reduction in wastewater flows and develop facilities for beneficial reuse of reclaimed water and biosolids for management and distribution of treated wastewater.

PU-8 Manage and develop the City's water facilities on a strategic timeline basis that recognizes the long-life cycle of the assets and the duration of the resources, to ensure a safe, economical, and reliable water supply for existing and planned urban development and economic diversification.

PU-9 Provide adequate solid waste facilities and services for the collection, transfer, recycling, and disposal of refuse.

Resource Conservation Element (RC)

RC-1 Make efficient use of existing public infrastructure.

RC-2 Promote land uses that conserve resources.

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RC-3 Actively engage, listen to, educate, and enlist the support of the Fresno community on the need and strategies for resource conservation.

RC-4 In cooperation with other jurisdictions and agencies in the San Joaquin Valley Air Basin, take necessary actions to achieve and maintain compliance with State and federal air quality standards for criteria pollutants.

RC-5 In cooperation with other jurisdictions and agencies in the San Joaquin Valley Air Basin, take timely and necessary actions to achieve and maintain reductions in greenhouse gas emissions and all strategies that reduce the causes of climate change in order to limit and prevent the related potential detrimental effects upon public health and welfare of present and future residents of the Fresno community.

RC-6 Ensure that Fresno has a reliable, long-range source of drinkable water.

RC-7 Promote water conservation through standards, incentives and capital investments.

RC-8 Reduce the consumption of non-renewable energy resources by requiring and encouraging conservation measures and the use of alternative energy sources.

RC-9 Preserve agricultural land outside of the area planned for urbanization under this General Plan.

RC-10 Conserve aggregate mineral resources within the Planning Area, as identified by the Division of Mines and Geology, and allow for responsible extraction to meet Fresno's needs.

RC-11 Strive to reduce the solid waste going to landfills to zero by 2035.

Historic and Cultural Resources Element (HCR)

HCR-1 Maintain a comprehensive, citywide preservation program to identify, protect and assist in the preservation of Fresno's historic and cultural resources.

HCR-2 Identify and preserve Fresno's historic and cultural resources which reflect important cultural, social, economic and architectural features so that residents will have a foundation upon which to measure and direct physical change.

HCR-3 Promote the idea of a "New City Beautiful" ethos by linking historic preservation, public art, planning principles for complete neighborhoods with green building and technology.

HCR-4 Foster an appreciation of Fresno's history and cultural resources.

Noise and Safety Element (NS)

NS-1 Protect the citizens of the city from the harmful and annoying effects of exposure to excessive noise.

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NS-2 Minimize risks of property damage and personal injury posed by geologic and seismic risks.

NS-3 Minimize the risks to property, life, and the environment due to flooding and stormwater runoff hazards.

NS-4 Minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.

NS-5 Protect the safety, health, and welfare of persons and property on the ground and in aircraft by minimizing exposure to airport-related hazards.

NS-6 Foster an efficient and coordinated response to emergencies and natural disasters.

Healthy Communities Element (HC)

HC-1 Work with neighborhood associations of local residents, businesses, and institutions on neighborhood and community health initiatives.

HC-2 Create complete, well-structured, and healthy neighborhoods and transportation systems.

HC-3 Create healthy, safe, and affordable housing.

HC-4 Improve property maintenance.

HC-5 Promote access to healthy and affordable food.

HC-6 Improve access to schools and their facilities for the community.

HC-7 Establish priorities and mechanisms for park facilities improvements linked to effectiveness and improving health.

HC-8 Support programs, leadership, and opportunities for Fresno's youth.

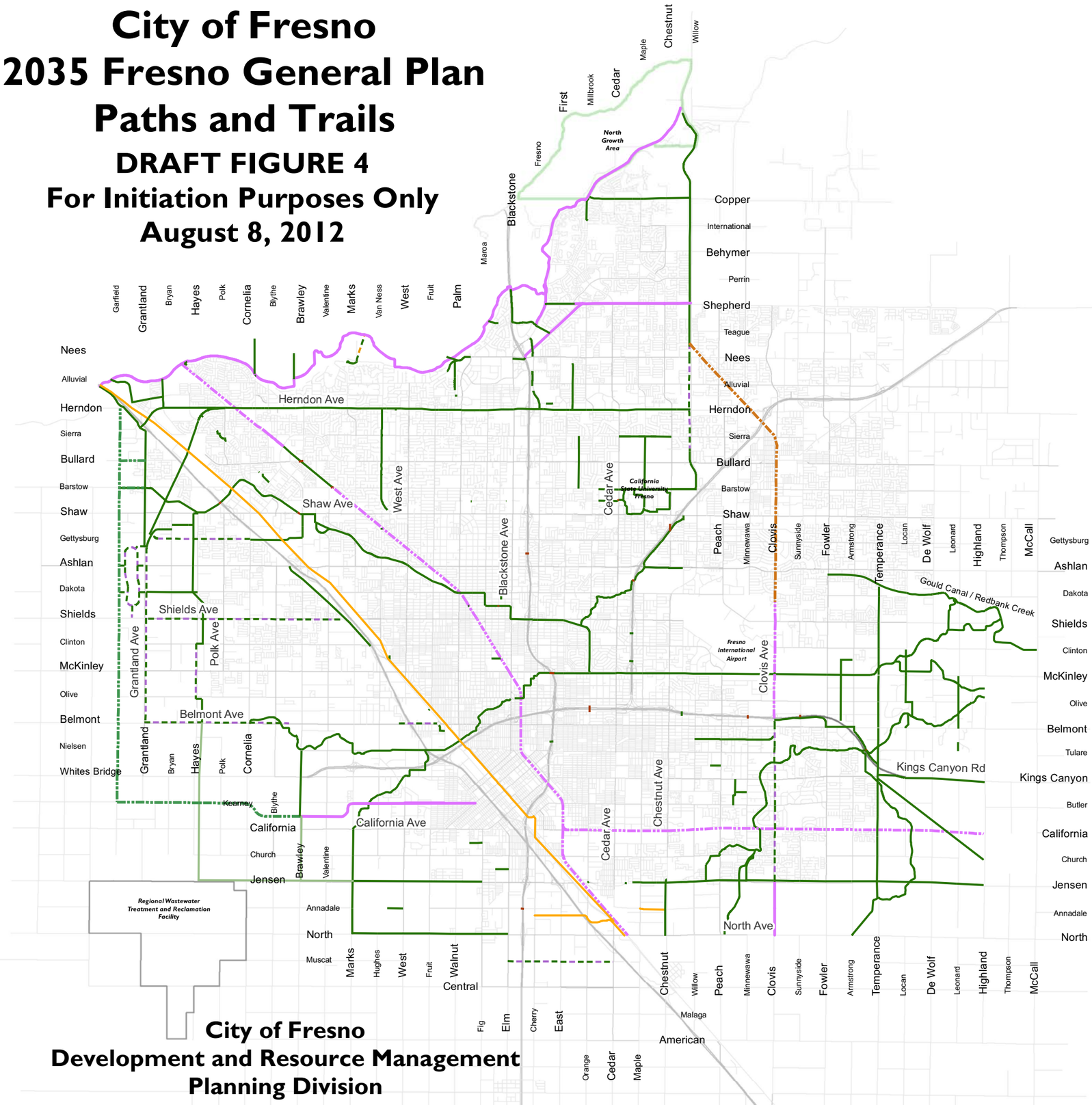
INITIATION REVIEW DRAFT

City of Fresno
2035 Fresno General Plan
Paths and Trails

DRAFT FIGURE 4

For Initiation Purposes Only

August 8, 2012



LEGEND

- Old Town Clovis Trail
- Greenbelt City/County (See note 1)
- Greenbelt Railroads (See note 2)
- Greenbelt
- Rails to Trails
- County Trail (See Note 3)
- Class I Bicycle Path
- Class I or Class II Bicycle Facility
- Class I or Class III Bicycle Facility
- High Cost Improvement

Note 1: Conceptual greenbelt alignment subject to city/county cooperative planning, adoption and implementation.

Note 2: Greenbelt required unless there is an existing railroad. Should existing railroad lines be vacated or relocated, it shall be converted to a greenbelt.

Note 3: To be determined by the County. City preferred location depicted.

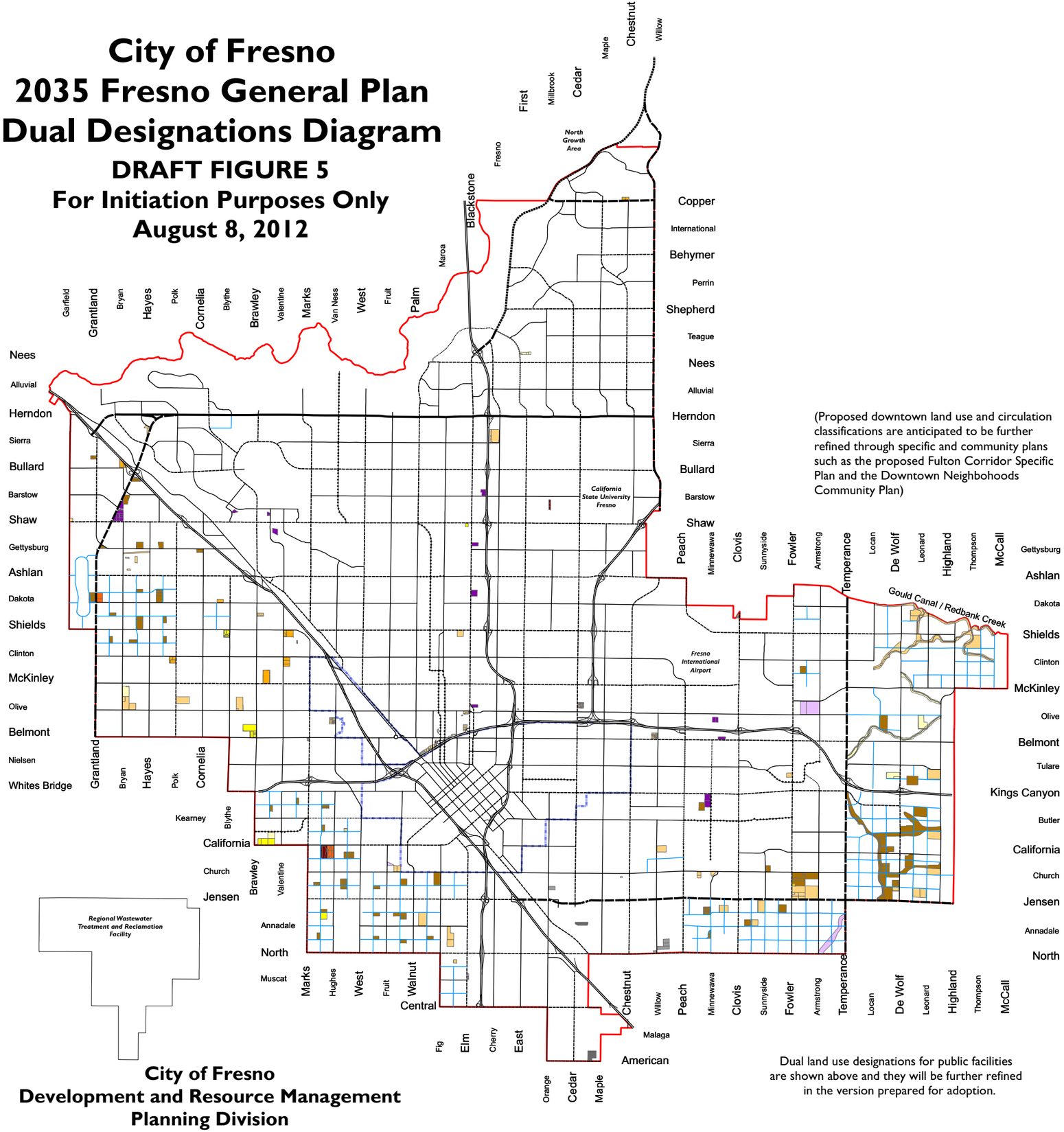
Note 4: The trail on the west side of State Route 99 between Ashlan and Clinton Avenues is dependent on the design of the realignment of State Route 99 in conjunction with the California High Speed Rail Authority and Caltrans.

Note 5: This map depicts paths and trails and supersedes Figure 5.2 of the 2010 City of Fresno Bicycle, Pedestrian and Trails Master Plan. For a complete bicycle system, refer to Class II bike lane and Class III bike route designations in the 2010 City of Fresno Bicycle, Pedestrian and Trails Master Plan.

City of Fresno
Development and Resource Management
Planning Division

City of Fresno
2035 Fresno General Plan
Dual Designations Diagram

DRAFT FIGURE 5
For Initiation Purposes Only
August 8, 2012



(Proposed downtown land use and circulation classifications are anticipated to be further refined through specific and community plans such as the proposed Fulton Corridor Specific Plan and the Downtown Neighbohoods Community Plan)

Dual land use designations for public facilities are shown above and they will be further refined in the version prepared for adoption.

LEGEND

RESIDENTIAL
- Low Density (1-3 D.U./acre)
- Medium Low Density (3.5-6 D.U./acre)
- Medium Density (5.0-12 D.U./acre)
- Medium High Density (12-16 D.U./acre)
- Urban Neighborhood (16-30 D.U./acre)
- High Density (30-45 D.U./acre)

COMMERCIAL
- Main Street
- Community
- Recreation
- General
- Highway & Auto
- Regional

EMPLOYMENT
- Office
- Business Park
- Regional Business Park
- Light Industrial
- Heavy Industrial

MIXED USE
- Corridor/Center Mixed Use
- Regional Mixed Use
- Neighborhood Mixed Use

OPEN SPACE
- Clear Zone
- Commercial-Recreational
- Community Park
- Flood Control Project
- Golf Course
- Lake, Pond
- Multi-Use
- Neighborhood Park
- Outdoor Environmental education area
- Open Space
- Park
- Ponding Basin
- Ponding Basin (Park use)
- Regional Park

PUBLIC FACILITIES
- Public/Quasi-public Facility
- Special School
- Elementary School
- Elementary & Middle School
- Elementary, Middle & High School
- Middle School
- High School
- College
- Airport
- Cemetery
- Church
- Community Activity Center
- Convalescent Hospital
- Fairgrounds
- Fire Station
- Government Offices
- Hospital
- Medical Center
- Neighborhood Center
- PG & E Substation
- Police Dressing Station
- Water Recharge Basin
- Waste Water Treatment Facility

BUFFER
- Buffer

BOUNDARIES
- Existing Fresno Sphere of Influence
- Growth Areas
- Downtown Neighborhoods

Circulation Legend
- Freeway
- Expressway
- Scenic Expressway
- Connector
- Super Arterial
- Arterial
- Scenic Arterial
- Ramp
- Scenic Drive
- Collector
- Scenic Collector

City of Fresno
Development and Resource Management
Planning Division

City of
FRESNO
Development and Resource
Management Department

2600 Fresno Street
Fresno, CA 93721
(559) 621-CITY

Exhibit B
CalEnviroScreen 2.0

California Communities Environmental Health Screening Tool, Version 2.0 (CalEnviroScreen 2.0)

Guidance and Screening Tool

August 2014

Matthew Rodriquez, Secretary
California Environmental Protection Agency

George V. Alexeeff, Ph.D., Director
Office of Environmental Health Hazard Assessment

OEHHA Authors:

John Faust

Laura August

George Alexeeff

Komal Bangia

Rose Cendak

Elyse Cheung-Sutton

Lara Cushing

Vanessa Galaviz

Tamara Kadir

Julian Leichty

Carmen Milanes

Karen Randles

Andrew Slocombe

Robbie Welling

Walker Wieland

Lauren Zeise

OEHHA Editors:

Allan Hirsch

Shankar Prasad

David Siegel

CalEPA Reviewers:

Miriam Barcellona Ingenito

Arsenio Mataka

Gina Solomon

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PREFACE TO VERSION 2.0

CalEnviroscreen 2.0 is the latest iteration of the CalEnviroScreen tool. It uses the same methodology as Version 1.1 except that the two indicators for drinking water and unemployment have been added, and the tool looks at pollution burdens and vulnerabilities in census tracts rather than ZIP codes. The two new indicators incorporate potential burdens to communities posed by contaminants in drinking water and potential social stressors relating to unemployment. The use of census tracts as the geographic scale may allow for a more precise screening of pollution burdens and vulnerabilities in communities. While race and ethnicity will not be used in compiling a score using CalEnviroScreen, an analysis that provides information on the racial and ethnic composition of communities throughout the state as it relates to CalEnviroScreen scores is being released separately. This information will help us to better understand the correlation between race/ethnicity and the pollution burdens facing communities in California. CalEPA and OEHHA are committed to updating and expanding this section as new versions of the tool are released.

GUIDANCE FROM THE SECRETARY

State law defines environmental justice to mean "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." One of our top priorities over the last three years has been to integrate the principles represented by this definition into the activities of the boards, departments and office within the California Environmental Protection Agency (CalEPA or Agency). CalEPA's mission is to restore, protect and enhance the environment, and to ensure public health, environmental quality and economic vitality; environmental justice and investment in communities burdened by pollution are critical to accomplishing this mission.

As an important first step to assuring that all Californians have access to environmental justice, it is necessary to identify the areas of the state that face multiple pollution burdens so programs and funding can be targeted appropriately toward improving the environmental health and economic vitality of the most impacted communities. Despite the best efforts of government, community groups and businesses, many Californians live in the midst of multiple sources of pollution and some people and communities are more vulnerable to the effects of pollution than others. For this reason, the Agency and the Office of Environmental Health Hazard Assessment (OEHHA) developed a science-based tool for evaluating multiple pollutants and stressors in communities, called the California Communities Environmental Health Screening Tool (CalEnviroScreen). The first version of CalEnviroScreen was released in April 2013, and Version 1.1 was released in September 2013.

We are now pleased to release Version 2.0 for public review. This version of CalEnviroScreen refines the tool by incorporating the additional indicators of drinking water and unemployment rates, modifying the geographic scale by using census tracts, and enhancing the current indicators by incorporation of the most up-to-date information. These changes are intended to improve the scientific basis of the tool, and make it more useful to CalEPA and to others.

To ensure that CalEnviroScreen is properly understood and utilized, we are also providing this guidance to the Agency, its boards, departments and office, as well as to the public and stakeholders. Our experience using CalEnviroScreen over the last year informs both our new version of the tool and this updated guidance.

Finally, the release of this new draft version of CalEnviroScreen is an indicator of CalEPA and OEHHA's ongoing commitment to regularly revise the tool, using new information as it becomes available to make the tool as meaningful and as current as possible.

Background

CalEnviroScreen is primarily designed to assist the Agency in carrying out its environmental justice mission to conduct its activities in a manner that ensures the fair treatment of all Californians, including minority and low-income populations. The development of the tool was a major step in the implementation of the Agency's 2004 Environmental Justice Action Plan, which called for the development of guidance to analyze the impacts of multiple pollution sources in California communities.

CalEPA released the first draft of CalEnviroScreen for public review and comment in July 2012. This

draft built upon a 2010 report[1] that described the underlying science and a general method for identifying communities that face multiple pollution burdens. The tool identified the portions of the state that have higher pollution burdens and vulnerabilities than other areas, and therefore are most in need of assistance. In a time of limited resources, CalEnviroScreen provides meaningful insight into how decision makers can focus available time, resources and programs to improve the environmental health of Californians, particularly those most burdened by pollution. The tool uses existing environmental, health, demographic and socioeconomic data to create a screening score for communities across the state. An area with a high score would be expected to experience much higher impacts than areas with low scores.

CalEPA and OEHHA solicited comments and suggestions, and considered them in making additional changes to CalEnviroScreen 1.0. These changes were finalized in April 2013. While updating the tool to Versions 1.1 and 2.0, CalEPA and OEHHA again reviewed comments received during the 12 public workshops and in the nearly 1,000 written comments associated with the initial development of CalEnviroScreen. We also considered input from our boards and departments that were evaluating the tool for their use. This current draft incorporates many of the suggestions we have received to date.

Uses

Uses of the tool by CalEPA and its boards, departments and office include administering environmental justice grants, promoting greater compliance with environmental laws, prioritizing site-cleanup activities and identifying opportunities for sustainable economic development in heavily impacted neighborhoods. Other entities and interested parties may identify additional uses for this tool and the information it provides.

Implementation of SB 535

CalEnviroScreen will inform CalEPA's identification of disadvantaged communities pursuant to Senate Bill 535 (De León, Chapter 830, Statutes of 2012). SB 535 requires CalEPA to identify disadvantaged communities based on geographic, socioeconomic, public health and environmental hazard criteria. It also requires that the investment plan developed and submitted to the Legislature pursuant to Assembly Bill 1532 (John A. Pérez, Chapter 807, Statutes of 2012) allocate no less than 25 percent of available proceeds from the carbon auctions held under California's Global Warming Solutions Act of 2006 to projects that will benefit these disadvantaged communities. At least 10 percent of the available moneys from these auctions must be directly invested in such communities. Since CalEnviroScreen has been developed to identify areas disproportionately affected by pollution and those areas whose populations are socioeconomically disadvantaged, it is well suited for the purposes described by SB 535.

Environmental Justice Activities

CalEnviroScreen aids the administration of the Agency's Environmental Justice Small Grant Program, and guides other grant programs as well as environmental education and community programs throughout the state. The tool also helps to inform Agency boards and departments when they are budgeting scarce resources for cleanup and abatement projects. Additionally, CalEnviroScreen helps to guide boards and departments when planning their community engagement and outreach efforts. Knowing which areas of the state have higher relative environmental burdens has not only assisted efforts to increase compliance with environmental laws in disproportionately impacted areas, but also provides CalEPA and its boards, departments and office with additional insights on the potential implications of their activities and decisions.

[1] OEHHA and CalEPA (2012) *Cumulative Impacts: Building a Scientific Foundation*, Sacramento, CA. Available online at: http://www.oehha.ca.gov/ej/cipa123110.html

Local and Regional Governments

Local and regional governments, including regional air districts, water districts and planning and transit agencies, may also find uses for this tool. CalEPA will continue to work with local and regional governments to further explore the applicability of CalEnviroScreen for other uses. This includes the possibility of helping to identify and plan for sustainable development opportunities in heavily impacted neighborhoods. These areas could also be targeted for cleaning up blight and promoting development to bring in jobs and increase economic stability. As an example, the tool is being used to develop planning and financial incentives to retain jobs and create new, sustainable business enterprises in disproportionately impacted communities.

Of course, it will be important to work with organizations such as economic development corporations, workforce investment boards, local chambers of commerce and others to develop strategies to help businesses thrive in the identified areas and to attract new businesses and services to those areas. CalEnviroScreen may also assist local districts and governments with meeting their obligations under certain state funding programs.

Finally, it is important to remember that CalEnviroScreen provides a broad environmental snapshot of a given region. While the data gathered in developing the tool could be useful for decision makers when assessing existing pollution sources in an area, more precise data are often available to local governments and would be more relevant in conducting such an examination.

General Notes and Limitations

CalEnviroScreen was developed for CalEPA and its boards, departments and office. Its publication does not create any new programs, regulatory requirements or legal obligations. There is no mandate express or implied that local governments or other entities must use the tool or its underlying data. Planning, zoning and development permits are matters of local control and local governments are free to decide whether the tool's output or the information contained in the tool provides an understanding of the environmental burdens and vulnerabilities in their localities.

While CalEnviroScreen assists CalEPA and its boards, departments and office in prioritizing resources and helping promote greater compliance with environmental laws, it is important to note some of its limitations. The tool's output provides a relative ranking of communities based on a selected group of available datasets, through the use of a summary score. The CalEnviroScreen score is not an expression of health risk, and does not provide quantitative information on increases in cumulative impacts for specific sites or projects. Further, as a comparative screening tool, the results do not provide a basis for determining when differences between scores are significant in relation to public health or the environment. Accordingly, the tool is not intended to be used as a health or ecological risk assessment for a specific area or site.

Additionally, the CalEnviroScreen scoring results are not directly applicable to the cumulative impacts analysis required under the California Environmental Quality Act (CEQA). The statutory definition of "cumulative impacts" contained in CEQA is substantially different than the working definition of "cumulative impacts" used to guide the development of CalEnviroScreen. Therefore, the information provided by this tool cannot substitute for analyzing a specific project's cumulative impacts as required in a CEQA environmental review.

Moreover, CalEnviroScreen assesses environmental factors and effects on a regional or community-wide basis and cannot be used in lieu of performing an analysis of the potentially significant impacts of any specific project. Accordingly, a lead agency must determine independently whether a proposed project's impacts may be significant under CEQA based on the evidence before it, using its own discretion and judgment. The tool's results are not a substitute for this required analysis. Also, this tool considers some social, health and economic

factors that may not be relevant when doing an analysis under CEQA. Finally, as mentioned above, the tool's output should not be used as a focused risk assessment of a given community or site. It cannot predict or quantify specific health risks or effects associated with cumulative exposures identified for a given community or individual.

Conclusion

We are proud of the collaborative work of OEHHA and the input of the departments and boards in CalEPA, as well as the level of public participation and level of input we have received in the development of CalEnviroScreen. This project represents the largest public screening tool effort in the nation – both in geographic scope and level of detail. It is an achievement that could not have been realized had it not been for the tireless efforts of OEHHA and the invaluable input of all of our stakeholders. The ongoing development and evolution of CalEnviroScreen has involved many residents, community-based organizations, nongovernmental organizations, local officials, state agencies and representatives from business, industry and academia. The release of CalEnviroScreen 1.0 was just the first step. This updated version of CalEnviroScreen is a result of a continued cooperative effort. We welcome your active participation as we move forward with future versions of CalEnviroScreen and work to advance environmental justice and economic vitality in California.

Matthew Rodriquez
Secretary for Environmental Protection

August 2014

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INTRODUCTION

Californians are burdened by environmental problems and sources of pollution in ways that vary across the state. Some Californians are more vulnerable to the effects of pollution than others. CalEnviroScreen 2.0 uses a science-based method for evaluating multiple pollution sources in a community while accounting for a community's vulnerability to pollution's adverse effects. The tool can be used to identify California's most burdened and vulnerable communities. This can help inform decisions at the California Environmental Protection Agency's (CalEPA) boards and departments by identifying places most in need of assistance.

Statewide Evaluation

Using CalEnviroScreen 2.0, a statewide analysis has been conducted that identifies communities in California most burdened by pollution from multiple sources and most vulnerable to its effects, taking into account their socioeconomic characteristics and underlying health status. In doing so, CalEnviroScreen

- Produces a *relative*, rather than absolute, measure of impact.
- Provides a baseline assessment and methodology that can be expanded upon and updated periodically as important additional information becomes available.
- Demonstrates a practical and scientific methodology for evaluating multiple pollution sources and stressors that takes into account a community's vulnerability to pollution.

Factors that contribute to a community's pollution burden or vulnerability are often referred to as stressors. Community impact assessment from multiple pollution sources and stressors is complex and difficult to approach with traditional risk assessment practices. Chemical-by-chemical, source-by-source, route-by-route risk assessment approaches are not well suited to the assessment of community-scale impacts, especially for identifying the most impacted places across all of California. Although traditional risk assessment may account for the heightened sensitivities of some groups, such as children and the elderly, it has not considered other community characteristics that have been shown to affect vulnerability to pollution, such as socioeconomic factors or underlying health status.

Given the limits of traditional risk assessment, the Office of Environmental Health Hazard Assessment (OEHHA) and CalEPA developed CalEnviroScreen to conduct statewide evaluations of community impacts. It built upon the general method and a description of the underlying science published in CalEPA's and OEHHA's 2010 report, *Cumulative Impacts: Building A Scientific Foundation*. The method emerged from basic risk assessment concepts and is sufficiently expansive to incorporate multiple factors that reflect community impacts that have not been included in traditional risk assessments. The tool presents a broad picture of the burdens and vulnerabilities different areas confront from environmental pollutants. It relies on the use of indicators to measure factors that affect pollution impacts in communities.

CalEnviroScreen 2.0 contains a number of important improvements over the 1.0 and 1.1 versions that were finalized and released last year. CalEnviroScreen 2.0 analyzes communities at the census tract, rather than ZIP code level. This provides a finer scale of resolution for many parts of the state. New indicators have been included to account for drinking water quality and vulnerability due to unemployment within communities, and a number of improvements have been made to the individual indicators that characterize community stressors.

Stakeholder Involvement

Transparency and public input into government decision making and policy development are the cornerstones of environmental justice. In that spirit, the framework for the CalEnviroScreen was developed with the assistance of the Cumulative Impacts and Precautionary Approaches Work Group, consisting of representatives of business and non-governmental organizations, academia and government. CalEPA also received input on the original CalEnviroScreen 1.0 tool at a series of regional and stakeholder-specific public workshops and an academic workshop - from California communities, businesses, local governments, California tribes, community-based organizations, academia and other stakeholders. We appreciate the time and effort that the Work Group, stakeholders and general public devoted to guide the development of CalEnviroScreen.

Work in this field continues and will presents opportunities to refine CalEnviroScreen 2.0. CalEPA remains committed to an open and public process in developing future versions of the tool.

This report begins by describing the tool's methodological approach, and how indicators of pollution burden and vulnerability are selected and combined to calculate a CalEnviroScreen score for an individual census tract. The report also describes how the data for individual indicators are selected and analyzed. Data representing the indicators for the different areas of the state are presented here as statewide maps.[2] The statewide maps for the individual indicators and the CalEnviroScreen scores are available online. The report concludes by providing general results for the statewide evaluation, presented as maps showing the census tracts with the highest CalEnviroScreen scores.

[2] The community scores for individual indicators are available online at http://www.oehha.ca.gov/ej/index.html.

METHOD

THE CALENVIROSCREEN MODEL

Definition of Cumulative Impacts

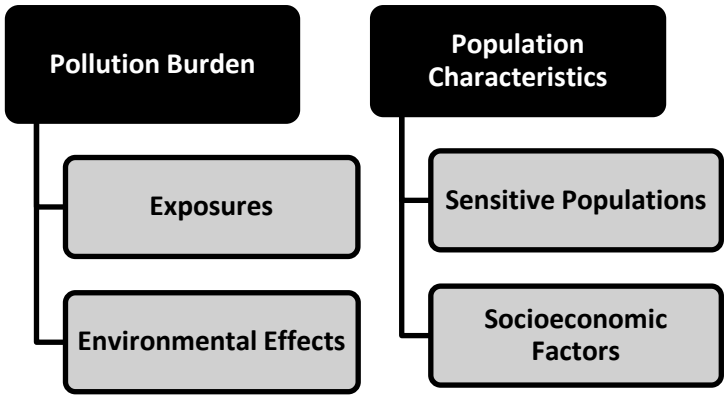
CalEPA adopted the following working definition of cumulative impacts[3] in 2005:

> *"Cumulative impacts means exposures, public health or environmental effects from the combined emissions and discharges, in a geographic area, including environmental pollution from all sources, whether single or multi-media, routinely, accidentally, or otherwise released. Impacts will take into account sensitive populations and socioeconomic factors, where applicable and to the extent data are available."*

CalEnviroScreen Model

The CalEnviroScreen model is based on the CalEPA working definition in that:

- The model is place-based and provides information for the entire State of California on a geographic basis. The geographic scale selected is intended to be useful for a wide range of decisions.
- The model is made up of multiple components cited in the above definition as contributors to cumulative impacts. The model includes two components representing pollution burden – exposures and environmental effects – and two components representing population characteristics – sensitive populations (e.g., in terms of health status and age) and socioeconomic factors.



[3] This definition differs from the statutory definition of "cumulative impacts" contained in the California Environmental Quality Act (CEQA). While the term is the same, they cannot be used interchangeably. For a detailed discussion of this issue, please see the Guidance from the Secretary.

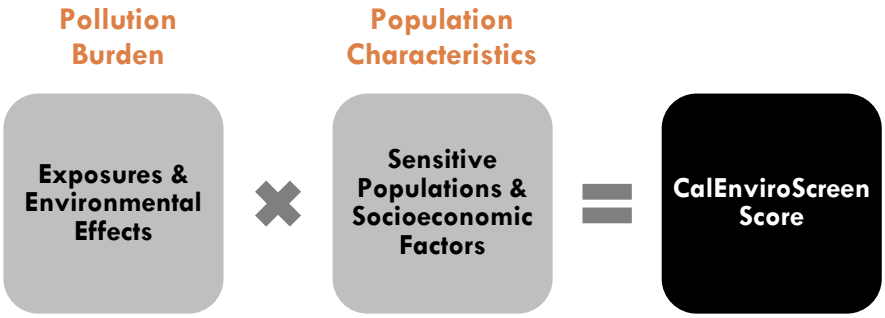
Model Characteristics

The model:

- Uses a suite of statewide indicators to characterize both pollution burden and population characteristics.
- Uses a limited set of indicators in order to keep the model simple.
- Assigns scores for each of the indicators in a given geographic area.
- Uses a scoring system to weight and sum each set of indicators within pollution burden and population characteristics components.
- Derives a CalEnviroScreen score for a given place relative to other places in the state, using the formula below.

Formula for Calculating CalEnviroScreen Score

After the components are scored, the scores are combined as follows to calculate the overall CalEnviroScreen Score:



Rationale for Formula

The mathematical formula for calculating scores uses multiplication. Scores for the pollution burden and population characteristics categories are multiplied together (rather than added, for example). Although this approach may be less intuitive than simple addition, there is scientific support for this approach to scoring.

Multiplication was selected for the following reasons:

1. *Scientific Literature*: Existing research on environmental pollutants and health risk has consistently identified socioeconomic and sensitivity factors as "effect modifiers." For example, numerous studies on the health effects of particulate air pollution have found that low socioeconomic status is associated with about a 3-fold increased risk of morbidity or mortality for a given level of particulate pollution (Samet and White, 2004). Similarly, a study of asthmatics found that their sensitivity to an air pollutant was up to 7-fold greater than non-asthmatics (Horstman *et al.*, 1986). Low-socioeconomic status African-American mothers exposed to traffic-related air pollution were twice as likely to deliver preterm babies (Ponce *et al.*, 2005). The young can be 10 times more sensitive to environmental carcinogen exposures than adults (OEHHA, 2009). Studies of increased

risk in vulnerable populations can often be described by effect modifiers that amplify the risk. This research suggests that the use of multiplication makes sense.

2. *Risk Assessment Principles*: Some people (such as children) may be 10 times more sensitive to some chemical exposures than others. Risk assessments, using principles first advanced by the National Academy of Sciences, apply numerical factors or multipliers to account for potential human sensitivity (as well as other factors such as data gaps) in deriving acceptable exposure levels (US EPA, 2012).
3. *Established Risk Scoring Systems*: Priority-rankings done by various emergency response organizations to score threats have used scoring systems with the formula:
   Risk = Threat × Vulnerability (Brody *et al.*, 2012).
   These formulas are widely used and accepted.

Maximum Scores for Combined Components

Component Group	Maximum Score*
Pollution Burden	
Exposures and Environmental Effects	10
Population Characteristics	
Sensitive Populations and Socioeconomic Factors	10
CalEnviroScreen Score	**Up to 100 (= 10 × 10)**

* Enough decimal places were retained in the calculation to eliminate ties.

Notes on Scoring System

In the CalEnviroScreen model, the Population Characteristics are a modifier of the Pollution Burden. In mathematical terms, the Pollution Burden is the multiplicand and Population Characteristics is the multiplier, with the CalEnviroScreen Score as the product. The final ordering of the communities is independent of the magnitude of the scale chosen for the Population Characteristics (without rounding scores). That is, the communities would be ordered the same in their final score if the Population Characteristics were scaled to 3, 5, or 10, for example. Here, a scale up to 10 was chosen for convenience.

Selection of Geographic Scale

CalEnviroScreen 2.0 uses the census tract scale as the unit of analysis. Census tract boundaries are available from the Census Bureau. These were updated in 2010. There are approximately 8,000 census tracts in California, representing a relatively fine scale of analysis. Census tracts are made up of multiple census blocks, which are the smallest geographic unit for which population data are available. Some census blocks have no people residing in them (unpopulated blocks).

CalEnviroScreen 2.0 Scores and Race/Ethnicity

The relationship between the calculated CalEnviroScreen score and race/ethnicity will be examined with the final CalEnviroScreen 2.0 data scheduled for release in June 2014.

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Brody TM, Di Bianca P, Krysa J (2012). Analysis of inland crude oil spill threats, vulnerabilities, and emergency response in the midwest United States. *Risk Analysis* **32**(10):1741-9. [Available at URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2012.01813.x/pdf].

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Samet JM, White RH (2004) Urban air pollution, health, and equity. *J Epidemiol Community Health*, **58**:3-5 [Available at URL: http://jech.bmj.com/content/58/1/3.full].

US EPA (2012). Dose-Response Assessment [Available at URL: http://www.epa.gov/risk/dose-response.htm].

INDICATOR SELECTION AND SCORING

The overall CalEnviroScreen community scores are driven by indicators. Here are the steps in the process for selecting indicators and using them to produce scores.

Overview of the Process

1. Identify potential indicators for each component.
2. Find sources of data to support indicator development (see Criteria for Indicator Selection below).
3. Select and develop indicator, assigning a value for each geographic unit.
4. Assign a percentile for each indicator for each geographic unit, based on the rank-order of the value.
5. Generate maps to visualize data.
6. Derive scores for pollution burden and population characteristics components (see Indicator and Component Scoring below).
7. Derive the overall CalEnviroScreen score by combining the component scores (see below).
8. Generate maps to visualize overall results.

The selection of specific indicators requires consideration of both the type of information that will best represent statewide pollution burden and population characteristics, and the availability and quality of such information at the necessary geographic scale statewide.

Criteria for Indicator Selection

An indicator should provide a measure that is relevant to the component it represents, in the context of the 2005 CalEPA cumulative impacts definition.

Indicators should represent widespread concerns related to pollution in California.

The indicators taken together should provide a good representation of each component.

Pollution burden indicators should relate to issues that may be potentially actionable by CalEPA boards and departments.

Population characteristics indicators should represent demographic factors known to influence vulnerability to disease.

Data for the indicator should be available for the entire state at the census tract level geographical unit or translatable to the census tract level.

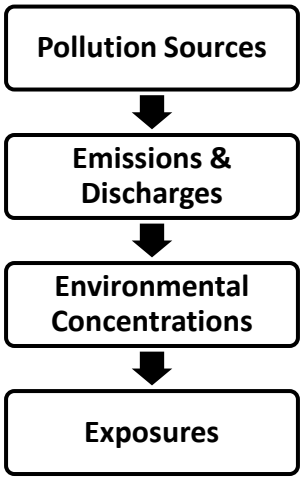
Data should be of sufficient quality, and be:

- Complete
- Accurate
- Current

Exposure Indicators

People may be exposed to a pollutant if they come in direct contact with it, by breathing contaminated air, for example.

No data are available statewide that provide direct information on exposures. Exposures generally involve movement of chemicals from a source through the environment (air, water, food, soil) to an individual or population. CalEnviroScreen uses data relating to pollution sources, releases, and environmental concentrations as indicators of potential human exposures to pollutants. Seven indicators were identified and found consistent with criteria for exposure indicator development. They are:



Ozone concentrations in air
PM2.5 concentrations in air
Diesel particulate matter emissions
Use of certain high-hazard, high-volatility pesticides
Toxic releases from facilities
Traffic density
Drinking water contaminants

Environmental Effect Indicators

Environmental effects are adverse environmental conditions caused by pollutants.

Environmental effects include environmental degradation, ecological effects and threats to the environment and communities. The introduction of physical, biological and chemical pollutants into the environment can have harmful effects on different components of the ecosystem. Effects can be immediate or delayed. The environmental effects of pollution can also affect people by limiting their ability to make use of ecosystem resources (e.g., eating fish or swimming in local rivers or bays). Also, living in an environmentally degraded community can lead to stress, which may affect human health. In addition, the mere presence of a contaminated site or high-profile facility can have tangible impacts on a community, even if actual environmental degradation cannot be documented. Such sites or facilities can contribute to perceptions of a community being undesirable or even unsafe.

Statewide data on the following topics were identified and found consistent with criteria for indicator development:

Toxic cleanup sites
Groundwater threats from leaking underground storage sites and cleanups
Hazardous waste facilities and generators

Impaired water bodies
Solid waste sites and facilities

Sensitive Population Indicators

Sensitive populations are populations with biological traits that result in increased vulnerability to pollutants.
Sensitive individuals may include those undergoing rapid physiological change, such as children, pregnant women and their fetuses, and individuals with impaired physiological conditions, such as the elderly or people with existing diseases such as heart disease or asthma. Other sensitive individuals include those with lower protective biological mechanisms due to genetic factors.

Pollutant exposure is a likely contributor to many observed adverse outcomes, and has been demonstrated for some outcomes such as asthma, low birth weight, and heart disease. People with these health conditions are also more susceptible to health impacts from pollution. With few exceptions, adverse health conditions are difficult to attribute solely to exposure to pollutants. High quality statewide data related to sensitive populations affected by toxic chemical exposures were identified and found consistent with criteria for development of these indicators:

Children and elderly
Asthma emergency department visits
Low birth-weight infants

Socioeconomic Factor Indicators

Socioeconomic factors are community characteristics that result in increased vulnerability to pollutants.
A growing body of literature provides evidence of the heightened vulnerability of people of color and lower socioeconomic status to environmental pollutants. For example, a study found that individuals with less than a high school education who were exposed to particulate pollution had a greater risk of mortality. Here, socioeconomic factors that have been associated with increased population vulnerability were selected.

Data on the following socioeconomic factors were identified and found consistent with criteria for indicator development:

Educational attainment
Linguistic isolation
Poverty
Unemployment

Indicator and Component Scoring

The indicator values for the census tracts for the entire state are ordered from highest to lowest. A percentile is calculated from the ordered values for all areas that have a score.* Thus each area's percentile rank for a specific indicator is relative to the ranks for that indicator in the rest of the places in the state.

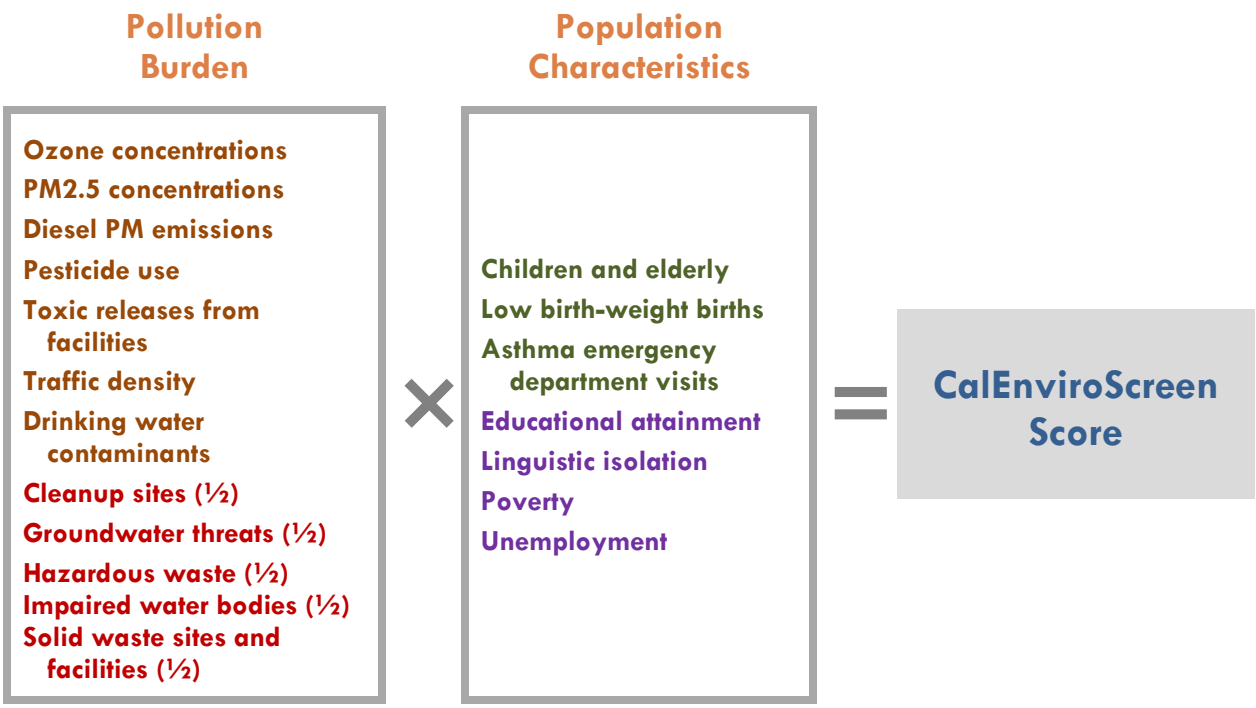
- The indicators used in this analysis have varying underlying distributions, and percentile rank calculations provide a useful way to describe data without making any potentially unwarranted assumptions about those distributions.
- A geographic area's percentile for a given indicator simply tells the percentage of areas with lower values of that indicator.
- A percentile cannot describe the magnitude of the difference between two or more areas. For example, an area ranked in the 30th percentile is not necessarily three times more impacted than an area ranked in the 10th percentile.

Indicators from Exposures and Environmental Effects components were grouped together to represent Pollution Burden. Indicators from Sensitive Populations and Socioeconomic Factors were grouped together to represent Population Characteristics (see figure below).

Scores for the Pollution Burden and Population Characteristics groups of indicators are calculated as follows:

- First, the percentiles for all the individual indicators in a group are averaged. Each indicator from the Environmental Effects component was weighted half as much as those indicators from the Exposures component. This was done because the contribution to possible pollutant burden from the Environmental Effects indicators was considered to be less than those from sources in the Exposures indicators. Thus the score for the Pollution Burden category is a weighted average, with Exposure indicators receiving twice the weight as Environmental Effects indicators.
- Second, Pollution Burden and Population Characteristics percentile averages are scaled so that they have a maximum value of 10 and a possible range of 0 to 10. Each average was divided by the maximum value observed in the state and then multiplied by 10 (see example calculation on Page 16). The scaling ensures that the pollution component and population component contribute equally to the overall CalEnviroScreen score.

* When a geographic area has no indicator value (for example, the census tract has no hazardous waste generators or facilities), it is excluded from the percentile calculation and assigned a score of zero for that indicator. When data are unavailable or missing for a geographic area (for example, the area is greater than 50 kilometers from an air monitor), it is excluded from the percentile calculation and is not assigned any score for that indicator. Thus the percentile score can be thought of as a comparison of one geographic area to other localities in the state where the hazard effect or population characteristic is present.



CalEnviroScreen Score and Maps

The overall CalEnviroScreen score is calculated from the Pollution Burden and Population Characteristics groups of indicators by multiplying the two scores. Since each group has a maximum score of 10, the maximum CalEnviroScreen Score is 100.

The geographic areas are ordered from highest to lowest, based on their overall score. A percentile for the overall score is then calculated from the ordered values. As for individual indicators, a geographic area's overall CalEnviroScreen percentile equals the percentage of all ordered CalEnviroScreen scores that fall below the score for that area.

Maps are developed showing the percentiles for all the census tracts of the state. Maps are also developed highlighting the census tracts scoring the highest.

Uncertainty and Error

There are different types of uncertainty that are likely to be introduced in the development of any screening method for evaluating pollution burden and population vulnerability in different geographic areas. Important ones are:

- The degree to which the data that are included in the model are correct.
- The degree to which the data and the indicator metric selected provide a meaningful measure of the pollution burden or population vulnerability.
- The degree to which data gaps or omissions influence the results.

Efforts were made to select datasets for inclusion that are complete, accurate and current. Nonetheless, uncertainties may arise because environmental conditions change over time, or large databases may contain errors or be incomplete, among others. Some of these uncertainties were addressed in the development of indicators. For example:

- Clearly erroneous place-based information for facilities or sites has been removed.
- Highly uncertain measurements (for example, >50 kilometers from an air monitor) have been excluded from the analysis.

Other types of uncertainty, such as those related to how well indicators measure what they are intended to represent, are more difficult to measure quantitatively. For example:

- How well data on chemical uses or emissions reflect potential contact with pollution.
- How well vulnerability of a community is characterized by demographic data.

Generally speaking, indicators are surrogates for the characteristic being modeled, so a certain amount of uncertainty is inevitable. That said, this model comprised of a suite of indicators is considered useful in identifying places burdened by multiple sources of pollution with populations that may be especially vulnerable. Places that score highly for many of the indicators are likely to be identified as impacted. Since there are tradeoffs in combining different sources of information, the results are considered most useful for identifying communities that score highly using the model. Using a limited data set, an analysis of the sensitivity of the model to changes in weighting showed it is relatively robust in identifying more impacted areas (Meehan August *et al.*, 2012). Use of broad groups of areas, such as those scoring in the highest 15 and 20 percent, is expected to be the most suitable application of the CalEnviroScreen results.

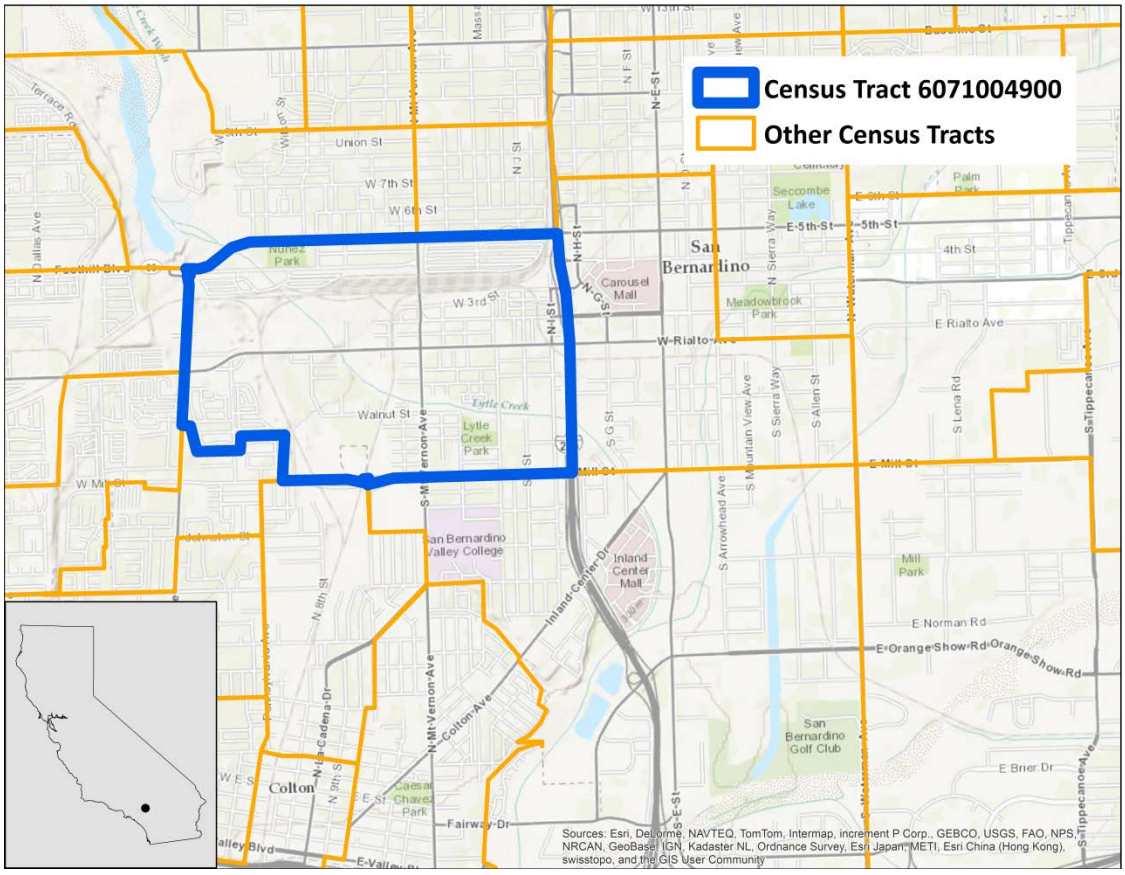
Reference

Meehan August L, Faust JB, Cushing L, Zeise L, Alexeeff, GV (2012). Methodological Considerations in Screening for Cumulative Environmental Health Impacts: Lessons Learned from a Pilot Study in California. *Int J Environ Res Public Health* ***9****(9)*: 3069-3084.

EXAMPLE CENSUS TRACT: INDICATOR RESULTS AND CALENVIROSCREEN SCORE

One example census tract in San Bernardino was selected to illustrate how an overall CalEnviroScreen score is calculated using the California Communities Environmental Health Screening Tool. Shown below are:

- An area map for the census tract and surrounding tracts.
- Tables for the indicators of Pollution Burden and Population Characteristics with percentile scores for each of the indicators.
- A table showing how a CalEnviroScreen score was calculated for the example area, using CalEnviroScreen 2.0.



Exposure Indicators							
Indicator	Ozone (conc.)	PM2.5 (conc.)	DieselPM (emissions)	Pesticide Use (lbs/sq. mi.)	Toxic Releases (RSEI toxicity-weighted releases)	Traffic (density)	Drinking Water (index)
Raw Value	0.79	12.31	23.35	0	851.4	1484.8	533.17
Percentile	98.47	74.24	71.47	0	63.31	73.41	83.86

Environmental Effects Indicators					
Indicator	Cleanup Sites (weighted sites)	Groundwater Threats (weighted sites)	Hazardous Waste Facilities/ Generators (weighted sites)	Impaired Water Bodies (number of pollutants)	Solid Waste Sites/Facilities (weighted sites and facilities)
Raw Value	21.3	5.75	0.73	1	0
Percentile	84.44	24.74	82.19	15.12	0

Sensitive Population Indicators			
Indicator	Children (<10) and Elderly (>65) (percent)	Asthma (rate per 10,000)	Low Birth Weight (percent)
Raw Value	25.9	104.45	0.05
Percentile	62.88	97.13	36.24

Socioeconomic Factor Indicators				
Indicator	Educational Attainment (percent)	Linguistic Isolation (percent)	Poverty (percent)	Unemployment (percent)
Raw Value	54	26.1	70.5	19.84
Percentile	95.05	89.35	94.39	92.90

CALCULATION OF CALENVIROSCREEN SCORE FOR TRACT 6071004900

	Pollution Burden		Population Characteristics	
	Exposures *(7 indicators)*	**Environmental Effects**[a] *(5 indicators)*	**Sensitive Populations** *(3 indicators)*	**Socioeconomic Factors** *(4 indicators)*
Indicator Percentiles	98.47 + 74.24 + 71.47 + 0.0 + 63.31 + 73.41 + 83.86	+ (0.5 × 84.44) + (0.5 × 24.74) + (0.5 × 82.19) + (0.5 × 15.12) + (0.5 × 0.0)	62.88 + 97.13 + 36.24	95.05 + 89.35 + 94.39 + 92.90
Average Percentile	568 ÷ (7+(0.5 × 5)) = 59.79		567.94 ÷ 7 = 81.13	
Scaled Component Scores (Range 0 – 10)	(59.79 ÷ 82. 49[b]) × 10 = 7.25		(81.13 ÷ 96. 22[c]) × 10= 8.43	
CalEnviroScreen Score	7.25 × 8.43 = 61.12 (61.12 is in the top 5% of CalEnviroScreen census tracts statewide)			

[a] Indicators from the Environmental Effects component were given half the weight of the indicators from the Exposures component.
[b] The tract with the highest average percentile for Pollution Burden in the state had a value of 82.49.
[c] The tract with the highest average percentile for Population Characteristics in the state had a value of 96.22.

INDIVIDUAL INDICATORS: DESCRIPTION AND ANALYSIS

POLLUTION BURDEN: EXPOSURE AND ENVIRONMENTAL EFFECT INDICATORS

AIR QUALITY: OZONE

Exposure Indicator

Ozone pollution causes numerous adverse health effects, including respiratory irritation and lung disease. The health impacts of ozone and other criteria air pollutants (particulate matter (PM), nitrogen dioxide, carbon monoxide, sulfur dioxide, and lead) have been considered in the development of health-based standards. Of the six criteria air pollutants, ozone and particle pollution pose the most widespread and significant health threats. The California Air Resources Board maintains a wide network of air monitoring stations that provides information that may be used to better understand exposures to ozone and other pollutants across the state.

Indicator

Amount of the daily maximum 8-hour ozone concentration over the California 8-hour standard (0.070 ppm), averaged over three years (2009 to 2011).

Data Source

Air Monitoring Network,
California Air Resources Board (CARB)

CARB, local air pollution control districts, tribes and federal land managers maintain a wide network of air monitoring stations in California. These stations record a variety of different measurements including concentrations of the six criteria air pollutants and meteorological data. In certain parts of the state, the density of the stations can provide high-resolution data for cities or localized areas around the monitors. However, not all cities have stations.

The information gathered from each air monitoring station audited by the CARB includes maps, geographic coordinates, photos, pollutant concentrations, and surveys.

http://www.arb.ca.gov/aqmis2/aqmis2.php
http://www.epa.gov/airquality/ozonepollution/
http://www.niehs.nih.gov/health/topics/agents/ozone/

Rationale

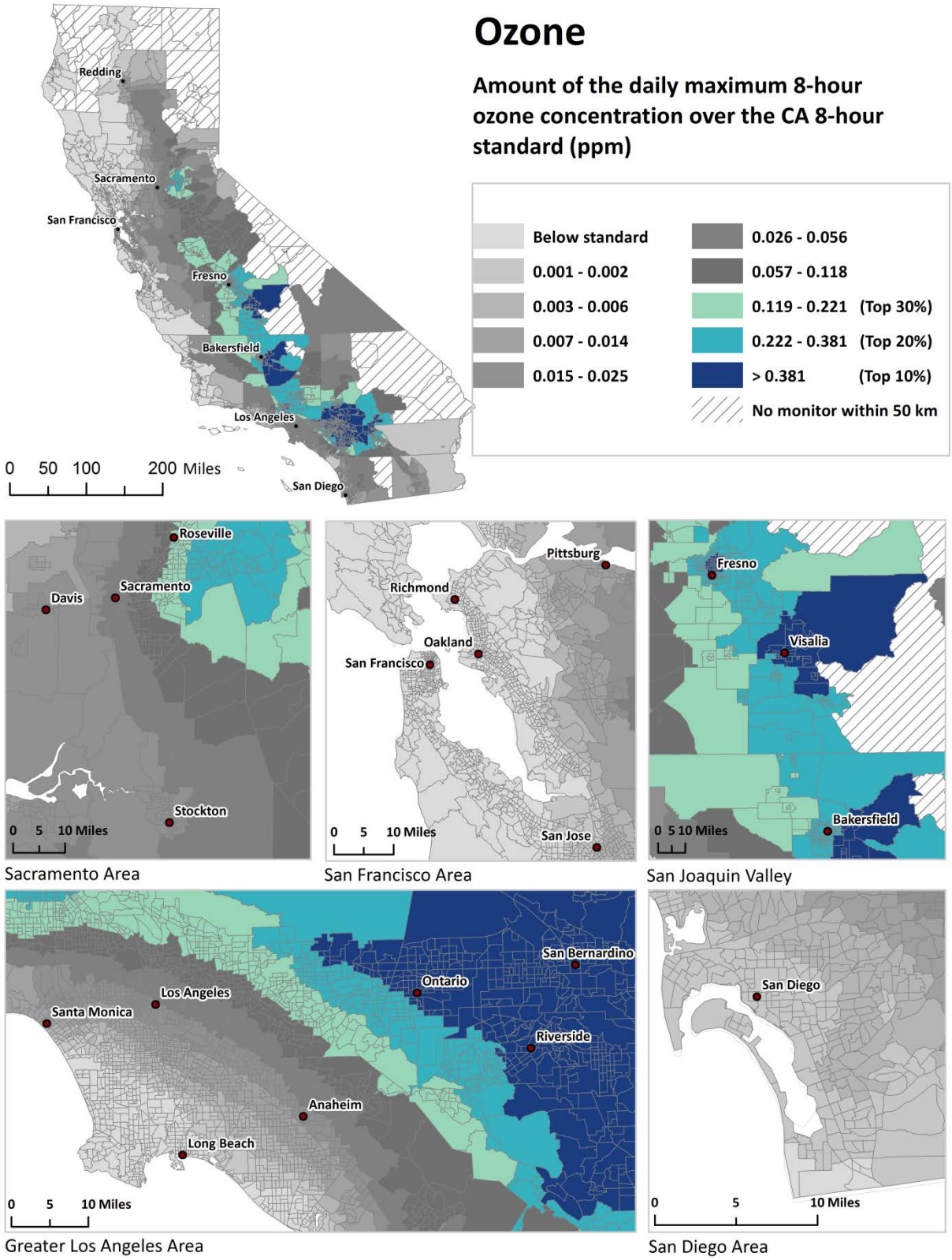
Ozone is an extremely reactive form of oxygen. In the upper atmosphere ozone provides protection against the sun's ultraviolet rays. Ozone at ground level is the primary component of smog. Ground-level ozone is formed from the reaction of oxygen-containing compounds with other air pollutants in the presence of sunlight. Ozone levels are typically at their highest in the afternoon and on hot days (NRC, 2008).

Adverse effects of ozone, including lung irritation, inflammation and exacerbation of existing chronic conditions, can be seen at even low exposures (Alexis *et al.* 2010, Fann *et al.* 2012, Zanobetti and Schwartz 2011). A long-term study in southern California found that rates of asthma hospitalization for children increased during warm season episodes of high ozone concentration (Moore *et al.* 2008). Additional studies have shown that the increased risk is higher among children under 2 years of age, young males, and African American children (Lin *et al.*, 2008, Burnett *et al.*, 2001). Increases in ambient ozone have also been

associated with higher mortality, particularly in the elderly, women and African Americans (Medina-Ramon, 2008). A study in New Mexico found an association between ozone and both cardiovascular and respiratory emergency room visits during spring and summer months when ambient ozone concentrations are highest (Rodopoulou *et al.*, 2014). Some of the relationships between CalEnviroScreen scores and race are explored in the final section of the report. Together with PM2.5, ozone is a major contributor to air pollution-related morbidity and mortality (Fann *et al.* 2012).

Method

- Daily maximum 8-hour average concentrations for all monitoring sites in California were extracted from CARB's air monitoring network database for the years 2009-2011.
- The California 8-hour standard (0.07 ppm) is subtracted from the monitoring data to arrive at the amount of the 8-hour concentration above the California standard. Only concentrations over the federal standard from 2009-2011 were used.
- For each day in the 2009-2011 time period, the 8-hour ozone concentrations over the standard were estimated at the geographic center of the census tract using a geostatistical method that incorporates the monitoring data from nearby monitors (ordinary kriging).
- The estimated daily concentrations over the standard were averaged to obtain a single value for each census tract.
- Census tracts were ordered by ozone concentration values and assigned a percentile based on the statewide distribution of values.
- Note: values at census tracts with centers more than 50 km from the nearest monitor were not estimated (signified by cross-hatch in map).


Ozone
Amount of the daily maximum 8-hour ozone concentration over the CA 8-hour standard (ppm)
Below standard
0.001 - 0.002
0.003 - 0.006
0.007 - 0.014
0.015 - 0.025
0.026 - 0.056
0.057 - 0.118
0.119 - 0.221 (Top 30%)
0.222 - 0.381 (Top 20%)
> 0.381 (Top 10%)
No monitor within 50 km
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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Burnett RT, Smith-Doiron M, Stieb D, Raizenne ME, Brook JR, *et al*. (2001). Association between Ozone and Hospitalization for Acute Respiratory Diseases in Children Less than 2 Years of Age. *American Journal of Epidemiology* **153**(5):444-452.

Fann N, Lamson AD, Anenberg SC, Wesson K, Risley D, Hubbell BJ (2012). Estimating the National Public Health Burden Associated with Exposure to Ambient PM2.5 and Ozone. *Risk Analysis* **32**(1):81-95.

Lin S, Liu X, Le, LH, Hwang, S (2008). Chronic Exposure to Ambient Ozone and Asthma Hospital Admissions among Children. *Environ Health Perspect* **116**(12):1725-1730.

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AIR QUALITY: PM2.5

Exposure Indicator

Particulate matter pollution, and fine particle (PM2.5) pollution in particular, has been shown to cause numerous adverse health effects, including heart and lung disease. PM2.5 contributes to substantial mortality across California. The health impacts of PM2.5 and other criteria air pollutants (ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, and lead) have been considered in the development of health-based standards. Of the six criteria air pollutants, particle pollution and ozone pose the most widespread and significant health threats. The California Air Resources Board maintains a wide network of air monitoring stations that provides information that may be used to better understand exposures to PM2.5 and other pollutants across the state.

Indicator

Annual mean concentration of PM2.5 (average of quarterly means), over three years (2009-2011).

Data Source

Air Monitoring Network,
California Air Resources Board (CARB)

CARB, local air pollution control districts, tribes and federal land managers maintain a wide network of air monitoring stations in California. These stations record a variety of different measurements including concentrations of the six criteria air pollutants and meteorological data. The density of the stations is such that specific cities or localized areas around monitors may have high resolution. However, not all cities have stations.

The site information gathered from each air monitoring station audited by CARB includes maps, locations coordinates, photos, pollutant concentrations, and surveys.

http://www.arb.ca.gov/aqmis2/aqmis2.php
http://www.epa.gov/airquality/particlepollution/

Rationale

Particulate matter (PM) is a complex mixture of aerosolized solid and liquid particles including such substances as organic chemicals, dust, allergens and metals. These particles can come from many sources, including cars and trucks, industrial processes, wood burning, or other activities involving combustion. The composition of PM depends on the local and regional sources, time of year, location and weather. The behavior of particles and the potential for PM to cause adverse health effects is directly related to particle size. The smaller the particle size, the more deeply the particles can penetrate into the lungs. Some fine particles have also been shown to enter the bloodstream. Those most susceptible to the effects of PM exposure include children, the elderly, and persons suffering from cardiopulmonary disease, asthma, and chronic illness (US EPA, 2012a).

PM2.5 refers to particles that have a diameter of 2.5 micrometers or less. Particles in this size range can have adverse effects on the heart

and lungs, including lung irritation, exacerbation of existing respiratory disease, and cardiovascular effects. The US EPA has set a new standard for ambient PM2.5 concentration of 12 μg/m^3, down from 15 μg/m^3. According to EPA's projections, by the year 2020 only seven counties nationwide will have PM2.5 concentrations that exceed this standard. All are in California (US EPA, 2012b).

In children, researchers associated high ambient levels of PM2.5 in Southern California with adverse effects on lung development (Gauderman *et al.,* 2004). Another study in California found an association between components of PM2.5 and increased hospitalizations for several childhood respiratory diseases (Ostro *et al.,* 2009). In adults, studies have demonstrated relationships between daily mortality and PM2.5 (Ostro *et al.* 2006), increased hospital admissions for respiratory and cardiovascular diseases (Dominici *et al.* 2006), premature death after long-term exposure, and decreased lung function and pulmonary inflammation due to short term exposures (Pope, 2009). A large study in six US communities, including Los Angeles, found an association between increased PM2.5 concentration and an increased risk of stroke (Adar *et al.*, 2013). A California study of long term PM2.5 exposure in women found significant associations with biomarkers of inflammation that can indicate increased risk of cardiovascular disease (Ostro *et al.,* 2014). Exposure to PM during pregnancy has also been associated with low birth weight and premature birth (Bell *et al.* 2007; Morello-Frosch *et al.,* 2010).

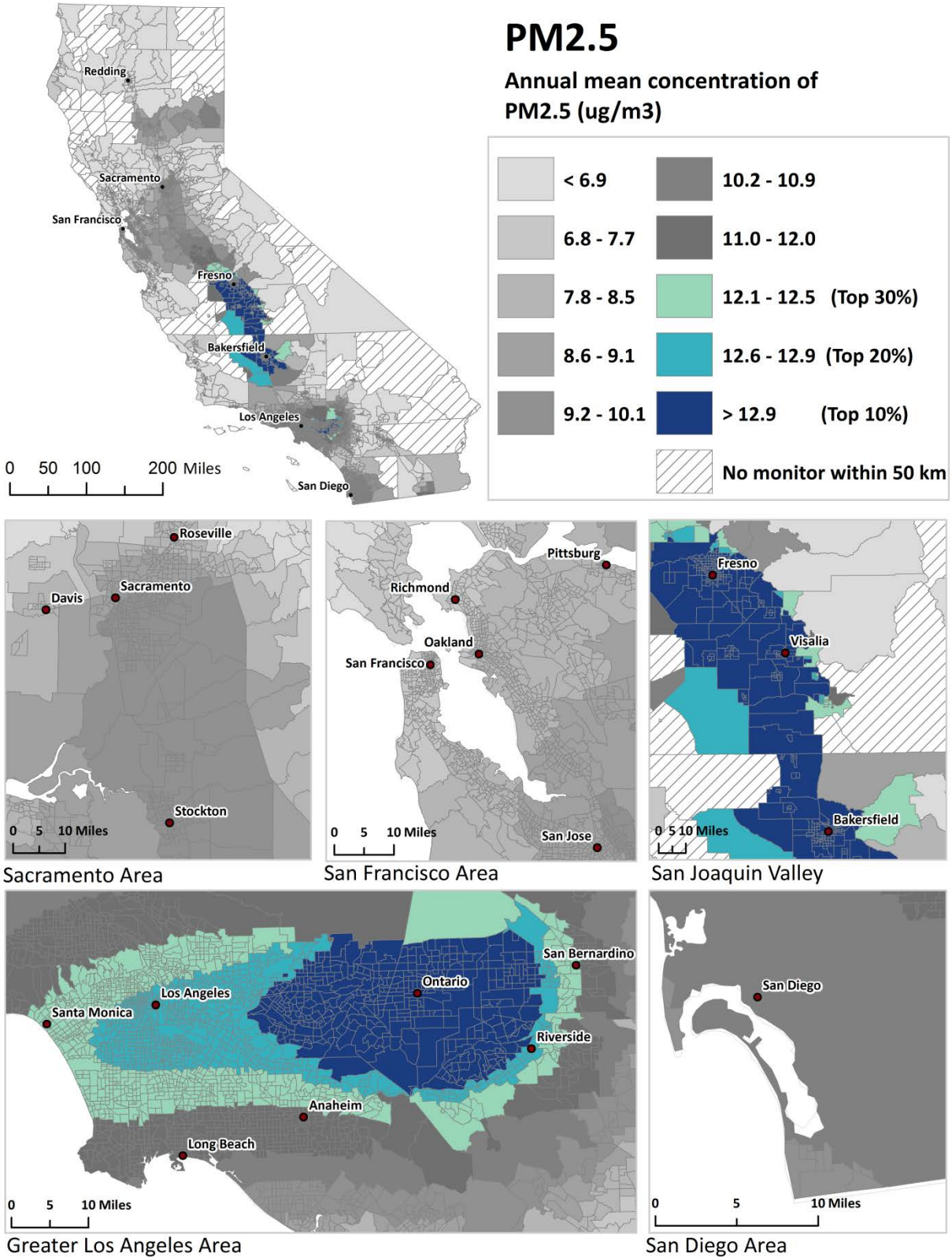
An additional source of PM2.5 in California is wildfires. Fires are not uncommon during dry seasons, particularly in Southern California and the Central Valley. Smoke particles fall almost entirely within the size range of PM2.5. Although the long term risks from exposure to smoke during a wildfire are relatively low, sensitive populations are more likely to experience severe symptoms, both acute and chronic (Lipsett *et al.* 2008). During the wildfires that spread throughout the state in June 2008, PM2.5 concentrations at a site in the northeast San Joaquin Valley were far above air quality standards and approximately ten times more toxic than normal ambient PM (Wegesser *et al.* 2009).

Method

- PM2.5 annual mean monitoring data for was extracted all monitoring sites in California from CARB's air monitoring network database for the years 2009-2011.
- Monitors that reported fewer than 75% of the expected number of observations, based on scheduled sampling frequency, were dropped from the analysis.
- For all measurements in the time period, the quarterly mean concentrations were estimated at the geographic center of the census tract using a geostatistical method that incorporates the monitoring data from nearby monitors (ordinary kriging).
- Annual means were then computed for each year by averaging the quarterly estimates and then averaging those over the three year

period.

- Census tracts were ordered by the PM2.5 concentration values and assigned a percentile based on the statewide distribution of values.
- Note: values at census tracts with centers more than 50 km from the nearest monitor were not estimated (signified by cross-hatch in map).


PM2.5
Annual mean concentration of PM2.5 (ug/m3)
< 6.9
6.8 - 7.7
7.8 - 8.5
8.6 - 9.1
9.2 - 10.1
10.2 - 10.9
11.0 - 12.0
12.1 - 12.5 (Top 30%)
12.6 - 12.9 (Top 20%)
> 12.9 (Top 10%)
No monitor within 50 km
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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DIESEL PARTICULATE MATTER

Exposure Indicator

Diesel particulate matter (diesel PM) occurs throughout the environment from both on-road and off-road sources. Major sources of diesel PM include trucks, buses, cars, ships and locomotive engines. Diesel PM is concentrated near ports, rail yards and freeways where many such sources exist. Exposure to diesel PM has been shown to have numerous adverse health effects including irritation to the eyes, throat and nose, cardiovascular and pulmonary disease, and lung cancer.

Indicator

Spatial distribution of gridded diesel PM emissions from on-road and non-road sources for a 2010 summer day in July (kg/day).

Data Source

California Air Resources Board (CARB)

The CARB produces grid-based emission estimates for a variety of pollutants by emissions category on a 4km by 4km statewide Cartesian grid system to support specific regulatory and research programs. Diesel PM emissions from on- and off-road sources were extracted for a July 2010 weekday from the latest grid-based emissions. This data source does not account for meteorological dispersion of emissions at the neighborhood scale, which can have local-scale and year-to-year variability, or significant local-scale spatial gradients known to exist within a few hundred meters of a high-volume roadway or other large source of diesel PM. Nevertheless it is a reasonable *regional* metric of exposure to diesel PM emissions.

http://www.arb.ca.gov/diesel

Rationale

Diesel PM is the particle phase of diesel exhaust emitted from diesel engines such as trucks, buses, cars, trains, and heavy duty equipment. This phase is composed of a mixture of compounds, including sulfates, nitrates, metals and carbon particles. The diesel particulate matter indicator is distinct from other air pollution indicators in CalEnviroScreen, PM2.5 in particular. Diesel PM includes known carcinogens, such as benzene and formaldehyde (Krivoshto *et al.*, 2008) and 50% or more of the particles are in the ultrafine range (US EPA, 2002). As particle size decreases, the particles may have increasing potential to deposit in the lung (Löndahl *et al.* 2012). The ultrafine fraction of diesel PM (aerodynamic diameter less than 0.1 μm) is of concern because researchers believe these particles penetrate deeper into the lung, can carry toxic compounds on particle surfaces, and are more biologically reactive than larger particles (Betha and Balasubramanian, 2013; Nemmar *et al.*, 2007). In urban areas, diesel PM is a major component of the particulate air pollution from traffic (McCreanor *et al.*, 2007).

Children and those with existing respiratory disease, particularly asthma, appear to be especially susceptible to the harmful effects of exposure to airborne PM from diesel exhaust, resulting in increased

asthma symptoms and attacks along with decreases in lung function (McCreanor *et al.*, 2007; Wargo, 2002).

People that live or work near heavily-traveled roadways, ports, railyards, bus yards, or trucking distribution centers may experience a high level of exposure (US EPA, 2002; Krivoshto *et al.*, 2008). People that spend a significant amount of time near heavily-traveled roadways may also experience a high level of exposure. A study of U.S. workers in the trucking industry found an increasing risk for lung cancer with increasing years on the job (Garshick *et al.*, 2008). The same trend was seen among railroad workers, who showed a 40% increased risk of lung cancer (Garshik *et al.*, 2004). Studies have found strong associations between diesel particulate exposure and exacerbation of asthma symptoms in asthmatic children who attend school in areas of heavy truck traffic (Patel *et al.* 2010, Spira-Cohen *et al.* 2011). Studies of both men and women demonstrate cardiovascular effects of diesel PM exposure, including coronary vasoconstriction and premature death from cardiovascular disease (Krivoshto *et al.*, 2008). A recent study of diesel exhaust inhalation by healthy non-smoking adults found an increase in blood pressure and other potential triggers of heart attack and stroke (Krishnan *et al.,* 2013)

Exposure to diesel PM, especially following periods of severe air pollution, can lead to increased hospital visits and admissions due to worsening asthma and emphysema-related symptoms (Krivoshto *et al.*, 2008). Diesel exposure may also lead to reduced lung function in children living in close proximity to roadways (Brunekreef *et al.*, 1997).

Method

Gridded diesel PM emissions from on-road sources were calculated as follows:

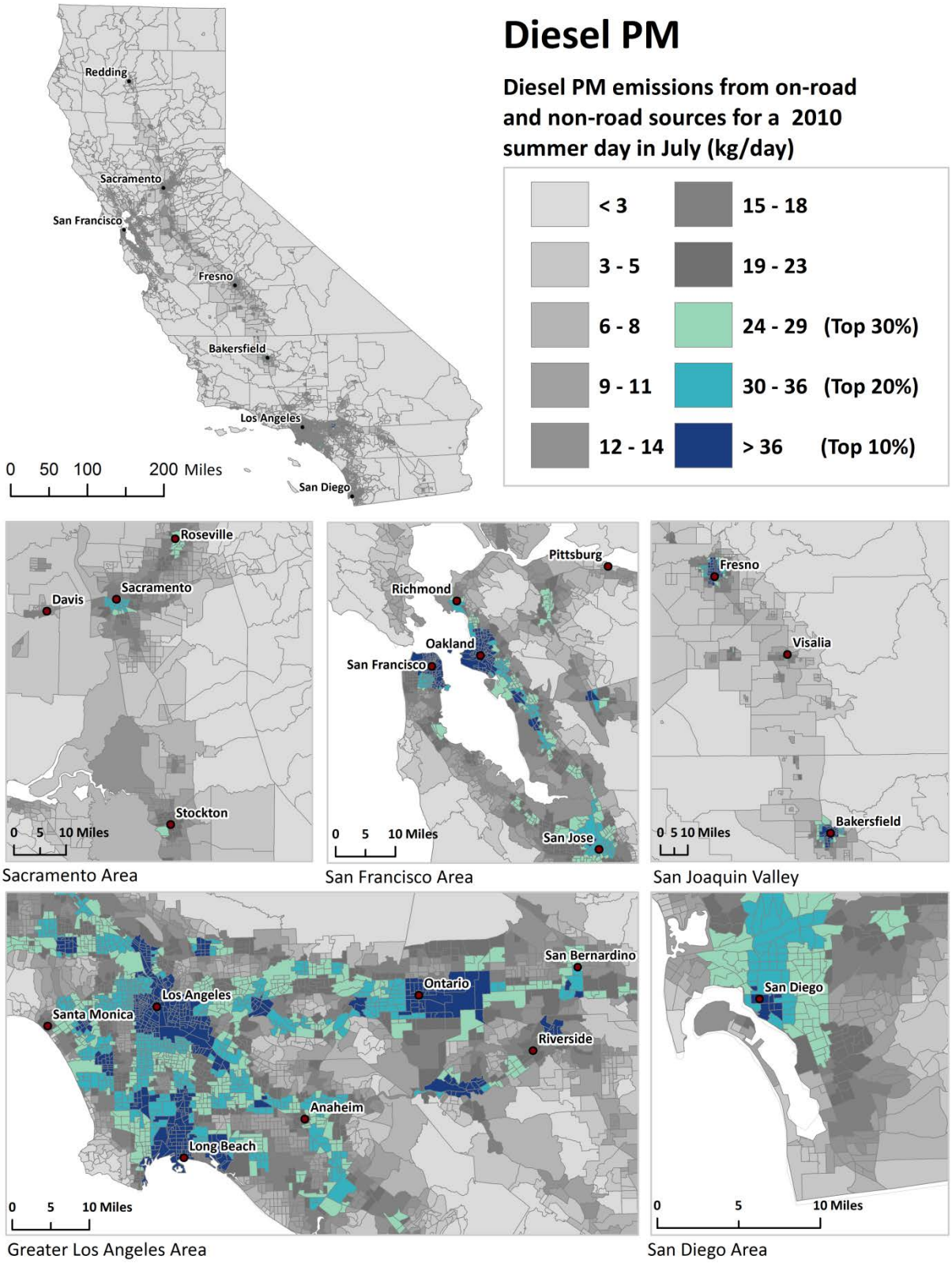
- CARB's on-road emissions model, EMFAC2013, was used to calculate 2010 county-wide estimates of diesel PM emissions for a July weekday. http://www.arb.ca.gov/msei/modeling.htm
- EMFAC2013 county-wide emission estimates are spatially distributed to 4km-by-4km grid cells based on the distribution of regional vehicle activity represented in local agency transportation networks and Caltrans' statewide transportation network (where local agency data are not available) using the Direct Travel Impact model (DTIM4). Transportation networks are produced from travel demand modeling conducted by local agencies and Caltrans.

Gridded diesel PM from non-road sources were calculated as follows:

- County-wide estimates of diesel PM from non-road sources for a July weekday were extracted from CARB's emissions inventory forecasting system, CEPAM. http://www.arb.ca.gov/app/emsinv/fcemssumcat2009.php
- County-wide emission estimates are spatially distributed to 4km-by-

4km grid cells based on a variety of gridded spatial surrogate datasets. Each category of emissions is mapped to a spatial surrogate that generally represents the expected sub-county locations of source-specific activities. The surrogates include, for example: Lakes and Coastline; Population; Housing and Employment; Industrial Employment; Irrigated Cropland; Unpaved Roads; Single-Housing Units; Forrest Land; Military Bases; Non-irrigated Pasture Land; Rail Lines; Non-Urban Land; Commercial Airports; and Ports.

Resulting gridded emission estimates from the on-road and non-road categories were summed into a single gridded dataset. Gridded diesel PM emission estimates are then allocated to census tracts in ArcMap using a weighted average where the proportion of a grid-cell intersecting a census tract is used as the weight. The resulting census tract totals are assigned a percentile based on the statewide distribution of values.


Diesel PM
Diesel PM emissions from on-road and non-road sources for a 2010 summer day in July (kg/day)
< 3
3 - 5
6 - 8
9 - 11
12 - 14
15 - 18
19 - 23
24 - 29 (Top 30%)
30 - 36 (Top 20%)
> 36 (Top 10%)
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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DRINKING WATER CONTAMINANTS

Exposure Indicator

Californians receive their drinking water from a wide variety of sources and distribution systems. In 2005, approximately 93% of Californians received their water from public water systems (USGS, 2009). According to the California Department of Public Health, approximately 98% of public water systems meet all federal and state drinking water standards (CDPH, 2011). However, drinking water quality varies with location, water source, treatment method, and the ability of the water purveyor to remove contaminants before distribution. Because water is universally consumed, drinking water contamination has the potential to result in widespread exposures. Contaminants may be introduced into drinking water sources in many ways, such as by natural occurrence, accidents, industrial releases, and agricultural runoff.

California water systems have a high rate of compliance with drinking water standards. In 2011, systems serving only between 1.4 and 2.7 percent of the state's population were in violation of one or more drinking water standards (CDPH, 2011 Annual Compliance Report). The drinking water contaminant index used in CalEnviroScreen 2.0 is not a measure of compliance with these standards. The drinking water contaminant index is a combination of contaminant data that takes into account the relative concentrations of different contaminants and whether multiple contaminants are present. The indicator does not indicate whether water is safe to drink.

Certain assumptions, data gaps and limitations within the indicator score methodology may affect the calculation of scores. For example, the indicator score is calculated using average contaminant concentrations over one compliance cycle (2005-2013). Therefore, those average concentrations may not be representative of current concentrations in treated drinking water. The indicator results do not provide a basis for determining when differences between scores are significant in relation to human health. Census tracts can encompass multiple public drinking water systems, and therefore, their scores may represent a combination of water contaminant data from several public drinking water systems and groundwater sources. As such, the drinking water contaminant score may not reflect the water that an *individual* resident of that tract is drinking. For a location within a census tract, more specific local water quality data may be available from the public water system serving that area. Public water systems are required to prepare annual Consumer Confidence Reports that provide detailed, system-specific information on water quality, health impacts and compliance with drinking water standards. These Consumer Confidence Reports provide drinking water quality information directly to the public. The U.S. Environmental Protection Agency offers guidance on finding water quality data in California: http://water.epa.gov/drink/local/ca.cfm

Indicator	*Drinking water contaminant index for selected contaminants*
Data Source	Drinking Water Systems Geographic Reporting Tool, California Environmental Health Tracking Program, California Department of Public Health (CDPH) http://www.ehib.org/page.jsp?page_key=61 Public Water System Location Data

Permitting/Inspections/Compliance/Monitoring/Enforcement (PICME) database, California Department of Public Health

Safe Drinking Water Information System, U.S. Environmental Protection Agency
http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/index.cfm

Water Quality Monitoring Database, CDPH
http://www.cdph.ca.gov/certlic/drinkingwater/Pages/EDTlibrary.aspx

Domestic Well Project, Groundwater Ambient Monitoring and Assessment (GAMA) Program, State Water Resources Control Board
http://www.waterboards.ca.gov/water_issues/programs/gama/domestic_well.shtml

Priority Basin Project, GAMA Program, State Water Resources Control Board and U.S. Geological Survey
http://www.waterboards.ca.gov/water_issues/programs/gama/priority_basin_projects.shtml

Rationale

Low income and rural communities, particularly those served by small community water systems, can be disproportionately exposed to contaminants in their drinking water (VanDerslice, 2011; Balazs *et al.*, 2011).

Much of California relies on groundwater for drinking. In agricultural areas, nitrate from fertilizer application or animal waste can leach to groundwater and cause contamination of drinking water wells, although the distribution of nitrate occurrence and concentrations varies with soil type and crops planted (Lockhart *et al.,* 2013). Rural residents of the San Joaquin Valley receive water primarily from shallow domestic wells,. Elevated levels of nitrate in drinking water are associated with methemoglobinemia (blue baby syndrome), and may be associated with birth defects and miscarriages (Ruckart *et al.*, 2007). Perchlorate, a groundwater contaminant that can come from geologic, industrial and agricultural sources, is common in drier regions of the state (Fram & Belitz, 2011). Although for most people, ingested perchlorate comes primarily from food, on average, across all age groups, 20 percent comes from drinking water (Huber *et al.,* 2011). Perchlorate exposure during pregnancy appears to affect thyroid hormone levels in newborns, which can disrupt normal development (Hershman 2005, Steinmaus *et al.,* 2010). A study of bladder cancer in the U.S. found that drinking surface water was associated with an increased risk of mortality, and the authors suspected a link to low-level pesticide contamination (Colli & Kolettis, 2010).

Arsenic, a known human carcinogen, is a naturally occurring contaminant often found in groundwater in arid and semiarid regions, particularly in the San Joaquin Valley. Exposure to arsenic through drinking water is associated with elevated lung and bladder cancer rates, especially with early-life exposures (Steinmaus *et al.,* 2013). Balazs et al. (2012) found

that communities with more low socioeconomic-status residents were more likely to be exposed to arsenic in their drinking water and more likely to receive water from systems with high numbers of water quality compliance violations. In an earlier study of nitrate concentrations and socioeconomic characteristics of water consumers, they found that small community water systems serving Latinos and renters supplied drinking water with higher levels of nitrate than systems serving fewer Latinos and a higher proportion of homeowners (Balasz *et al.*, 2011).

Method

A drinking water contaminant metric was calculated for each census tract through four broad steps (detailed more fully below):

1. Drinking water system boundaries were identified based upon established boundaries or, where necessary, the boundaries were approximated.
2. Drinking water contaminant data were associated with each water system and average concentrations were calculated for each contaminant and system.
3. The systems' average water contaminant concentration was re-allocated from the system boundaries to census tracts. The census tracts were then ranked to obtain a percentile score for each contaminant and tract.
4. A census tract contaminant index was calculated as the sum of the percentiles for all contaminants.

Drinking Water System Boundaries

- Water system boundaries were downloaded from the CDPH Environmental Health Investigation Branch's Drinking Water Systems Geographic Reporting Tool.
- If the system boundaries were not available, but system source locations were available, boundaries were approximated based on their locations and the population served by the system.
- For areas without known water systems and source locations, township boundaries from the Public Land Survey System (approximately 6 miles square) were treated as the boundaries for the purpose of assigning water quality to people living in that area.

Drinking Water Contaminant Metric Calculation

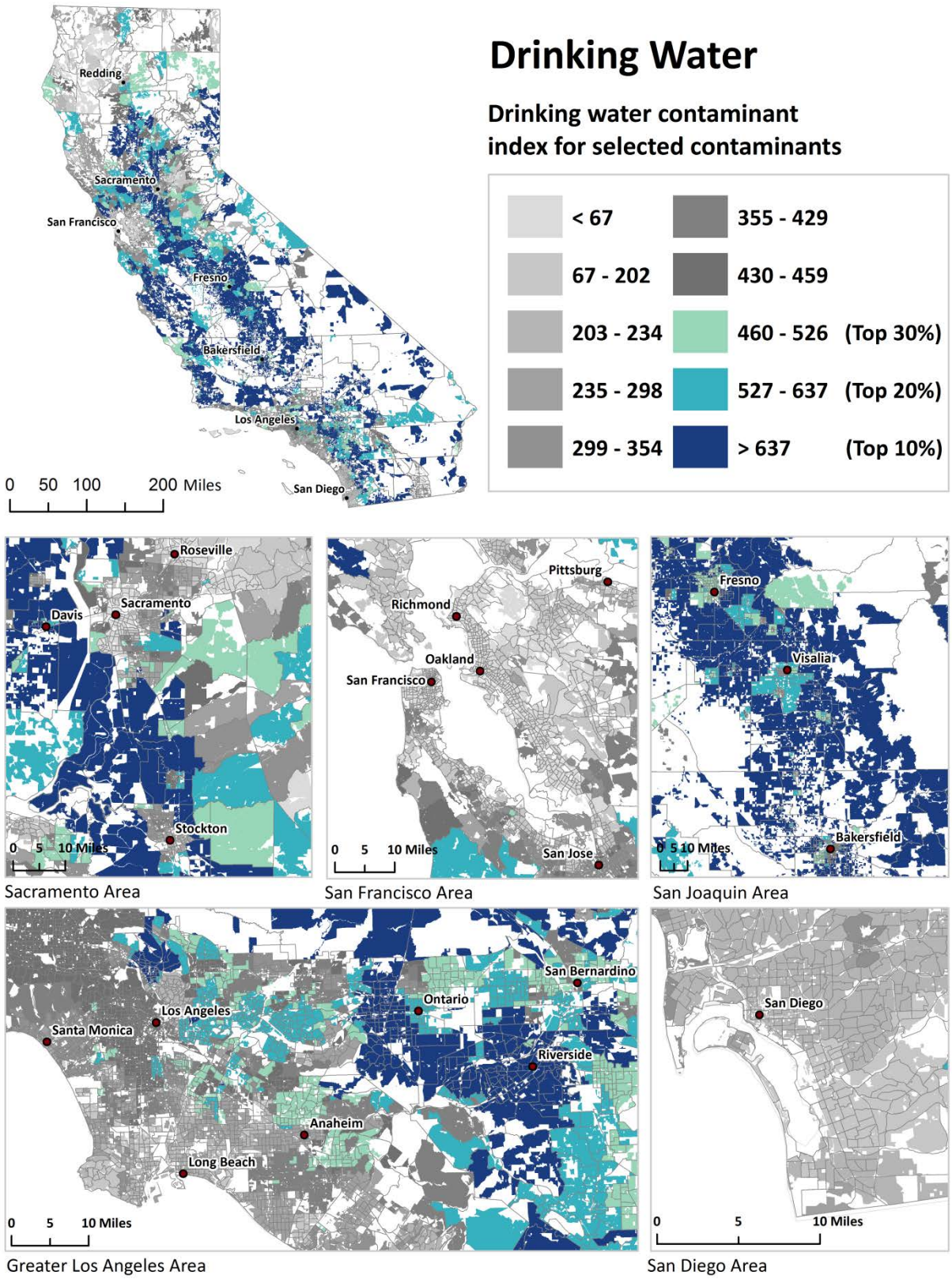
- A subset of contaminants tested in drinking water across California was selected for the analysis (see Appendix) based on frequency of testing and detection in California drinking water. Monitoring data for these chemicals were obtained from CDPH's Water Quality Monitoring database from 2005-2013, the three most recent compliance periods. Water quality data representing treated/delivered water were associated with their water system first. If no treated/delivered water quality data for a system

was available, but the system purchased water from wholesalers, the wholesaler's water quality was associated with the system. If no treated/delivered water data were reported in that time period for a given contaminant and system, water quality data from untreated or raw sources were used for that contaminant and system.

- For large water systems serving more than 100,000 people that rely on local sources of water and purchase water from wholesalers, the fraction of water that was purchased was identified from publicly available information (e.g., water quality reports). If no information was found on fraction purchased, it was assumed that half of the water was purchased (including all systems serving less than 100,000 people that purchase water from wholesalers).
- Time-weighted average concentrations of each contaminant were calculated for each year for each sample source within a system. The average yearly concentrations were then averaged to create a source concentration. Then, the source concentrations within a system were averaged to calculate one concentration value for each chemical in each system. If purchased water from wholesalers was included, the calculation was adjusted by the fraction purchased.
- Areas without system or sample source data were assigned the average groundwater quality data for sources in the township in which they were located (raw or untreated community or non-community water system data, Domestic Well Project water quality data, and Priority Basin water quality data). People in these areas were assumed to drink groundwater.
- Violations of the Maximum Contamination Level for any chemical contaminant and Total Coliform rule were also summed for each water system, serving as a basis for a "violation index."

Re-allocation from Water System Boundaries to Census Tracts

- Census *blocks* were assigned the contaminant concentration or violation index of the systems in which they fell. Partial census blocks were apportioned by area.
- Census tract concentration estimates for each contaminant were calculated as the population-weighted sum of the contaminant concentration for the census blocks (or partial blocks) within the tract. Violation index data were similarly calculated.
- The census tracts were ordered by the value of their contaminant concentrations or violation index. Percentiles were calculated.
- The overall drinking water contaminant score for a census tract is the sum of its percentiles for all contaminants and violations.



Note: This map displays only the populated portions of census tracts in California.

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Appendix

Contaminants Evaluated

Contaminant	Public Health Goal	Maximum Contaminant Level
Arsenic	0.004 µg/l	10 µg/l
Cadmium	0.04 µg/l	5 µg/l
Chromium, Hexavalent	0.02 µg/l	10 µg/l
Dibromochloropropane (DBCP)	0.0017 µg/l	0.2 µg/l
Lead	0.2 µg/l	15 µg/l
Nitrate (NO_3)	45 mg/l	45 mg/l
Perchlorate	6 µg/l	6 µg/l
Total Trihalomethanes (THM)	---	80 µg/l
Trichloroethylene (TCE)	1.7 µg/l	5 µg/l
Uranium	0.43 pCi/l	20 pCi/l

Violation Types Evaluated

Violation Type
MCL Violation
Total Coliform Rule Violation

PESTICIDE USE

Exposure Indicator

Communities near agricultural fields, primarily farm worker communities, may be at risk for exposure to pesticides. Drift or volatilization of pesticides from agricultural fields can be a significant source of pesticide exposure. Complete statewide data on human exposures to pesticides do not exist. The most robust pesticide information available statewide are data maintained by the California Department of Pesticide Regulation showing where and when pesticides are used across the state. Pesticide use, especially use of volatile chemicals that can easily become airborne, can serve as an indicator of potential exposure. Similarly, unintended environmental damage from the use of pesticides may increase in areas with greater use.

Indicator

Total pounds of selected active pesticide ingredients (filtered for hazard and volatility) used in production-agriculture per square mile.

Data Source

Pesticide Use Reporting,
California Department of Pesticide Regulation (DPR)

In California, all agricultural pesticide use must be reported monthly to county agricultural commissioners, who report the data to DPR. California has a broad legal definition of agricultural use—production agricultural is defined as pesticides used on any plant or animal to be distributed in the channels of trade and non-production agricultural includes pesticide applications to parks and recreational lands, rights-of-ways, golf courses, and cemeteries for example. Non-agricultural control includes home, industrial, institutional, structural, vector control, and veterinary uses. Production agricultural pesticide use data are publicly available for each Meridian-Township-Range-Section (MTRS) in California and was used to create this indicator. An MTRS, or section, is roughly equivalent to one square mile. Data are available statewide except for some areas that are exempt from reporting, such as some military and tribal lands.

Non-production agricultural and non-agricultural pesticide use data is only available at the county scale and was not included in the indicator due to the large geographic scale.

http://www.DPR.ca.gov/docs/pur/purmain.htm

Rationale

To determine whether pesticide exposure may be occurring as a result of agricultural use, DPR established a pesticide air monitoring network for agricultural areas where there is high use of pesticides likely to concentrate in air. Preliminary results for the first year of monitoring show that more than half of pesticides sampled were detected, although none were above the health screening levels (CDPR, 2012). Pesticide air monitoring is not available statewide.

High use of pesticides, however, has been correlated with exposure and with acute pesticide-related illness, and there is evidence of association with chronic disease outcomes. Pregnant, low income Latinas residing in an agricultural area of California had pesticide metabolite levels in

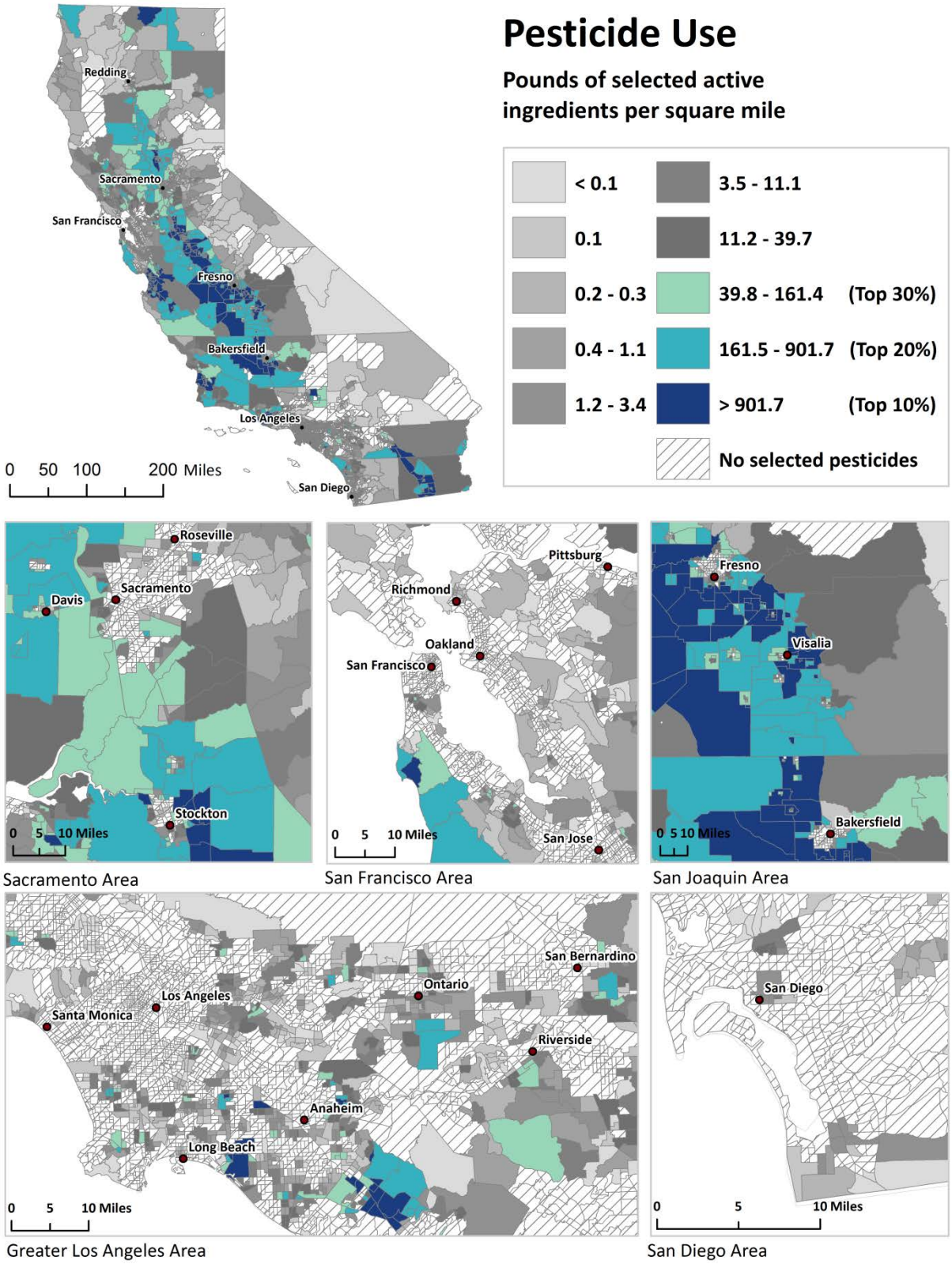
their urine up to 2.5 times higher than a representative sample of U.S. women (Bradman *et al.*, 2005). Some research indicates that proximity to agricultural fields is correlated with measured concentrations in homes (Bradman *et al.*, 2007; Harnly *et al.*, 2009). A recent study in California comparing farmworker homes to homes of low income urban residents found indoor concentrations of an agricultural pesticide only in homes of farmworkers (Quiros-Alcala *et al.,* 2011). Another study, based on data from the California Pesticide Use Report database, found that nearby agricultural pesticide use was significantly associated with pesticide concentrations in carpet dust (Gunier *et al.*, 2011).

A large cohort study of male pesticide applicators found a significant association between the use of four specific insecticides and aggressive prostate cancer (Koutros *et al.*, 2012). Prenatal exposure to the organophosphate chlorpyrifos has been associated with abnormalities in brain structure in children (Rauh *et al.*, 2012). An examination of national pesticide illness data concluded that agricultural workers and residents near agriculture had the highest rates of pesticide poisoning from drift incidents. Soil fumigation accounted for most of the cases (Lee *et al.*, 2011). DPR has also documented numerous pesticide drift incidents that have led to illness in California (O'Malley *et al.*, 2005). Because of their physical and chemical characteristics, fumigants and other volatile pesticides are most likely to be involved in pesticide drift incidents and illnesses. However, any pesticide that is applied by air or sprayed during windy conditions can drift over neighboring communities (Coronado *et al.*, 2011; Lee *et al.*, 2011).

Method

Specific pesticides included in the measure of pesticide use were narrowed from the list of all registered pesticides in use in California to focus on a subset of 69 chemicals that are filtered for hazard and volatility. Volatility is indicative of higher likelihood of drift and exposure (See Appendix).

- Production agricultural pesticide use records were obtained for the entire state for the years 2009, 2010, and 2011.
- Production pesticide use (total pounds of selected active ingredient) for MTRS records were matched to census tracts using a match file created in the GIS software ArcMap.
- Production pesticide use for each census tract was divided by each census tract's area.


Pesticide Use
Pounds of selected active ingredients per square mile
< 0.1
0.1
0.2 - 0.3
0.4 - 1.1
1.2 - 3.4
3.5 - 11.1
11.2 - 39.7
39.8 - 161.4 (Top 30%)
161.5 - 901.7 (Top 20%)
> 901.7 (Top 10%)
No selected pesticides
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Area
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

Appendix

Pesticide Use – Filter for Hazard and Volatility

Specific pesticides included in the measure of pesticide use were identified from the list of all registered pesticides through consideration of both hazard and likelihood of exposure.

The more hazardous pesticides were identified using a list generated under the Birth Defect Prevention Act of 1984 (SB 950) and the Proposition 65 list (Safe Drinking Water and Toxic Enforcement Act of 1986). As part of a review process of active ingredients under the SB 950 program, pesticides are classified as "High", "Moderate", or "Low" priority for potential adverse health effects using studies of sufficient quality to characterize risk. The prioritization of each pesticide is a subjective process based upon the nature of potential adverse effects, the number of potential adverse effects, the number of species affected, the no observable effect level (NOEL), potential human exposure, use patterns, quantity used, and US EPA evaluations and actions, among others. Proposition 65 requires the state to maintain a list of chemicals that cause cancer or reproductive toxicity. For the purpose of developing an exposure indicator, pesticides that were prioritized as "Low," not prioritized under SB 950, or not on the Proposition 65 list were removed from the analysis.

The analysis was further limited to pesticides of high or moderate volatility. Higher volatility was considered to increase the likelihood of exposures. A list of pesticide volatilities was obtained from DPR. Pesticides not appearing on this list were researched for chemical properties in the open literature. Pesticides with volatility less than 10^{-6} mm Hg were removed from the indicator analysis.

The filtering of pesticides for both hazard and volatility resulted in a list of 69 pesticides that were included in the analysis here. The pesticides that are included in the indicator calculation are identified below.

- *1,3-Dichloropropene*
- *2,2-Dibromo-3-nitrilopropionamide (DBNPA)*
- *2,2-dichlorovinyl dimethyl phosphate (DDVP, Dichlorvos)*
- *Acephate*
- *Acrolein*
- *Aldicarb*
- *Azinphos-methyl (Guthion)*
- *Bromoxynil heptanoate*
- *Bromoxynil octanoate*
- *Buprofezin*
- *Carbaryl (Sevin)*
- *Carbofuran*
- *Chloropicrin*
- *Chlorothalonil*
- *Chlorpyrifos*
- *Chlorthal-dimethyl (DCPA, Dacthal)*
- *Clomazone*
- *Cycloate (Ro-Neet)*
- *Cyprodinil*
- *Dazomet*
- *Diazinon*
- *Dichloran*
- *Dimethoate*
- *Dimethyl disulfide (Paladin)*
- *Endosulfan**
- *Ethalfluralin*
- *Ethoprop*
- *Fenamiphos*
- *Fenpropathrin*
- *Fenthion*
- *Fludioxonil*
- *Flumioxazin*
- *Fosthiazate*
- *Hydrogen cyanamide*
- *Imazalil*
- *Linuron*
- *Malathion*
- *Metalaxyl*
- *Metam-sodium*
- *Methamidophos (Monitor)*
- *Methidathion*
- *Methomyl*
- *Methyl bromide*
- *Methyl isothiocyanate*
- *Methyl parathion*
- *Metrafenone*
- *Molinate*
- *Myclobutanil*
- *Naled*
- *Oxydemeton-methyl*
- *Pentachloronitrobenzene (PCNB)*
- *Phosphine*
- *Metam-potassium*
- *Propetamphos*
- *Propoxur (Baygon)*
- *Propylene oxide*
- *Pyrimethanil*
- *S,S,S-Tributyl phoshorotrithioate (DEF)*
- *S-Ethyl dipropylthiocarbamate (EPTC)*
- *Sodium cyanide*
- *Sodium tetrathiocarbonate*
- *Sulfur dioxide*
- *Sulfuryl fluoride*
- *Thiram*
- *Triclopyr, butoxyethyl ester (TBEE)*
- *Triclopyr, triethylamine salt (TEA)*
- *Triflumizole*
- *Trifluralin*
- *Ziram*

** Added based on its designation as a Toxic Air Contaminant (AB 1807 Program).*

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TOXIC RELEASES FROM FACILITIES

Exposure Indicator

There is widespread concern regarding exposures to chemicals that are released from industrial facilities. Statewide information directly measuring exposures to toxic releases has not been identified. However, some data on the *release* of pollutants into the environment is available and may provide some relevant evidence for potential subsequent exposures. The U.S. Environmental Protection Agency (US EPA) maintains a toxic substance inventory of on-site releases to air, water, and land and underground injection of any classified chemical, as well as quantities transferred off-site. The data are reported by each facility. US EPA has a computer-based screening tool called Risk Screening Environmental Indicators (RSEI) that analyzes these releases and models potential toxic exposures.

Indicator

Toxicity-weighted concentrations of modeled chemical releases to air from facility emissions and off-site incineration.

Data Source

Risk Screening Environmental Indicators (RSEI)
U.S. Environmental Protection Agency (US EPA)
Toxic Release Inventory (TRI)

The TRI program was created by the federal Emergency Planning and Community Right-to-Know Act (EPCRA) and Pollution Prevention Act. The program maintains a database of emissions and other releases for certain toxic chemicals. The database is updated annually and includes:

- Chemicals identified in EPCRA Section 313 (593 individually listed chemicals and 30 chemical categories including three categories containing 62 chemicals); and
- Persistent, Bioaccumulative and Toxic (PBT) Chemicals (16 specific chemicals and 4 chemical classes).

Facilities are required to report if they have 10 or more full-time employees, operate within a set of industrial sectors outlined by TRI, and manufacture more than 25,000 pounds or otherwise use more than 10,000 pounds of any listed chemical during the calendar year. Lower reporting thresholds apply for PBT chemicals (10 or 100 pounds) and dioxin-like chemicals (0.1 gram).

RSEI is a computer-based screening tool that analyzes factors related to toxic releases that may result in chronic human health risks. RSEI analyzes these factors and calculates a numeric score. To give the score meaning, it must be ranked against other RSEI scores. RSEI combines TRI release data with toxicity estimates and models the dispersion of chemicals in air by incorporating physicochemical properties, weather and geography. US EPA gives each chemical release and potential exposure pathway is given a toxic weight. The toxicity weights are drawn from various programs of the US EPA, CalEPA, and the Agency for Toxic Substances and Disease Registry and consider both cancer and non-cancer endpoints. The resulting measure of exposure is additive across

chemicals.

For all air releases, an EPA plume model is used to estimate long-term pollutant concentrations downwind of a stack or area source. The air releases resulting from incineration of waste after transfers to off-site facilities are modeled in the same manner. RSEI assigns the toxicity weighted concentrations to an 810 m by 810 m grid cell system. The total concentration based hazard scores for the entire grid cell system are available from US EPA as RSEI Geographic Microdata.

http://www.epa.gov/opptintr/rsei/pubs/rsei_methodology_v2.3.1.pdf
http://www.epa.gov/opptintr/rsei/pubs/rsei_users_manual_v2.3.1.pdf
http://www.epa.gov/tri/index.htm
http://www.epa.gov/oppt/rsei/pubs/technical_appendix_a_toxicity_v2.3.1.pdf

Rationale

The Toxics Release Inventory (TRI) provides public information on emissions and releases into the environment from a variety of facilities across the state. TRI data do not, however, provide information on the extent of public exposure to these chemicals. That said, US EPA has stated that "[d]isposal or other releases of chemicals into the environment occur through a range of practices that could ultimately affect human exposure to the toxic chemicals." (US EPA, 2010). A study of pollution in the printed wiring board industry found that among states with high TRI emissions in 2006, RSEI risk scores for California were by far the highest. According to the study, California combines high toxic emissions with a high risk score, based on location, composition of emissions and population exposure modeling (Lam *et al.*, 2011).

Air monitoring data at hundreds of locations across the United States have identified over a dozen hazardous air pollutants at concentrations that exceed California cancer or non-cancer benchmarks (McCarthy *et al.*, 2009). Many of the locations that these authors found to have elevated levels are near major industrial sources, and many of the chemicals monitored are the same as those that are emitted from these facilities. In California, a study that modeled concentrations of air toxic chemicals found significant levels of risk (Morello-Frosch *et al.*, 2000). Although this study found that mobile sources accounted for a major portion of the risk, the authors pointed out that for some communities, local industrial sources were a major contributor.

In addition to routine chemical releases, some communities located near TRI facilities are at risk from exposure to accidental chemical releases. A study of self-reported accident rates at U.S. chemical facilities over a five year period reported that 1,205 facilities (7.8% of facilities in the database) had at least one accident during the reporting period, and an additional 355 facilities (2.3%) had multiple accidents during the reporting period (Kleindorfer *et al.*, 2003). Associated with these events were a total of 1,987 injuries and 32 deaths among workers, and 167 injuries among nonemployees, including emergency responders. There were 215 total hospitalizations and 6,057 individuals given other medical treatments. Over 200,000 community residents were involved in

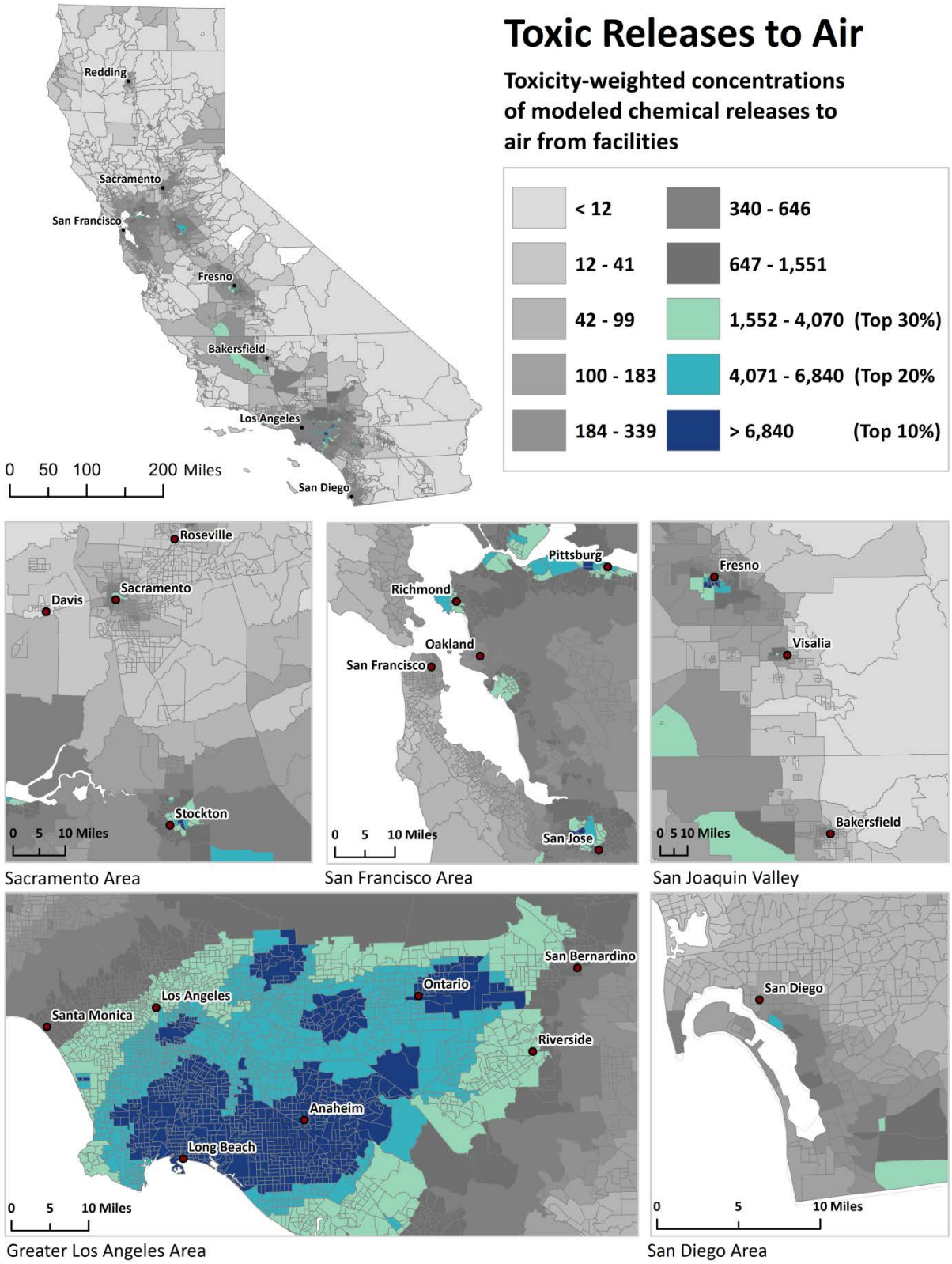
evacuations and shelter-in-place incidents over that five year period.

Several studies have examined the potential for health effects from living near TRI facilities. For example, a case-control study reported an increase in risk for diagnosis of brain cancer in children of mothers living within a mile of a TRI facility that released carcinogens (Choi *et al.*, 2006). In another study, TRI air and water concentrations were associated with an increase in infant, but not fetal, mortality rates (Agarwal *et al.*, 2010). A study that compared county-level TRI releases and health data found that increased chemical releases to air were significantly associated with higher total mortality as well as mortality from cardiovascular disease (Hendryx *et al.,* 2014).

Multiple studies have observed greater emissions in low-income and disadvantaged areas (Szasz and Meuser, 1997). Additionally, race and ethnicity have been correlated with the presence of toxic release facilities. People of color in studied regions of southern California were found to have a greater likelihood of living in areas with higher toxic releases (Morello-Frosch *et al.*, 2002; Sadd *et al.*, 1999).

Method

- Geometric Microdata for all 2010 TRI air releases modeled by RSEI was obtained. (Releases to land and water were not included.)
- Toxicity-weighted concentrations in air for the RSEI grid were converted to 2010 census blocks using an area-based conversion method.
- Census tract-level estimates were made by taking a land-area weighted average of the block-level values for each tract. Land area information was obtained from a 2010 Census Tiger Line block shapefile.
- Census tracts were sorted based on the toxicity-weighted concentration estimate and assigned a percentile based on their position in the distribution.


Toxic Releases to Air
Toxicity-weighted concentrations of modeled chemical releases to air from facilities
< 12
12 - 41
42 - 99
100 - 183
184 - 339
340 - 646
647 - 1,551
1,552 - 4,070 (Top 30%)
4,071 - 6,840 (Top 20%
> 6,840 (Top 10%)
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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TRAFFIC DENSITY

Exposure Indicator

While California has the strictest auto emissions standards in the U.S., the state is also known for its freeways and heavy traffic. Traffic is a significant source of air pollution, particularly in urban areas, where more than 50% of particulate emissions come from traffic. Exhaust from vehicles contains a large number of toxic chemicals, including nitrogen oxides, carbon monoxide, and benzene. Traffic exhaust also plays a role in the formation of photochemical smog. Health effects of concern from these pollutants include heart and lung disease, cancer, and increased mortality.

Indicator

Traffic density – Sum of traffic volumes adjusted by road segment length (vehicle-kilometers per hour) divided by total road length (kilometers) within 150 meters of the census tract boundary.

Data Source

Traffic Volume Linkage Tool,
California Environmental Health Tracking Program (CEHTP)
Environmental Health Investigations Branch,
California Department of Public Health

Data on the amount of traffic traveling on major roadways statewide are available. Traffic data are compiled under the California Department of Transportation's (Caltrans) Highway Performance Monitoring System (HPMS) every four years. The data consist of traffic volumes along various pre-defined segments of roadways across the state. Locally maintained roads are not included in the data.

A Traffic Volume Linkage Tool developed under CEHTP uses the annual average daily traffic volumes from the 2004 HPMS data to calculate traffic-related metrics within a circular buffer of any geographic coordinate in California.

For this analysis, CEHTP used the 2004 HPMS data and the Traffic Volume Linkage Tool to calculate traffic density within a 150 meter buffer of the census tract boundary. Traffic density was calculated as the sum of all road length-adjusted traffic volumes per hour divided by the total road length (from HPMS) in and within 150 meters of each census tract.

The most recent year for which data are available for use by this tool is 2004.

http://www.cehtp.org/p/tools_traffic

Rationale

Traffic density is used to represent the number of mobile sources in a specified area, resulting in human exposures to chemicals that are released into the air by vehicle exhaust, as well as other effects related to large concentrations of motor vehicles. Major roadways have been associated with a variety of effects on communities, including noise, vibration, injuries, and local land use changes such as increased numbers of gas stations. For example, motorists often detour through residential

streets near major roads in order to avoid congestion or traffic controls, a phenomenon known as "rat-running"; this phenomenon can increase risk of injuries among pedestrians or bicyclists in these communities. Vehicle speed is directly associated with risk of pedestrian fatality, and speeds along major roadways tend to be higher than normal speeds on residential streets.

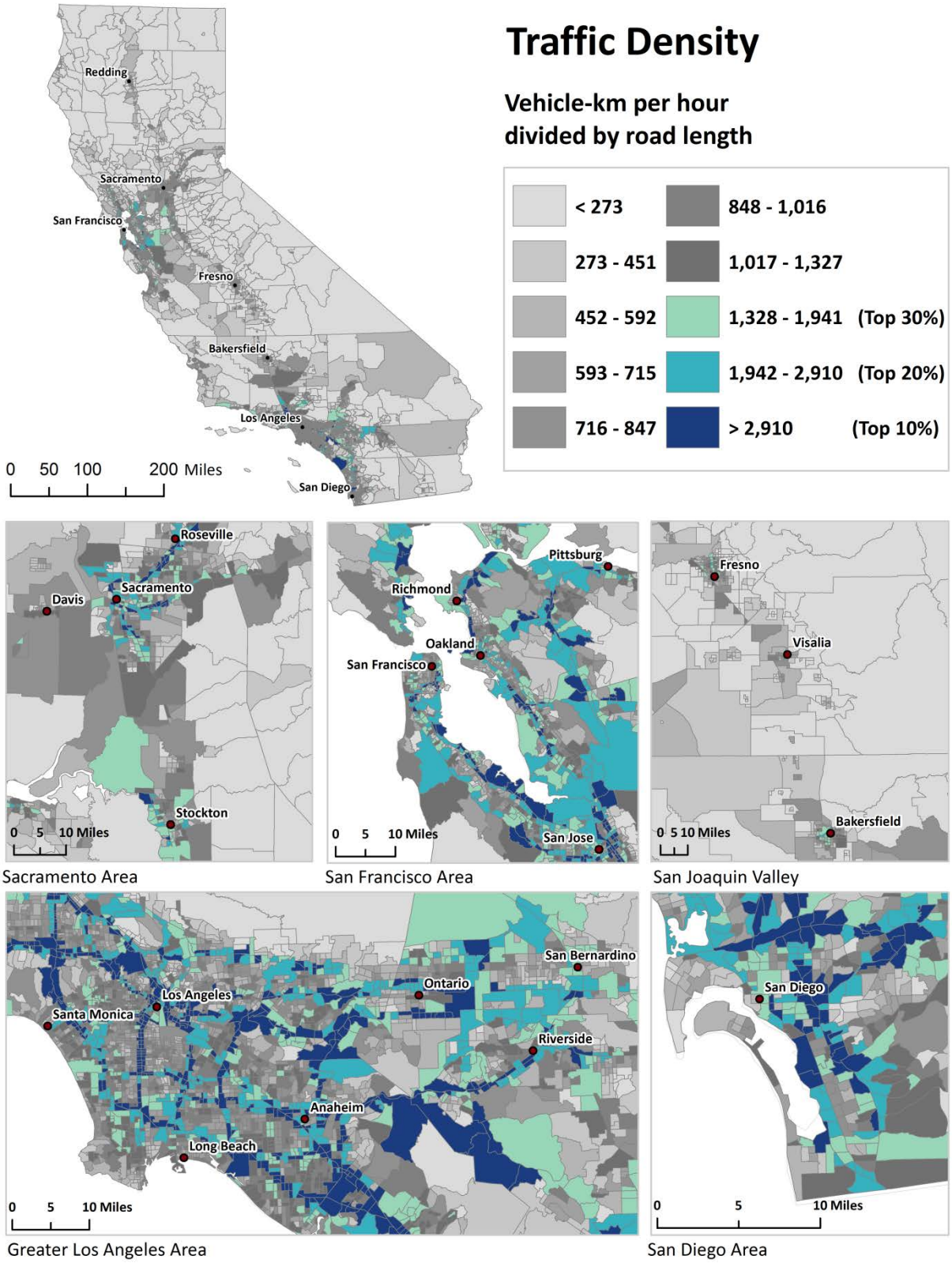
Studies have shown that non-white and low income people make up the majority of residents in high-traffic areas (Gunier *et al*. 2003; Tian *et al*., 2013) and that schools that are located near busy roads are more likely to be in poor neighborhoods than those farther away (Green *et al*. 2004). A U.S. Centers for Disease Control and Prevention study based on the 2010 Census found that Latinos, non-whites, foreign born and people who speak a language other than English at home were most likely to live within 150 meters of a major highway (Boehmer *et al*., 2013). In addition, children who live or attend schools near busy roads are more likely to suffer from asthma and bronchitis than children in areas with lower traffic density. This relationship has been seen in both developed (Patel *et al., 2011;* Schultz *et al*. 2012) and developing countries (Baumann *et al*., 2011).

Exposure to air pollutants from vehicle emissions has been linked to adverse birth outcomes, such as low birth weight and preterm birth (Ghosh *et al*., 2012; Ritz *et al*. 2007). A recent study of children in Los Angeles found that those with the highest prenatal exposure to traffic-related pollution were up to 15% more likely to be diagnosed with autism than children of mothers in the lowest quartile of exposure (Becerra *et al*., 2013). The Atherosclerosis in Communities study, a cohort study with over 15,000 participants, found that traffic density and distance to roadways were associated with reduced lung function in adult women (Kan *et al*., 2007). Road density and traffic volume were associated with adult male mortality from cardiovascular disease in an urban area in Brazil (Habermann and Gouveia, 2012). Motor vehicle exhaust is also a major source of polycyclic aromatic hydrocarbons (PAH), which can damage DNA and may cause cancer (IARC, 2010).

Method

- A 150 meter buffer was placed around each of the census tracts in California. A buffer was chosen to account for roadways near census tract boundaries. The selected buffer distance of 150 meters, or about 500 feet, is taken from the California Air Resources Board Air Quality and Land Use Handbook recommendations, which states that most particulate air pollution from traffic drops off after approximately 500 feet (CARB, 2005).
- The buffered boundaries were put into the Traffic Volume Linkage Tool.
- Traffic density was calculated using two metrics from the tool: 1) the sum of all length-adjusted traffic volumes within the buffered census tract (vehicle-km/hr), then divided by 2) the sum of the length of all road segments within the buffered census tract (km).

- Due to differences in the length of road segments within Highway Performance Monitoring (HPMS), a length-adjusted traffic volumes metric was selected. This metric multiplies traffic volumes by length of the road segment in HPMS.
- Traffic density is calculated as traffic volumes (adjusted by road segment lengths) divided by the total road length within the 150 meter buffer of each census tract (vehicles-km/hr/km).
- Census tracts were sorted by traffic density and assigned percentiles based on the distribution.


Traffic Density
Vehicle-km per hour divided by road length
< 273
273 - 451
452 - 592
593 - 715
716 - 847
848 - 1,016
1,017 - 1,327
1,328 - 1,941 (Top 30%)
1,942 - 2,910 (Top 20%)
> 2,910 (Top 10%)
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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CLEANUP SITES

Environmental Effects Indicator

Sites undergoing cleanup actions by governmental authorities or by property owners have suffered environmental degradation due to the presence of hazardous substances. Of primary concern is the potential for people to come into contact with these substances. Some of these "brownfield" sites are also underutilized due to cleanup costs or concerns about liability. The most complete set of information available related to cleanup sites and brownfields in California is maintained by the Department of Toxic Substances Control.

Indicator

Sum of weighted sites within each census tract.

Since the nature and the magnitude of the threat and burden posed by hazardous substances vary among the different types of sites as well as the site status, the indicator takes both into account. Weights were also adjusted based on proximity to populated census blocks.

Data Source

EnviroStor Cleanup Sites Database,
Department of Toxic Substances Control (DTSC)

US Environmental Protection Agency, Region 9
Region 9 NPL Sites (Superfund Sites) Polygons

EnviroStor is a public database that provides access to information maintained by DTSC on site cleanup. The database contains information on numerous types of cleanup sites, including Federal Superfund, State Response, Corrective Action, School Cleanup, Voluntary Cleanup, Tiered Permit, Evaluation, Historical, and Military Evaluation sites. The database contains information related to the status of the site such as required cleanup actions, involvement/land use restriction, or "no involvement."

US EPA maintains and distributes the dataset for National Priorities List (NPL) Superfund sites nationwide. The data come in polygon format and generally represent the parcel boundaries of the sites or the estimated extent of contamination.

http://www.envirostor.dtsc.ca.gov/public/
https://edg.epa.gov/clipship/

Rationale

Contaminated sites can pose a variety of risks to nearby residents. Hazardous substances can move off-site and impact surrounding communities through volatilization, groundwater plume migration, or windblown dust. Studies have found levels of organochlorine pesticides in blood (Gaffney *et al.* 2005) and toxic metals in house dust (Zota *et al.* 2011) that were correlated with residents' proximity to contaminated sites.

A study of pregnant women living near Superfund sites in New York state found an increased risk of having a low birth weight male child (Baibergenova *et al.* 2003). A later study in New York City found an association between prevalence of liver disease and the number of Superfund sites per 100 square miles (Ala *et al.* 2007). A demographic

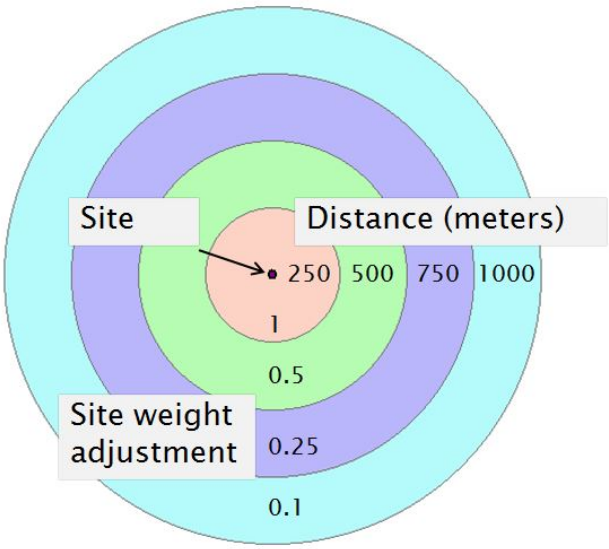
study of socioeconomic factors in communities in Florida found that census tracts with Superfund sites had significantly higher proportions of African Americans, Latinos and people employed in "blue collar" occupations than census tracts that did not contain a Superfund site (Kearney and Kiros, 2009). Some of the relationships between CalEnviroScreen scores and race have been added to the final section of this report.

It generally takes many years for a site to be certified as clean, and cleanup work is often delayed due to cost, litigation, concerns about liability or detection of previously unrecognized contaminants. Contaminated sites also have the potential to degrade nearby wildlife habitats, resulting in potential ecological impacts as well as threats to human health.

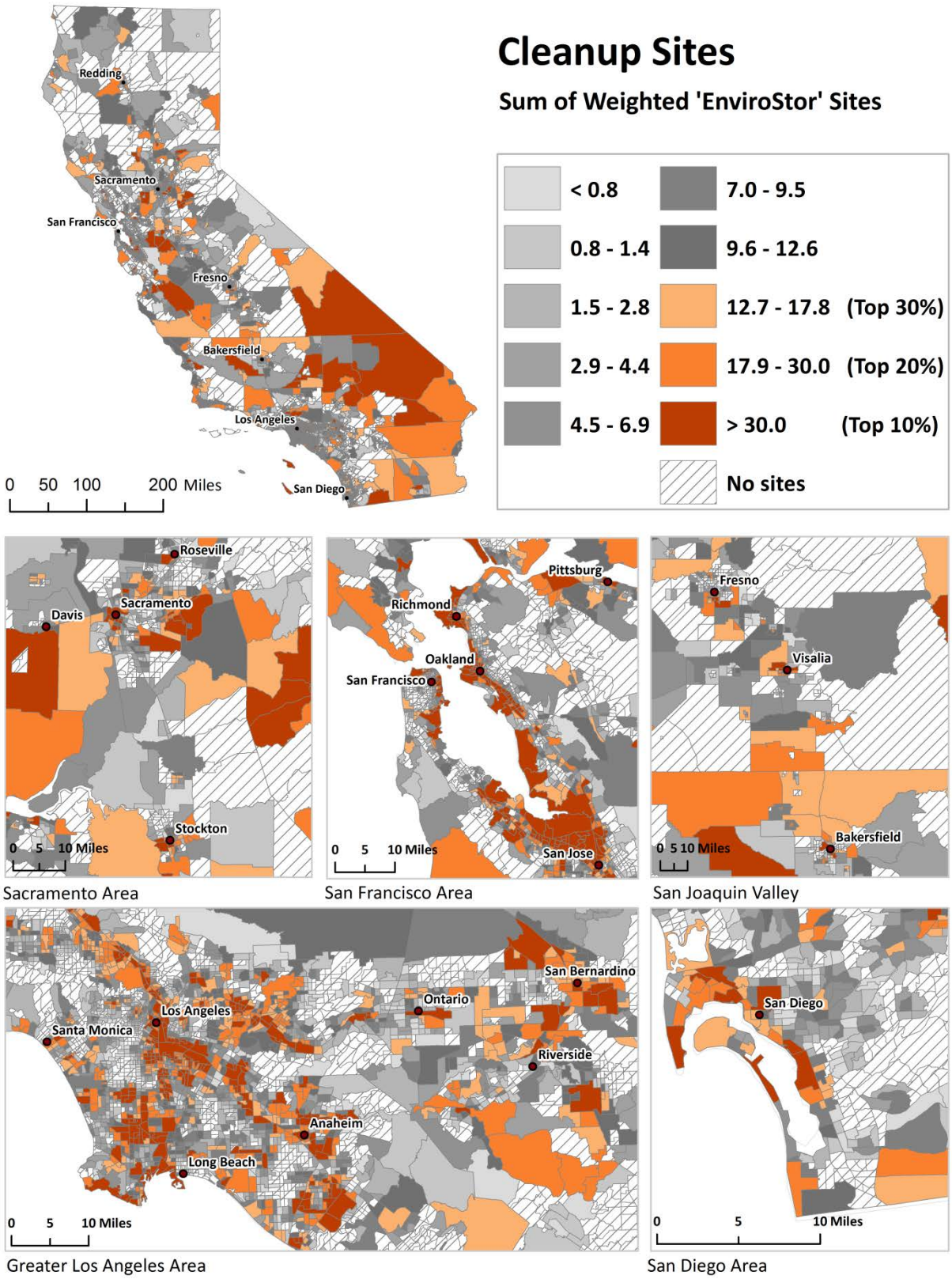
Method

- Data on cleanup site type, status, and location (coordinate or address) for the entire state were downloaded from the EnviroStor (http://www.envirostor.dtsc.ca.gov/public/data_download.asp) Cleanup Sites database.
- Sites with a valid latitude and longitude were mapped and sites with address only were geocoded in ArcMap. Sites without a valid latitude and longitude or unrecognizable address were excluded from the analysis.
- US EPA Region 9 National Priority List (NPL) polygon shapefile boundary data were downloaded from the Environmental Dataset Gateway.
- Polygon boundaries of California NPL sites were identified. Sites were assigned a score of 10 or 12 (as a federal Superfund site).
- EnviroStor sites with a NPL polygon representation were used instead of points.
- Several types of sites and statuses were excluded from the analysis because they indicate neither the presence of hazardous waste nor potential environmental risk (See Appendix).
- Each remaining site was scored on a weighted scale of 0 to 12 in consideration of both the site type and status (See Appendix). Higher weights were applied to Superfund, State Response sites, and cleanups compared to evaluations, for example. Similarly, higher weights were applied to sites that are undergoing active remediation and oversight by DTSC, relative to those with little or no state involvement.
- The weights for all sites were adjusted based on the distance they fell from populated census blocks. Sites further than 1000m from any populated census block were excluded from the analysis.
- Site weights were adjusted by multiplying the weight by 1 for sites less than 250m, 0.5 for sites 250-500m, 0.25 for sites 500-750m, and 0.1 for sites 750-1000m from the nearest populated census

blocks within a given tract.



- Each census tract was scored based on the sum of the adjusted weights (in ArcMap).
- Summed census tract scores were ordered and assigned percentiles.


Cleanup Sites
Sum of Weighted 'EnviroStor' Sites
< 0.8
0.8 - 1.4
1.5 - 2.8
2.9 - 4.4
4.5 - 6.9
7.0 - 9.5
9.6 - 12.6
12.7 - 17.8 (Top 30%)
17.9 - 30.0 (Top 20%)
> 30.0 (Top 10%)
No sites
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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Appendix

Weighting Matrix for Cleanup Sites

Cleanup Sites from the EnviroStor Cleanup Sites database were weighted on a scale of 0 to 12 in consideration of both the site type and status. The table below shows the weights applied for each site type and status.

Site and status types excluded from the analysis:
School Investigation and *Border Zone/Hazardous Waste Evaluation* site types were not included in the analysis. Sites with the following statuses were also not included in the analysis: *Agreement – Work Completed*, *Referrals*, *Hazardous Waste Disposal Land Use,* and *De-listed*. Sites with statuses of *Certified, Completed,* and *No Further Action* were assigned a weight of zero and were effectively not included in the analysis. These sites and status types were excluded because they are not indicative of hazardous waste or potential environmental risk.

For a given census tract, the weighted scores of all facilities in the area were summed. Definitions used in the table are defined below.

Site Type	Status		
	Low • Certified • Completed • No Further Action	Medium • Inactive-Needs Eval. • Inactive • Certified Operation & Maintenance – Land Use Restrictions • Certified Operation & Maintenance	High • Active • Backlog • Inactive- Action Required
Low • Evaluation • Historical • Military Evaluation	0	4	6
Medium • Corrective Action • School Cleanup • Voluntary Cleanup • Tiered Permit	1	7	9
High • State Response • Superfund	2	10	12

Definitions*

- *Active*: Identifies that an investigation and/or remediation is currently in progress and that DTSC is actively involved, either in a lead or support capacity.
- *Certified Operation and Maintenance (O&M)*: Identifies sites that have certified cleanups in place but require ongoing O&M activities.
- *Certified*: Identifies completed sites with previously confirmed releases that are subsequently certified by DTSC as having been remediated satisfactorily under DTSC oversight.
- *Corrective Action*: Identifies sites undergoing "corrective action," defined as investigation and cleanup activities at hazardous waste facilities (either Resource Conservation and Recovery Act (RCRA) or State-only) that either were eligible for a permit or received a permit. These facilities treat, store, dispose and/or transfer hazardous waste.
- *Evaluation*: Identifies suspected, but unconfirmed, contaminated sites that need or have gone through a limited investigation and assessment process.
- *Inactive – Action Required*: Identifies non-active sites where, through a Preliminary Endangerment Assessment (PEA) or other evaluation, DTSC has determined that a removal or remedial action or further extensive investigation is required.
- *Inactive - Needs Evaluation*: Identifies inactive sites where DTSC has determined a Preliminary Endangerment Assessment or other evaluation is required.

- *No Further Action*: Identifies completed sites where DTSC determined after investigation, generally a PEA (an initial assessment), that the property does not pose a problem to public health or the environment.
- *School Cleanup*: Identifies proposed and existing school sites that are being evaluated by DTSC for possible hazardous materials contamination at which remedial action occurred.
- *State Response*: Identifies confirmed release sites where DTSC is involved in remediation, either in a lead or oversight capacity. These confirmed release sites are generally high-priority and high potential risk.
- *Superfund*: Identifies sites where the US EPA proposed, listed, or delisted a site on the National Priorities List (NPL).
- *Tiered CA Permit Sites*: These facilities manage waste not regulated under RCRA, but regulated as a hazardous waste by the State of California. These facilities include but are not limited to recyclers, oil transfer stations, and precious metals recyclers.
- *Voluntary Cleanup*: Identifies sites with either confirmed or unconfirmed releases, and the project proponents have requested that DTSC oversee evaluation, investigation, and/or cleanup activities and have agreed to provide coverage for DTSC's costs.

* EnviroStor Glossary of Terms (http://www.envirostor.dtsc.ca.gov/public/EnviroStor%20Glossary.pdf)

Number of Cleanup Sites in CalEnviroScreen 2.0: Approximately 5,600

Site Type	% of Sites
Military Evaluation	20%
Voluntary Cleanup	18%
Tiered Permit	16%
State Response	15%
Evaluation	9%
Corrective Action	8%
Historical	6%
School Cleanup	6%
National Priorities List (NPL) (with boundaries)	2%
Federal Superfund (boundaries unavailable)	1%

GROUNDWATER THREATS

Environmental Effects Indicator

Many activities can pose threats to groundwater quality. These include the storage and disposal of hazardous materials on land and in underground storage tanks at various types of commercial, industrial, and military sites. Thousands of storage tanks in California have leaked petroleum or other hazardous substances, degrading soil and groundwater. Storage tanks are of particular concern when they can affect drinking water supplies. Storage tank sites can expose people to contaminated soil and volatile contaminants in air. In addition, the land surrounding these sites may be taken out of service due to perceived cleanup costs or concerns about liability. The most complete set of information related to sites that may impact groundwater and require cleanup is maintained by the State Water Resources Control Board.

Indicator

Sum of weighted scores for sites within each census tract.

The nature and the magnitude of the threat and burden posed by sites maintained in GeoTracker vary significantly by site type (e.g., leaking underground storage tank or cleanup site) and status (e.g., Completed Case Closed or Active Clean up). The indicator takes into account information about the type of site, its status, and its proximity to populated census blocks.

Data Source

GeoTracker Database,
State Water Resources Control Board (SWRCB)

GeoTracker is a public web site that allows the SWRCB, regional water quality control boards and local agencies to oversee and track projects at cleanup sites that can impact groundwater. The GeoTracker database contains information on locations and water quality of wells that could be contaminated, as well as potential sources of groundwater contamination. These include leaking underground storage tanks (LUSTs), leaking military underground storage tanks (USTs) cleanup and land disposal sites, and cleanup sites, industrial sites, airports, dairies, dry cleaners, and publicly-owned sewage treatment plants. For each site, there is additional information on the status of cleanup activities. Groundwater quality data are extracted from monitoring and records maintained by SWRCB, the Department of Water Resources, Department of Public Health, Department of Pesticide Regulation, U.S. Geological Survey and Lawrence Livermore National Laboratory. The database is constantly updated and sites are never deleted from the database, where they may ultimately be designated 'clean closed.'

A separate GeoTracker database contains information on the location of underground storage tanks (not leaking), which was not used.

http://geotracker.waterboards.ca.gov/

Rationale

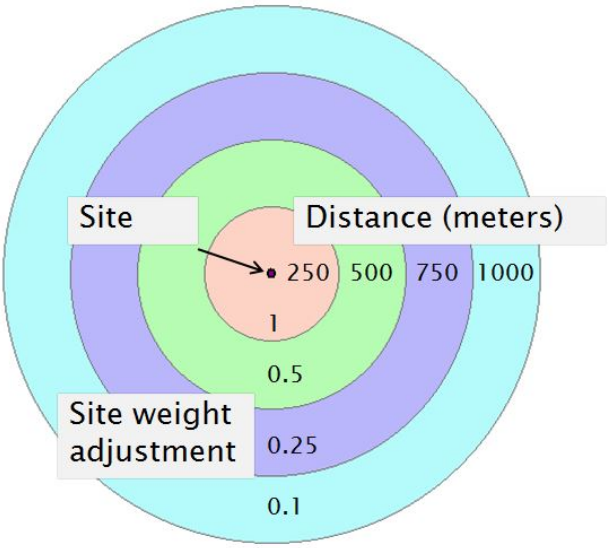
Common groundwater pollutants found at LUST and cleanup sites in California include gasoline and diesel fuels, chlorinated solvents and other volatile organic compounds (VOCs) such as benzene, toluene, and

methyl tert-butyl ether (MTBE); heavy metals such as lead, chromium and arsenic; polycyclic aromatic hydrocarbons (PAHs); persistent organic pollutants like polychlorinated biphenyls (PCBs); DDT and other insecticides; and perchlorate (SWRCB, 2012; DPR, 2011; US EPA, 2002). An assessment of benzene exposure from a fuel leak concluded that soil and groundwater contamination could put nearby residents at risk and could have caused adverse health effects (Santos *et al.,* 2013). Dioxins and dioxin-like substances have been detected in groundwater in areas where treated wastewater has been used for irrigation (Mahjoub *et al*., 2011) and near wood treatment facilities (Karouna-Renier *et al*., 2007). The occurrence of storage tanks, leaking or not, provides a good indication of potential concentrated sources of some of the more prevalent compounds in groundwater. For example, the detection frequency of VOCs found in gasoline is associated with the number of UST or LUST sites within one kilometer of a well (Squillace and Moran, 2007). The occurrence of chlorinated solvents in groundwater is also associated with the presence of cleanup sites (Moran *et al*., 2007). Some of these cancer-causing compounds have in turn been detected in drinking water supplies in California (Williams *et al*., 2002). People who live near shallow groundwater plumes containing VOCs may also be exposed via the intrusion of vapors from soil into indoor air (Picone *et al*., 2012; Yao *et al*., 2013).

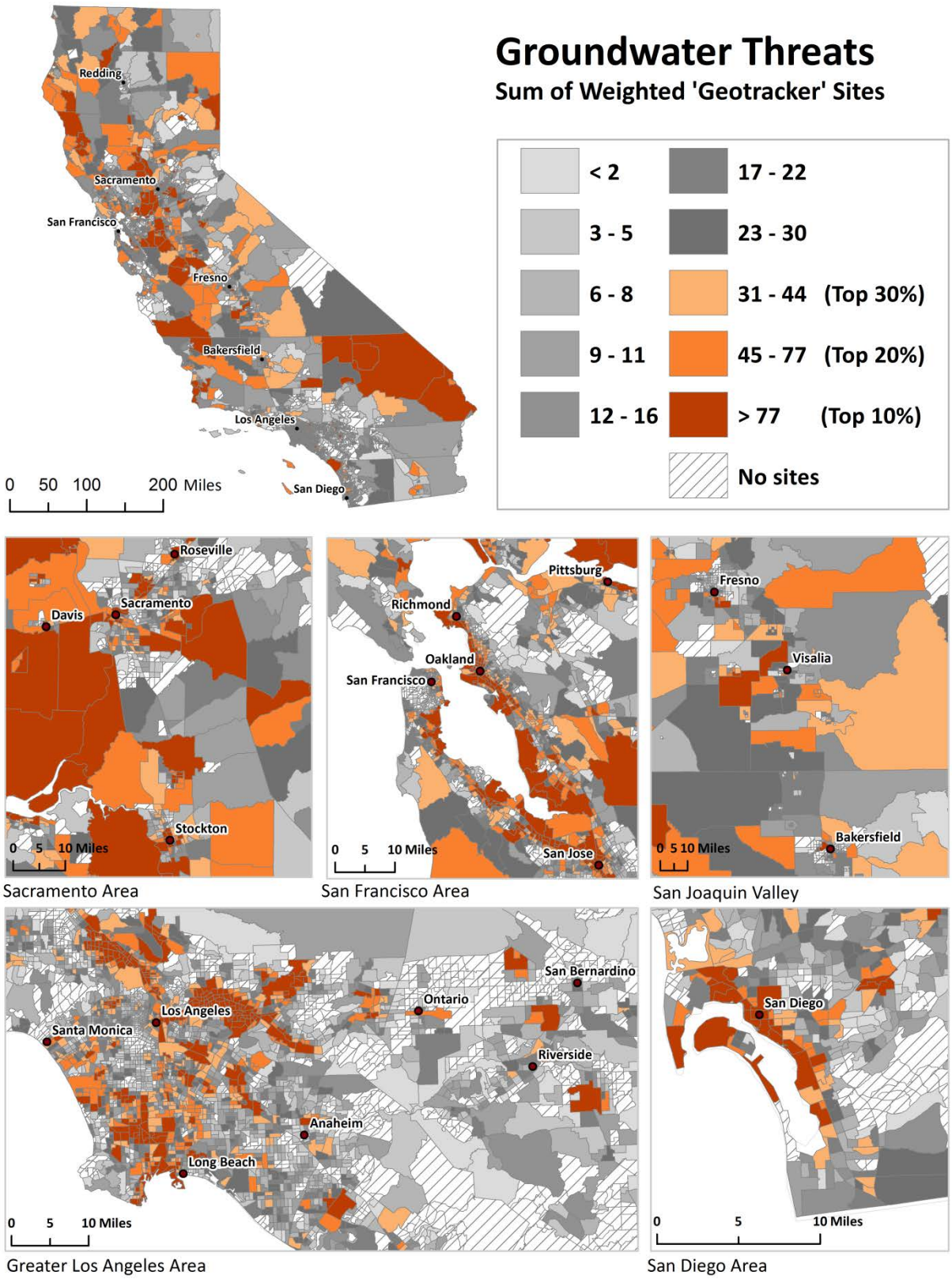
Method

- Data on cleanup site type, status, and location (coordinate or address) for the entire state were downloaded from GeoTracker (http://geotracker.waterboards.ca.gov/data_download.asp; GeoTracker Cleanup Sites).
- Sites with a valid latitude and longitude were mapped and sites with address only were geocoded in ArcMap. Sites without a valid latitude and longitude or unrecognizable address were excluded from the analysis.
- Certain types of sites and statuses were excluded from the analysis because they are not indicative of a hazard or a potential environmental risk (see Appendix). Each remaining site was scored on a weighted scale of 1 to 15 in consideration of both the site type and status. (See Appendix.)
- The weights for all sites, except LUST Cleanup Program and military UST sites, were adjusted based on the distance they fell from populated census blocks. Sites further than 1000m from any populated census block were excluded from the analysis. LUST Cleanup Program and military UST sites were not adjusted, but if these sites fell further than 250m from populated census blocks, they were excluded.
- Site weights were adjusted by multiplying the weight by 1 for sites less than 250m, 0.5 for sites 250-500m, 0.25 for sites 500-750m, and 0.1 for sites 750-1000m from the nearest populated census blocks within a given tract. Sites outside of a census tract, but less

than 1000m from one of that tract's populated blocks were similarly adjusted based on the distance to the nearest block from that tract (See image below).



- Each census tract was scored based on the sum of the adjusted weights for sites it contains or is near (in ArcMap).
- Census tracts were ordered based on their summed scores and were assigned percentiles.


Groundwater Threats
Sum of Weighted 'Geotracker' Sites
< 2
3 - 5
6 - 8
9 - 11
12 - 16
17 - 22
23 - 30
31 - 44 (Top 30%)
45 - 77 (Top 20%)
> 77 (Top 10%)
No sites
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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Appendix

Weighting Matrix for Groundwater Threats

Groundwater threats from the GeoTracker database were weighted on a scale of 1 to 15 in consideration of both the site type and status. The following table shows the weights applied for each site type and status.

Sites with a status type of *Completed – Case Closed* and *Open-Referred* were excluded from the analysis because they are completed or were referred and tracked by another agency.

For a given census tract, the weighted scores of all facilities in the area were summed after adjusting for proximity to populated census blocks.

Site Type	Status	Weight
Land Disposal Sites [Military Privatized Site*]	Open – Remediation	10
	Open - Assessment & Interim Remedial Action	10
	Open - Site Assessment	6
	Open	3
	Open – Operating	3
	Open - Verification Monitoring	3
	Open - Closed / Monitoring	2
	Open – Inactive	2
	Open - Eligible for Closure	Exclude
	Open – Proposed	Exclude
LUST Sites [Military UST Site*]	Open – Remediation	3
	Open - Assessment & Interim Remedial Action	3
	Open - Site Assessment	2
	Open - Verification Monitoring	2
	Open – Inactive	1
	Open - Eligible for Closure	Exclude
Cleanup Program Sites [Military Cleanup Site*]	Open - Assessment & Interim Remedial Action	15
	Open – Remediation	15
	Open - Site Assessment	10
	Open - Reopen Case	10
	Open - Verification Monitoring	6
	Open – Inactive	3
	Open - Eligible for Closure	Exclude

*Military sites have unique site types, but receive the same weights as their Land Disposal, Cleanup, and LUST site types of the same status.

Site Type Definitions*:

- *Cleanup Program Site* (Site Cleanup Program): In general, Site Cleanup Program sites are areas where a release of pollutants has occurred that is not addressed in the other core regulatory programs (e.g., permitted facilities, USTs). The funding for the Program is primarily cost reimbursement from responsible parties.
- *Land Disposal Site:* The Land Disposal program regulates water quality aspects of discharges to land for disposal, treatment, or storage of waste at waste management facilities and units such as landfills, waste piles and land treatment units under California

Code of Regulations, Title 27. A land disposal unit is an area of land, or a portion of a waste management facility, at which waste is discharged.

- *Military Cleanup Site:* Military Cleanup Program sites are areas where a release of pollutants from an active or closed military facility has occurred. The military fully funds for the Program oversight.
- *Military Privatized Site:* These sites are within the Site Cleanup Program. They are unique because these sites have been transferred by the military into non-military ownership with or without further cleanup necessary.
- *Military Underground Storage Tanks (UST):* Military UST Program sites are areas where a release of pollutants from an underground storage tank has occurred at a military or former military installation. The military fully funds for the Program oversight costs.

Status Definitions for Land Disposal Sites*:

- *Open - Operating:* A land disposal site that is accepting waste. These sites have been issued waste discharge requirements by the appropriate Regional Water Quality Control Board.
- *Open - Proposed:* A land disposal site that is in the process of undergoing the permit process from several agencies. These sites have not been issued waste discharge requirements by the appropriate Regional Water Quality Control Board, and are not accepting waste.
- *Open – Closing/with Monitoring:* A land disposal site that is no longer accepting waste and is undergoing all operations necessary to prepare the site for post-closure maintenances in accordance with an approved plan for closure.
- *Open – Closed/with Monitoring:* A land disposal site that has ceased accepting waste and was closed in accordance with applicable statutes, regulations, and local ordinances in effect at time of closure. Land disposal site in post closure maintenance period as waste could have an adverse effect on the quality of the waters of the state. Site has waste discharge requirements.
- *Open – Inactive:* A land disposal site that has ceased accepting waste but has not been formally closed or is still within the post closure monitoring period. Site does not pose a significant threat to water quality and does not have groundwater monitoring. Site may or may not have waste discharge requirements.
- *Completed – Case Closed/No Monitoring:* A land disposal site that ceased accepting waste and was closed in accordance with applicable statutes, regulations, and local ordinances in effect at time of closure. The land disposal site was monitored for at least 30 years and Water Board staff has determined that wastes no longer pose a threat to water quality. Site does not have waste discharge requirements.

Status Definitions for Other Site Types*:

- *Completed – Case Closed*: A closure letter or other formal closure decision document has been issued for the site.
- *Open – Assessment & Interim Remedial Action*: An "interim" remedial action is occurring at the site AND additional activities such as site characterization, investigation, risk evaluation, and/or site conceptual model development are occurring.
- *Open – Inactive*: No regulatory oversight activities are being conducted by the Lead Agency.

- *Open – Remediation*: An approved remedy or remedies has/have been selected for the impacted media at the site and the responsible party (RP) is implementing one or more remedy under an approved cleanup plan for the site. This includes any ongoing remedy that is either passive or active, or uses a combination of technologies. For example, a site implementing only a long term groundwater monitoring program, or a "monitored natural attenuation" (MNA) remedy without any active groundwater treatment as part of the remedy, is considered an open case under remediation until site closure is completed.
- *Open – Site Assessment*: Site characterization, investigation, risk evaluation, and/or site conceptual model development are occurring at the site. Examples of site assessment activities include, but are not limited to, the following: 1) identification of the contaminants and the investigation of their potential impacts; 2) determination of the threats/impacts to water quality; 3) evaluation of the risk to humans and ecology; 4) delineation of the nature and extent of contamination; 5) delineation of the contaminant plume(s); and 6) development of the Site Conceptual Model.
- *Open – Verification Monitoring* (use only for UST, Chapter 16 regulated cases): Remediation phases are essentially complete and a monitoring/sampling program is occurring to confirm successful completion of cleanup at the Site. (e.g. No "active" remediation is considered necessary or no additional "active" remediation is anticipated as needed. Active remediation system(s) has/have been shut-off and the potential for a rebound in contaminant concentrations is under evaluation).
- *Open – Reopen Case* (available selection only for previously closed cases): This is not a case status. This field should be selected to record the date that the case was reopened for further investigation and/or remediation. A case status should immediately be selected from the list of case status choices after recording this date.
- *Open – Eligible for Closure*: Corrective action at the Site has been determined to be completed and any remaining petroleum constituents from the release are considered to be low threat to Human Health, Safety, and the Environment. The case in GeoTracker is going through the process of being closed.

* *Available through Geotracker website: http://geotracker.waterboards.ca.gov/.*

Number of Groundwater Threat Sites in CalEnviroScreen 2.0: Approximately 14,000

Facility Type	% of Total
Cleanup Program Site	42%
LUST Site	30%
Military Cleanup Site	15%
Land Disposal Site	8%
Military UST Site	4%
Military Privatized Site	<1%

HAZARDOUS WASTE GENERATORS AND FACILITIES

Environmental Effects Indicator

Most hazardous waste must be transported from hazardous waste generators to permitted recycling, treatment, storage, or disposal facilities (TSDF) by registered hazardous waste transporters. Most shipments must be accompanied by a hazardous waste manifest. There are widespread concerns for both human health and the environment from sites that serve for the processing or disposal of hazardous waste. Many newer facilities are designed to prevent the contamination of air, water, and soil with hazardous materials, but even newer facilities may negatively affect perceptions of surrounding areas in ways that have economic, social and health impacts. The Department of Toxic Substances Control maintains data on permitted facilities that are involved in the treatment, storage, or disposal of hazardous waste as well as information on hazardous waste generators.

Indicator

Sum of weighted permitted hazardous waste facilities and hazardous waste generators within each census tract.

Data Source

EnviroStor Hazardous Waste Facilities Database and
Hazardous Waste Tracking System,
Department of Toxic Substances Control (DTSC)

EnviroStor is a public web site that provides access to detailed information on hazardous waste permitted facilities. Information included in the database includes the facility name and address, geographic location, facility type and status.

DTSC also maintains information on the manifests created for the transport of hazardous waste from generators in its Hazardous Waste Tracking System. Manifests include the generators' name and identification number, the transporter, the designated recipient and description of the type and quantity of waste classified by a coding system. Data are currently available for 2009.

http://www.envirostor.dtsc.ca.gov/public/data_download.asp
http://hwts.dtsc.ca.gov/

Rationale

Hazardous waste by definition that is potentially dangerous or harmful to human health or the environment. US EPA and DTSC both have standards for determining when waste materials must be managed as hazardous waste. Hazardous waste can be liquids, solids, or contained gases. It can include manufacturing by-products, and discarded used or unused materials such as cleaning fluids (solvents) or pesticides. Used oil and contaminated soil generated from a site clean-up can be hazardous wastes (DTSC, Defining Hazardous Waste). In 1995, 97% of toxic chemicals released nationwide came from small generators and facilities (McGlinn, 2000). Generators of hazardous waste may treat waste onsite or send it elsewhere for disposal.

The potential health effects that come from living near hazardous waste

disposal sites have been examined in a number of studies (Vrijheid, 2000). While there is sometimes limited assessment of exposures that occur in nearby populations, there are studies that have found health effects, including diabetes and cardiovascular disease, associated with living in proximity to hazardous waste sites (Kouznetsova *et al*., 2007; Sergeev and Carpenter, 2005).

Location of hazardous waste sites in communities has long been an environmental justice concern in California. For example, a recent study of 82 hazardous waste treatment, storage, and disposal facilities in Los Angeles County found that the communities most affected by the facilities are composed of working-class and ethnic minority populations living near industrial areas (Aliyu et al, 2011). A 1997 study correlated race/ethnicity with the location of hazardous waste treatment, storage and disposal facilities for both African-American and Latino populations (Boer *et al*., 1997).

Electronic waste is defined as universal waste rather than hazardous waste by California law, and is subject to different rules for handling and transportation. However, some components of electronic devices contain hazardous materials, and facilities that collect or recycle electronic waste are potential sources of exposure to toxic chemicals (DTSC, 2010; CalRecycle, 2012).

Method

Permitted hazardous waste facilities:

- Permitted facility data were obtained from the DTSC website.
- Facilities were scored on a weighted scale in consideration of the type and permit status for the facility (See Appendix).
- Site locations were mapped or geocoded (in ArcMap).

Hazardous waste generators:

- Generator data were obtained from DTSC from the Hazardous Waste Tracking System for 2010 to 2012.
- Only large quantity generators (producing over 1,000 kg of waste per month[4] for at least one of the three years) and generators producing RCRA waste[5] were included.
- Facilities were scored on a weighted scale in consideration of the volume of waste generated (see Appendix).
- Site locations were mapped or geocoded (in ArcMap).

Proximity Adjustment:

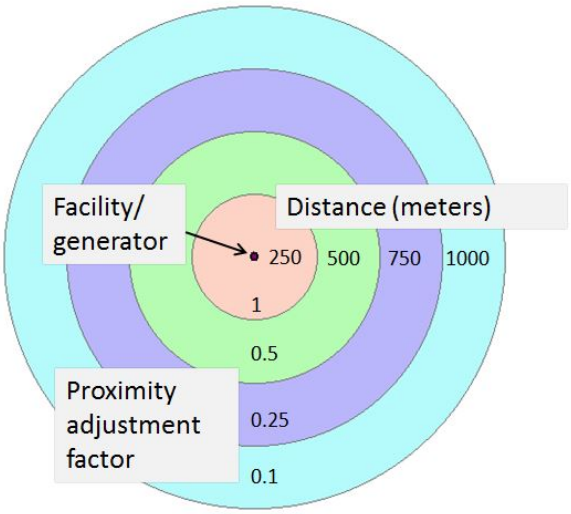
- The weights for facilities (permitted and generators) were adjusted based on the distance they fell from populated census blocks. All

[4] Corresponds to over 13.1 tons per year

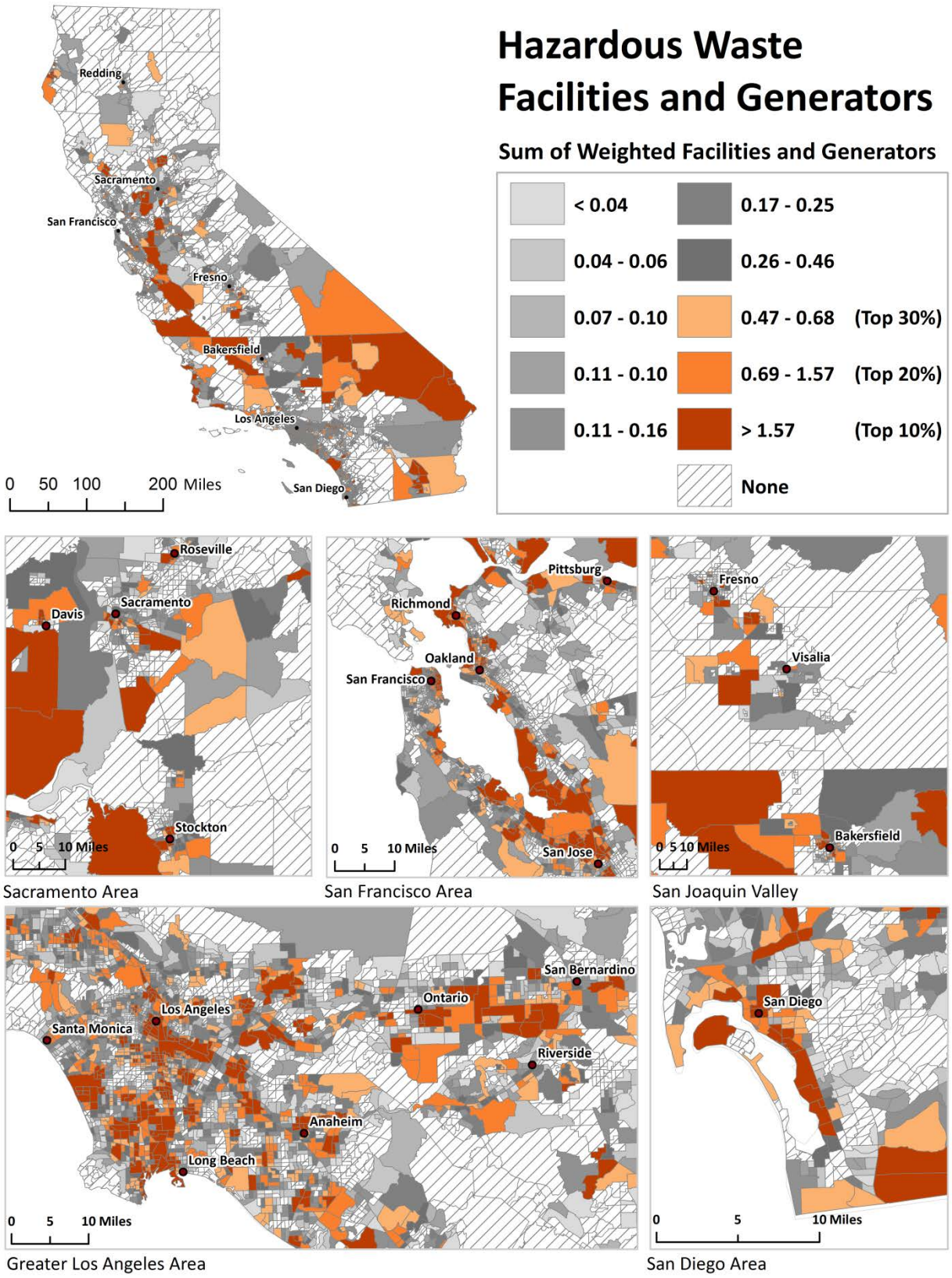
[5] RCRA: Resource Conservation and Recovery Act governs the federal management of hazardous wastes; (List of RCRA waste: http://www.epa.gov/osw/inforesources/data/br91/na_apb-p.pdf)

facilities further than 1,000m from any populated census block were excluded from the analysis.

- Site weights were adjusted by multiplying the weight by 1 for facilities less than 250m, 0.5 for sites 250-500m, 0.25 for sites 500-750m, and 0.1 for sites 750-1000m from the nearest populated census blocks within a given tract. Facilities outside of a census tract, but less than 1000m from one of that tract's populated blocks were similarly adjusted based on the distance to the nearest block from that tract (See image below).



- Each census tracts was scored based on the sum of the adjusted weights for sites it contains or is near (in ArcMap).
- Census tracts were ordered based on their summed scores and were assigned percentiles.


Hazardous Waste Facilities and Generators
Sum of Weighted Facilities and Generators
< 0.04
0.04 - 0.06
0.07 - 0.10
0.11 - 0.10
0.11 - 0.16
0.17 - 0.25
0.26 - 0.46
0.47 - 0.68 (Top 30%)
0.69 - 1.57 (Top 20%)
> 1.57 (Top 10%)
None
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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Appendix

Weighting Matrix for Permitted Hazardous Waste Facilities and Hazardous Waste Generators

Permitted Hazardous Waste Facilities from DTSC's permitted facilities database were weighted on a scale of 1 to 15 in consideration of the facility activity, permit type and permit status. The score for any given Permitted Hazardous Waste Facility represents the sum of its Facility Activity, Permit Type and Permit Status. Hazardous waste generators were weighted on a scale of 0.1 to 2 based on the yearly amount of waste generated.

The following tables show the weights applied to the facilities and generators. Greater concerns were identified for permitted hazardous waste facilities that handle much of the hazardous waste generated from the ~30,000 generators in California. Only large quantity generators (> 1,000 kg per month or >13.1 tons per year) that produce RCRA waste were included due to the large number of hazardous waste generators producing small amounts of less hazardous types of waste. In 2010 to 2012 this represents about 4,500 generators. Higher weights were given to generators that produced larger volumes of waste. For all census tract codes, the weighted and proximity adjusted scores of all facilities and generators in the area were summed.

Permitted Hazardous Waste Facilities

	Weight	Activity or Status
Facility Activity (base weight)	**10**	Landfill
	7	Treatment
	4	Storage
	2	Post-closure
Permit Type *(additional weight)*	**1**	Large facilities
	1	Non-RCRA facilities
	2	RCRA facilities
Permit Status *(additional weight)*	**0**	Permit current
	1	Permit expired, less than 5 years
	2	Permit expired, 5 years but less than 10
	3	Permit expired, 10 or more years
	3	No permit, interim status

Hazardous Waste Generators

Generator Type	Weight	Quantity of Waste
Large Quantity Hazardous Waste Generators (> 13.1 tons per year)	**0.1**	< 100 tons/yr
	0.5	100 – 1,000 tons/yr
	2	>1,000 tons/yr

Number of Hazardous Waste Generators and Permitted Facilities in CalEnviroScreen 2.0: Approximately 4,400

Facility Type	% of Total
Large hazardous waste generator with RCRA waste	97%
Permitted hazardous waste storage facility	3%*

**Permitted storage facilities are weighted much higher than generators.*

IMPAIRED WATER BODIES

Environmental Effects Indicator

Contamination of California streams, rivers, and lakes by pollutants can compromise the use of the water body for drinking, swimming, fishing, aquatic life protection, and other beneficial uses. When this occurs, such bodies are considered "impaired." Information on impairments to these water bodies can help determine the extent of environmental degradation within an area.

Indicator

Summed number of pollutants across all water bodies designated as impaired within the area.

Data Source

303(d) List of Impaired Water Bodies,
State Water Resources Control Board (SWRCB)

The SWRCB provides information relevant to the condition of California surface waters. Such information is required by the Federal Clean Water Act. Every two years, State and Regional Water Boards assess the quality of California surface waters. Lakes, streams and rivers that do meet water quality standards, or are not expected to meet water quality standards, are listed as impaired under Section 303(d) of the Clean Water Act.

http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/TMDLs/303dlist.shtml

Rationale

Rivers, lakes, estuaries and marine waters in California are important for many different uses. Water bodies used for recreation may also be important to the quality of life of nearby residents if subsistence fishing is critical to their livelihood (CalEPA, 2002). Water bodies also support abundant flora and fauna. Changes in aquatic environments can affect biological diversity and overall health of ecosystems. Aquatic species important to local economies may be impaired if the habitats where they seek food and reproduce are changed. Marine wildlife like fish and shellfish that are exposed to toxic substances may potentially expose local consumers to toxic substances as well (CalEPA, 2002). Excessive hardness, unpleasant odor or taste, turbidity, color, weeds, and trash in the waters are types of pollutants affecting water aesthetics (CalEPA, 2002), which in turn can affect nearby communities.

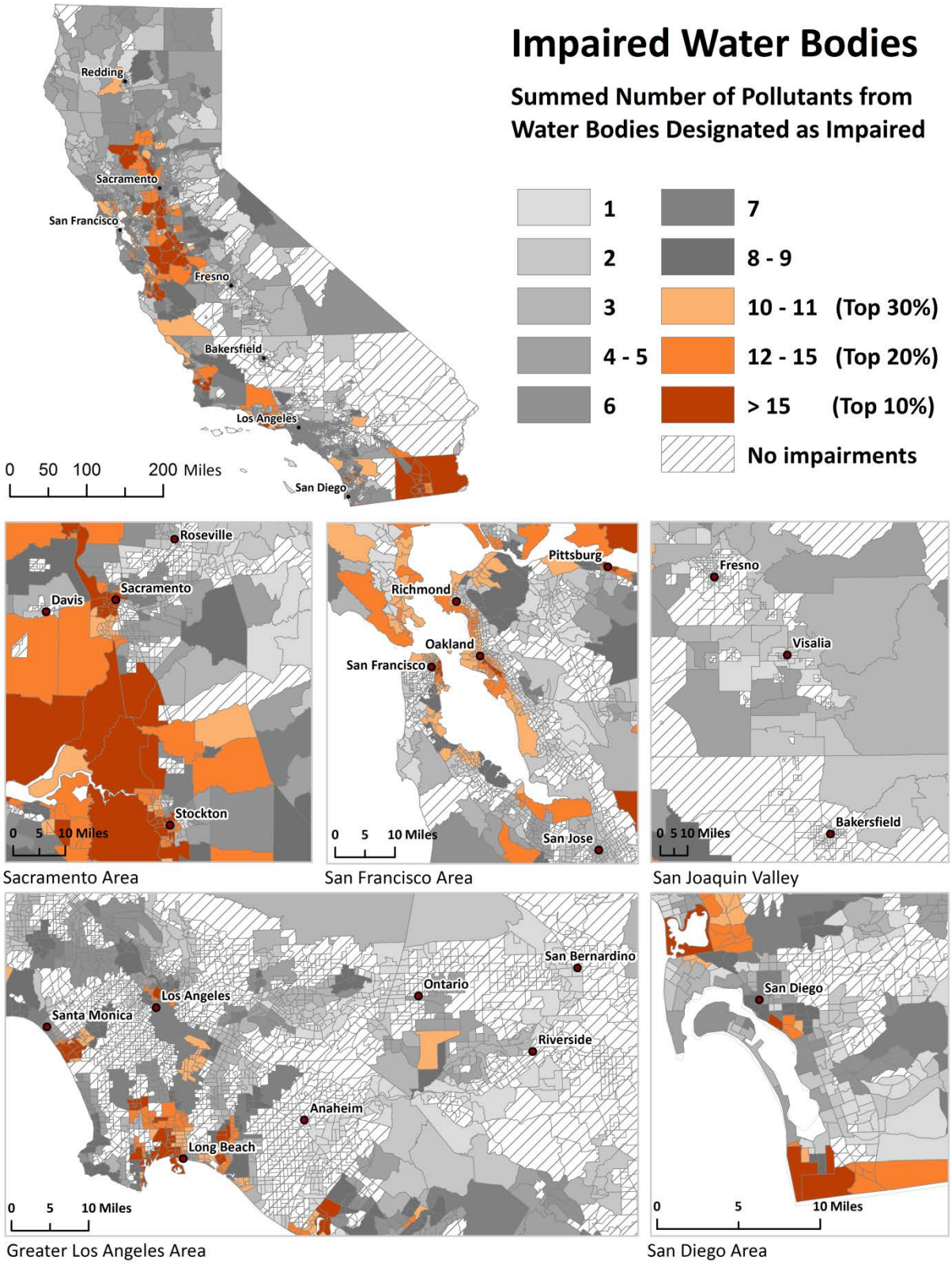
Communities of color, low-income communities, and tribes generally depend on the fish, aquatic plants, and wildlife provided by nearby surface waters to a greater extent than the general population (NEJAC, 2002). Some communities that rely on resources provided by nearby surface waters have populations of lower socioeconomic status than the general population. For example, certain fishing communities along California's northern coast have lower educational attainment and median income than California as a whole (Pomeroy *et al.*, 2010). Low-income communities in California that rely on fishing and waterfront businesses have been affected by a recent decline in the fishing

community (California State Lands Commission, 2011). Lower per capita income has been associated with increased levels of certain surface water pollutants, as have a higher percentage of minorities and people of color (Farzin and Grogan, 2012). In addition, a study in the Sacramento-San Joaquin Delta found that fish consumption for certain subsistence fishers was higher than rates used for planning and regulation of polluted waters, and that mercury consumption from fish was significantly above US EPA advisory levels (Shilling *et al.,* 2010).

Two studies, one in England and one in San Antonio, Texas, found that people who lived near water bodies with significant impairments were more likely to believe that the water bodies were safe, and therefore to visit them more often, than people who lived further away (Georgiou *et al.,* 2000; Brody *et al.,* 2004).

Method

- Data on water body type, water body ID, and pollutant type were downloaded in Excel format, and GIS data showing the visual representation of all water bodies were downloaded from the SWRCB website. http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml)
- All water bodies were identified in all census tracts in the GIS software ArcMap.
- The number of pollutants listed in streams or rivers that fell within 1 kilometer (km) or 2 km of a census tract's populated blocks were counted. The 2 km buffer distance was applied to major rivers (>100 km in length, plus the Los Angeles River and Imperial Valley canals and drainage ways). The 1 km buffer distance was applied to all smaller streams/rivers.
- The number of pollutants listed in lakes, bays, estuaries or shoreline that fell within 1 km or 2 km of a census tract's populated blocks were counted. The 2 km buffer distance was applied to major lakes or bays greater than 25 square kilometers in size, plus all the Sacramento/San Joaquin River Delta waterways. The 1 km buffer distance was applied for all other lakes/bays.
- The two pollutant counts were summed for every census tract.
- Each census tract was scored based on the sum of the number of individual pollutants found within and/or bordering it. For example, if two stream sections within a census tract were both listed for the same pollutant, the pollutant was only counted once.
- Census tracts were ordered based on their summed scores and were assigned percentiles.


Impaired Water Bodies
Summed Number of Pollutants from Water Bodies Designated as Impaired
1
2
3
4 - 5
6
7
8 - 9
10 - 11 (Top 30%)
12 - 15 (Top 20%)
> 15 (Top 10%)
No impairments
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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SOLID WASTE SITES AND FACILITIES

Environmental Effects Indicator

Many newer solid waste landfills are designed to prevent the contamination of air, water, and soil with hazardous materials. However, older sites that are out of compliance with current standards or illegal solid waste sites may degrade environmental conditions in the surrounding area and pose a risk of exposure. Other types of facilities, such as composting, treatment and recycling facilities, may raise concerns about odors, vermin, and increased truck traffic. While data that describe environmental effects from the siting and operation of all types of solid waste facilities are not currently available, the California Department of Resources Recycling and Recovery (CalRecycle) maintains data on facilities that operate within the state, as well as sites that are abandoned, no longer in operation, or illegal.

Indicator

Sum of weighted solid waste sites and facilities.

Data Source

Solid Waste Information System (SWIS) and
Closed, Illegal, and Abandoned (CIA) Disposal Sites Program,
California Department of Resources Recycling and Recovery, CalRecycle

SWIS is a database which tracks solid waste facilities, operations, and disposal sites throughout California. Solid waste sites found in this database include landfills, transfer stations, material recovery facilities, composting sites, transformation facilities, waste tire sites, and closed disposal sites.

The CIA Disposal Sites Program is a subset of the SWIS database, and includes closed landfills and disposal sites that have not met minimum state standards for closure as well as illegal and abandoned sites. Sites within CIA have been prioritized to assist local enforcement agencies investigate the sites and enforce state standards.

http://calrecycle.ca.gov/SWFacilities/Directory/
http://www.calrecycle.ca.gov/SWFacilities/CIA/

Rationale

Solid waste sites can have multiple impacts on a community. Waste gases like methane and carbon dioxide can be released into the air from disposal sites for decades, even after site closure (US EPA, 2011; Ofungwu and Eget, 2005). Fires, although rare, can pose a health risk from exposure to smoke and ash (CalRecycle, 2010a; US Fire Administration, 2002). Odors and the known presence of solid waste may impair a community's perceived desirability and affect the health and quality of life of nearby residents (Heaney *et al.*, 2011).

Although all active solid waste sites are regulated, CalRecycle has recorded a number of old closed disposal sites and landfills that are monitored less frequently. Former abandoned disposal sites present potential for human or animal exposure to uncovered waste or burn ash. Such sites are of concern to State and local enforcement agencies

(CalRecycle, 2010b).

Many of the studies that address the potential toxicity of solid waste site emissions look at the biological effects of landfill leachate on selected species of animals and plants in the laboratory. New ecological test methods have demonstrated that exposure to landfill soil containing a mixture of hazardous chemicals can cause genetic changes that are associated with adverse effects on the reproductive system (Roelofs *et al.*, 2012). In addition, an epidemiologic study of human births near landfills in Wales found an increase in the rate of birth defects after the opening or expansion of sites (Palmer *et al.*, 2005). A study conducted after an accidental fire at a municipal landfill in Greece found unacceptably high levels of dioxins in food products, primarily meat, milk and olives, from an area near the landfill (Vassiliadou *et al.*, 2009).

Method: Closed, Illegal, and Abandoned (CIA) sites:

- CIA data were obtained from CalRecycle for all priorities. (Only high priority CIA sites data are available online.)
- Unconfirmed and non-solid waste sites were removed from the analysis.
- Each remaining site was scored on a weighted scale in consideration of CalRecycle's prioritization categories (see table in Appendix).
- Site locations were mapped or geocoded (in ArcMap).

Active Solid Waste Information (SWIS) sites:

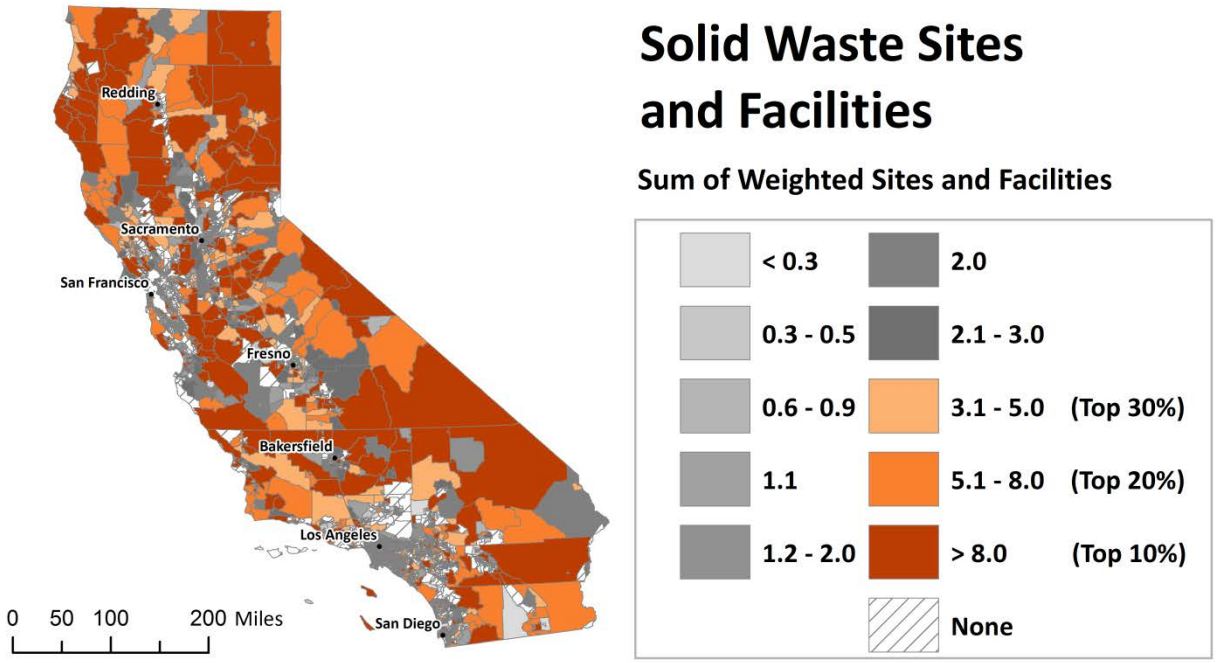
- SWIS data were obtained from the CalRecycle website.
- CIA records were filtered from the database because SWIS contains an inventory of both active and CIA sites.
- Of the remaining sites, Clean Closed, Absorbed, Inactive and Planned sites were not included.
- Each remaining site was scored on a weighted scale in consideration of the category type of solid waste operation (see table in Appendix).
- Site locations were mapped or geocoded (in ArcMap).
- To account for the relatively large land area of certain solid waste landfills that process greater than 3000 tons per day, the area of these sites from the SWIS database was used to create a circular perimeter approximation around its mapped location.

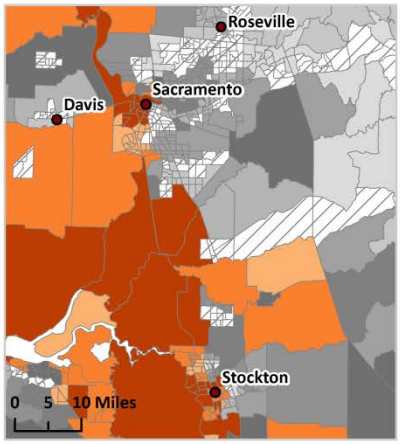
All sites:

- The weights for all sites, including the approximated large landfill perimeters, were adjusted based on the distance they fell from populated census blocks. Sites further than 1000m from any populated census block were excluded from the analysis.
- Site weights were adjusted by multiplying the weight by 1 for sites

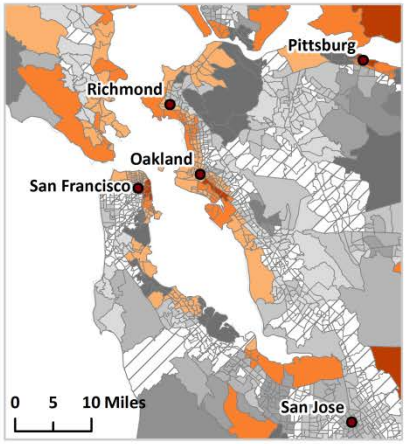
less than 250m, 0.5 for sites 250-500m, 0.25 for sites 500-750m, and 0.1 for sites 750-1000m from the nearest populated census blocks within a given tract. Sites outside of a census tract, but less than 1000m from one of that tract's populated blocks were similarly adjusted based on the distance to the nearest block from that tract.

- Each census tract was scored based on the sum of the adjusted weights for sites it contains or is near.
- Census tracts were ordered based on their summed scores and were assigned percentiles.

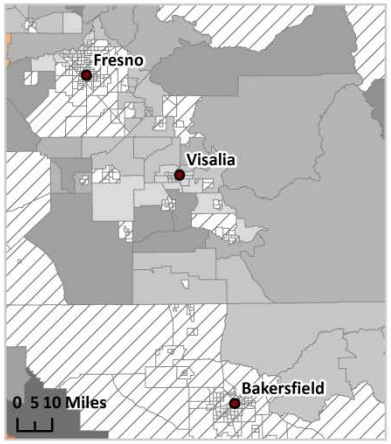




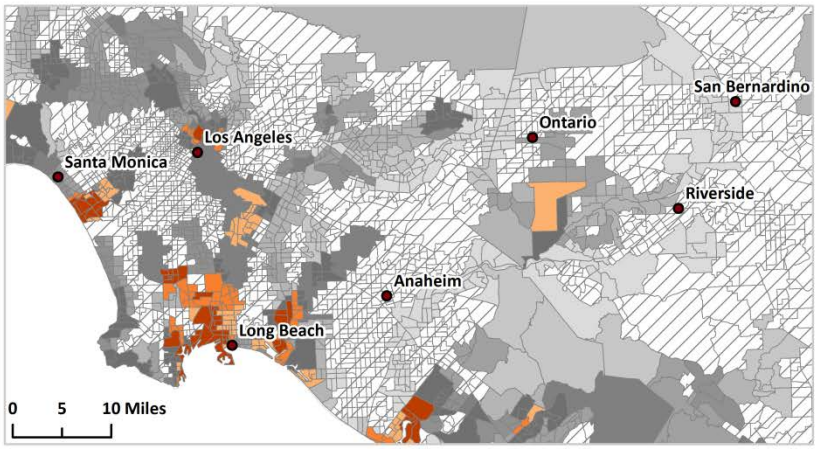
Sacramento Area



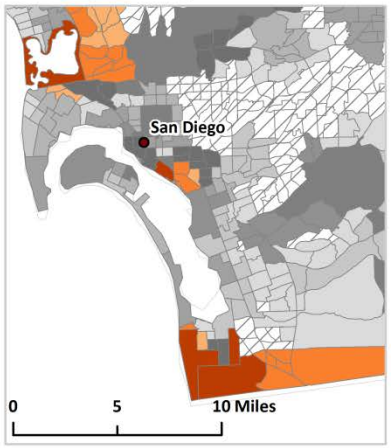
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

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Appendix

Weighting Matrix for Solid Waste Sites and Facilities

Solid Waste Sites and Facilities from the Solid Waste Information System were weighted on a scale of 1 to a maximum of 13 in consideration of both the site type and violation history. The following table shows the weights applied to the facilities and sites. The score for any given Solid Waste Site or Facility represents the sum of its 'Site or Facility Type' and 'Violations'. For all census tracts, the weighted scores of all facilities in the area were summed after adjusting for proximity to populated census blocks.

Category	Criteria	Site or Facility Type	Violations (any in previous 12 months) [1]
Closed, Illegal, or Abandoned Site [1]	Priority Code [2]	**6** (Priority Code A) **4** (Priority Code B) **2** (Priority Code C) **1** (Priority Code D)	NA
Solid Waste Landfill or Construction, Demolition and Inert (CDI) Debris Waste Disposal (active) [3]	Tonnage	**8** (> 10,000 tpd) **7** (> 3,000 to < 10,000 tpd) **6** (> 1,000 to < 3,000 tpd) **5** (> 100 to < 1,000 tpd) **4** (< 100 tpd)	**3** (gas) **1** (each for litter, dust, noise, vectors, and site security)
Solid Waste Disposal Site (closed, closing, inactive) [4]	Tonnage	**1** (All)	**3** (gas) **1** (each for litter, vector, site security)
Inert Debris: Engineered Fill	Regulatory Tier [5]	**2** (Notification)	**1** (each for dust, noise, vectors, site security)
Inert Debris: Type A Disposal	Regulatory Tier [5]	**3** (Permitted)	**1** (each for dust, noise, vectors, site security)
Composting	Regulatory Tier [5]	**4** (Permitted) **3** (Permitted: Chipping & Grinding, 200 to ≤500 tpd) **2** (Notification)	**1** (each for vector, odor, litter, hazard, nuisance, noise, dust, site security) **1** (fire)
Transfer/Processing	Regulatory Tier [5]	**5** (Permitted: large vol.) **3** (Permitted: medium vol.; direct transfer) **2** (Notification)	**1** (each for dust, litter, vector/bird/animal, fire, site security)
Waste Tire	Regulatory Tier [5]	**4** (Major) **2** (Minor)	**2** (each for storage, fire) **1** (each for vectors, site security)

[1] Violations: Recurring requirements ensures only facilities that exhibit a pattern and practice of non-compliance receive a higher impact score and reduces point-in-time fluctuations. Explosive gas violations have a greater potential environmental impact than dust, noise, and vectors (from SWIS and the Waste Tire Management System).

[2] CIA Sites weighted per established CIA Site Priority Code scoring methodology (A through D; additional information available at http://www.calrecycle.ca.gov/SWFacilities/CIA/forms/prioritize.htm).

[3] Active landfills (other than Contaminated Soil Disposal Sites and Nonhazardous Ash Disposal/Monofill Facilities) are all in the Full Permit tier, so permitted tonnage (from SWIS) is used to scale impact score.

[4] Solid Waste Disposal Site (closed) means the site was closed pursuant to state closure standards that became operative in 1989. Closed sites associated with the CIA Site database were closed prior to 1989 in accordance with standards applicable at the time of closure.

[5] Regulatory Tier used to weight the site or facility. Placement within a regulatory tier accounts for the type of waste and amount of waste processed per day or onsite at any one time. See SWIS for compost and transfer/processing; Waste Tire Management System (WTMS) for waste tire sites.

Number of Solid Waste Sites and Facilities in CalEnviroScreen 2.0: Approximately 2,800

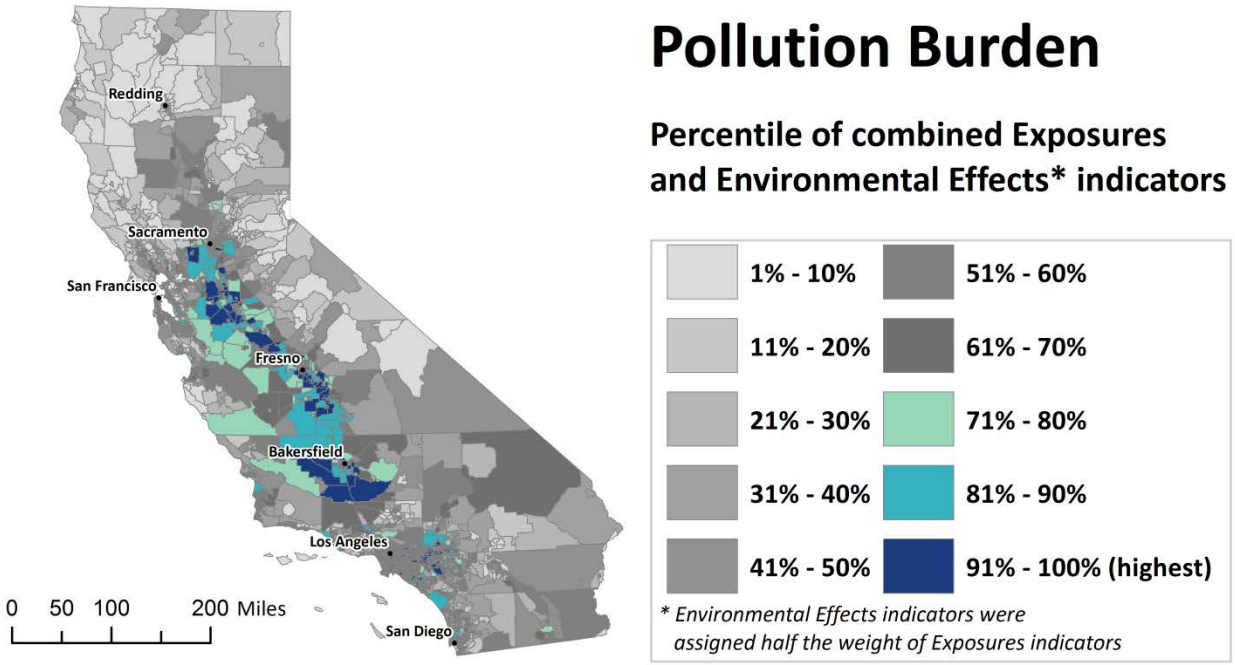
Facility Type	% of Total
Disposal (closed)	50%
Transfer/Processing (open)	24%
Composting	13%
Disposal (active)	11%
Waste Tire	2%
Transfer/Processing (closed)	<1%

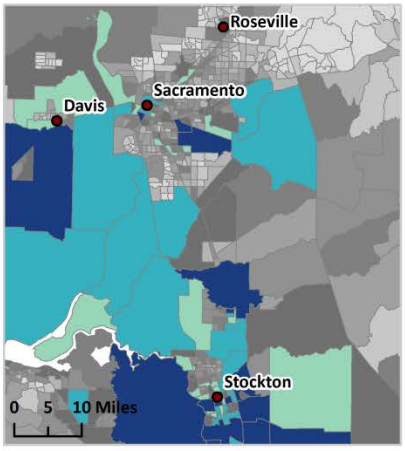
SCORES FOR POLLUTION BURDEN (RANGE OF POSSIBLE SCORES: 0.1 TO 10)

Pollution Burden scores for each census tract are derived from the average percentiles of the six Exposures indicators (ozone and PM2.5 concentrations, diesel PM emissions, pesticide use, toxic releases from facilities, and traffic density) and the five Environmental Effects indicators (cleanup sites, impaired water bodies, groundwater threats, hazardous waste facilities and generators, and solid waste sites and facilities).

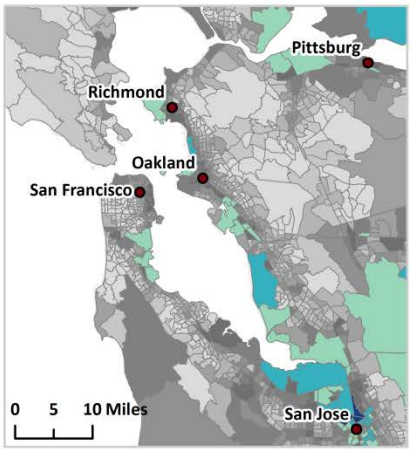
Indicators from the Environmental Effects component were given half the weight of the indicators from the Exposures component. The calculated average pollution buden score (average of the indicators) was divided by 10 and rounded to one decimal place for a Pollution Burden score ranging from 0.1 -10.

Note: The map on the following page shows pollution scores divided into deciles.

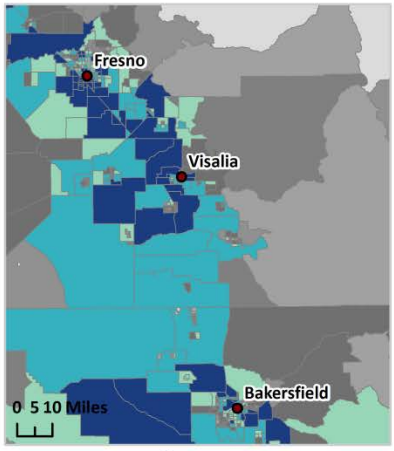




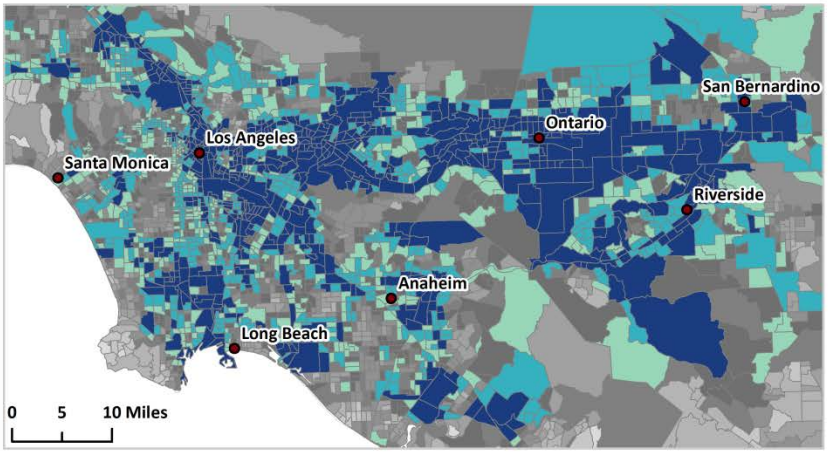
Sacramento Area



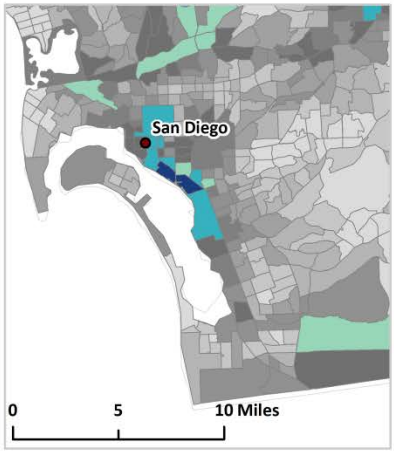
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

POPULATION CHARACTERISTICS: SENSITIVE POPULATION AND SOCIOECONOMIC FACTOR INDICATORS

AGE: CHILDREN AND ELDERLY

Sensitive Populations Indicator

Children can be especially sensitive to the adverse effects of pollutants for many reasons. Children are often more susceptible to the health effects of air pollution because their immune systems and organs are still immature. Irritation or inflammation caused by air pollution is more likely to obstruct their narrow airways. Children, especially toddlers and young children, may have higher background exposures to multiple contaminants from contact with the ground, from breathing through their mouths, and from spending a significant amount of time outdoors. Further, exposure to toxic contaminants in air or other sources during infancy or childhood could affect the development of the respiratory, nervous, endocrine and immune systems, and could increase the risk of cancer later in life.

Elderly populations can also be more vulnerable to adverse health effects from exposures to pollutants than younger adults. This population is more likely to have health conditions that may worsen responses, such as weakened immune system and existing cardiovascular and respiratory disease. A history of exposure to pollutants, or interactions with medications, may influence responses.

Indicator

Percent of population under age 10 or over age 65.

Data Source

U.S. Census Bureau

As part of the 2010 decennial census, the U.S. Census Bureau questionnaire asked all census respondents for the age and date of birth of all members of the household. Datasets describing the number of individuals in different age categories are available for California at different geographic scales. The data are made available using the American FactFinder website.

http://factfinder2.census.gov/

Rationale

Sensitivity of Children

Biological differences account for children's enhanced susceptibility to environmental pollutants. Children have smaller airways, a higher oxygen demand, and lower body weight than adults. Studies have demonstrated that children under the age of two have the highest exposure to lead in soil and household dust because of hand-to-mouth behavior. Even low levels of lead in a child's blood can result in intellectual delays, attention deficit-hyperactivity disorder and behavior problems. Childhood lead poisoning is associated with poverty, recent immigrant status and lack of private health insurance (Bellinger 2004; Howarth 2012; Wright *et al.* 2008, Canfield *et al.* 2003).

Children may spend 70% of their time outdoors, where they are exposed to contaminants in outdoor air. Air pollution can contribute to asthma, aggravated by children's high breathing rates and increased particle deposition in their small airways. Because children have low

body weights and high oxygen demands, they can also ingest higher amounts of chemicals than adults in relation to their size (OEHHA, 2001).

Children have proportionately greater skin surface area than adults, allowing body heat to be lost more readily and requiring a higher rate of metabolism to maintain body temperature and fuel growth and development. The resulting higher oxygen and food requirements can lead to higher exposures to environmental contaminants in air and food (Cohen Hubal *et al.*, 2000). In addition, the skin of children, especially newborns, is softer than the skin of adults and therefore can be more readily penetrated by chemicals. Infants may have higher exposures to fat-soluble chemicals once the layer of fat underlying the skin develops at approximately 2-3 months of age, continuing through the toddler period (OEHHA, 2001). The percentage of body fat generally decreases with age (Cohen Hubal *et al.*, 2000). Once environmental chemicals have been absorbed, the infant's immature renal system is unable to eliminate them as effectively as older children and adults (Sly and Flack, 2008).

Sensitivity of the Elderly

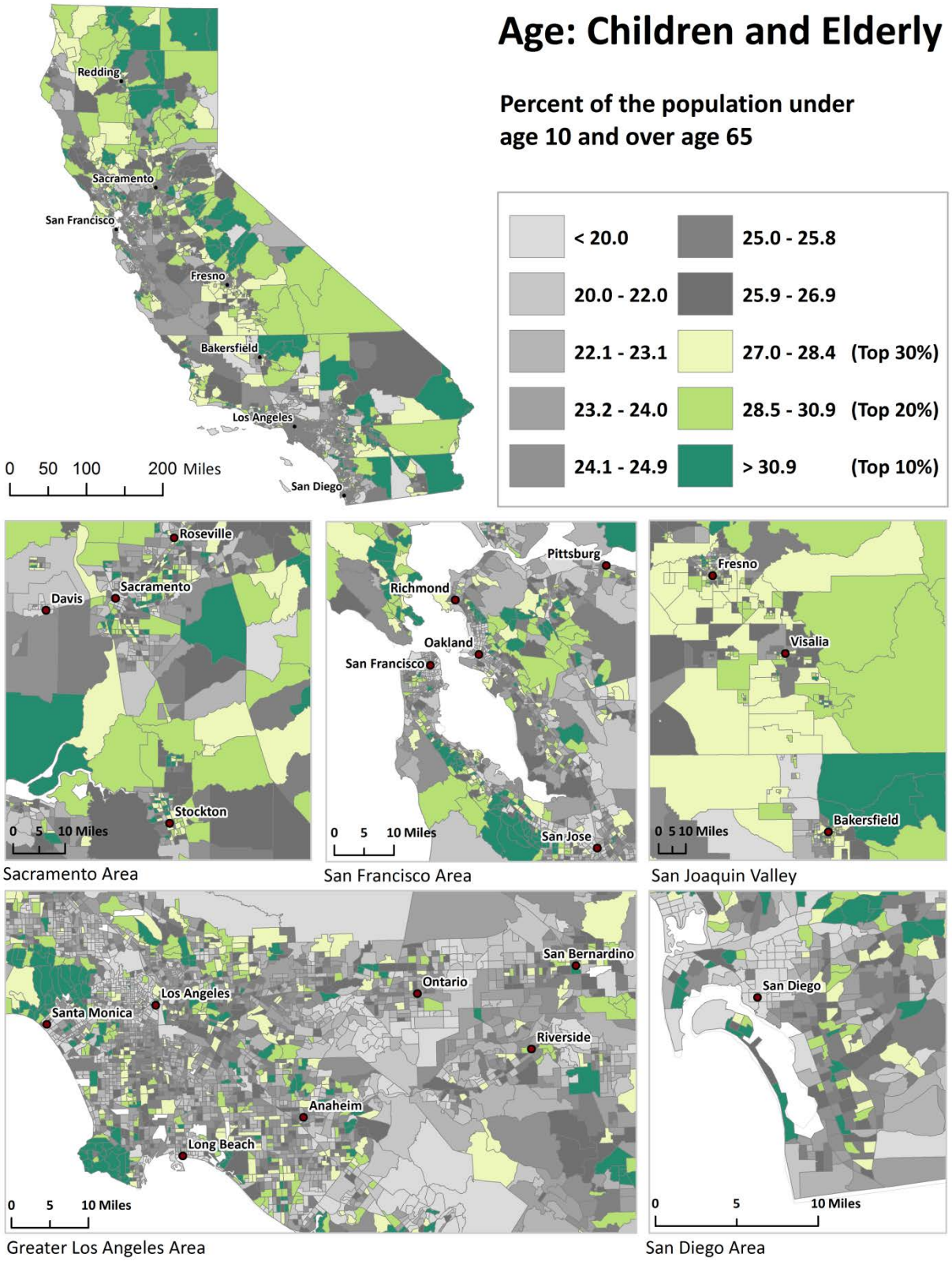
The mechanisms of absorption, distribution, metabolism, and excretion change with age. There is a reduction in lean body mass, certain blood proteins, and total body water as we get older. In comparison to younger adult populations, there is more variation in elderly individuals' capacity to metabolize substances. Reduced metabolic rates result in decreases in blood flow, prolonging the process of chemical elimination. In addition, renal function can be reduced by 50% in the elderly (Pedersen, 1997). Heart disease, which is found in the majority of elderly populations, increases susceptibility to the effects of exposure to particulate matter and can decrease heart rate and oxygen saturation (Adler, 2003).

Researchers in Korea in the 1990s noted that an increase in air pollution resulted in an increased risk for stroke in adults over the age of 65 (Hong *et al.*, 2002). Increased prevalence of stroke has also been associated with higher concentrations of carbon monoxide, sulfur dioxide, ozone, and nitrogen oxide (Adler, 2003). A study involving senior citizens in Denver found an increased hospitalization rate for heart attacks, atherosclerosis, and pulmonary heart disease on days with high air pollution levels. A review of studies of pollution exposure in older adults concluded that the elderly are more susceptible to health effects from air pollution than younger adults or the general population (Shumake *et al.*, 2013). Sulfur dioxide and carbon monoxide exposure have also been linked to longer hospital stays for cardiac dysrhythmias and congestive heart failure, respectively (Koken *et al.*, 2003).

Contaminants in drinking water, such as arsenic, may also pose a threat to the elderly. Arsenic accumulates in cardiovascular tissue and can trigger inflammation of the arteries, increasing the risk of atherosclerosis and vascular disease (Adler, 2003).

Method

- A dataset containing the number of people in different age groups by census tracts was downloaded for the State.
- The total percentage of individuals less than 10 years of age was calculated by summing the percentage of people less than 5 years of age and the percentage of people aged 5 to 9 years of age.
- The percentage of children and elderly in each census tract was calculated by summing the total percentage of individuals less than 10 years of age and the total percentage of individuals greater than 65 years of age in each census tract. Census tracts were ordered by this percentage. A percentile score for each census tract was determined by its place in the distribution of all census tracts.


Age: Children and Elderly
Percent of the population under age 10 and over age 65
< 20.0
20.0 - 22.0
22.1 - 23.1
23.2 - 24.0
24.1 - 24.9
25.0 - 25.8
25.9 - 26.9
27.0 - 28.4 (Top 30%)
28.5 - 30.9 (Top 20%)
> 30.9 (Top 10%)
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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ASTHMA

Sensitive Populations Indicator

Asthma is a chronic lung disease characterized by episodic breathlessness, wheezing, coughing, and chest tightness. While the causes of asthma are poorly understood, it is well established that exposure to traffic and outdoor air pollutants, including particulate matter, ozone, and diesel exhaust, can trigger asthma attacks. Nearly three million Californians currently have asthma and about five million have had it at some point in their lives. Children, the elderly and low-income Californians suffer disproportionately from asthma (California Health Interview Survey, 2009). Although well-controlled asthma can be managed as a chronic disease, asthma can be a life-threatening condition, and emergency department visits for asthma are a very serious outcome, both for patients and for the medical system.

Indicator

Spatially modeled, age-adjusted rate of emergency department (ED) visits for asthma per 10,000 (averaged over 2007-2009).

Data Source

California Office of Statewide Health Planning and Development (OSHPD)
California Environmental Health Tracking Program (CEHTP)
Environmental Health Investigations Branch,
California Department of Public Health

Since 2005, hospitals licensed by the state of California to provide emergency medical services are required to report all emergency department (ED) visits to OSHPD. Federally-owned facilities, including Veterans Administration and Public Health Services hospitals are not required to report. The ED dataset includes information on the principal diagnosis, which can be used to identify which patients visited the ED because of asthma.

ED utilization does not capture the full burden of asthma in a community because not everyone with asthma requires emergency care, especially if they receive preventive care, avoid asthma triggers and undertake disease maintenance. However, there is limited state-wide monitoring of other indicators, such as planned and unplanned doctor's visits, that might provide a better indication of overall disease burden. Some ED visits result in hospitalization, and OSPHD collects data on hospitalization due to asthma in addition to emergency department visits. ED visits are thought to provide a better comparative measure of asthma burden than hospitalizations and deaths because the data capture a larger portion of the overall burden and include less severe occurrences.

CEHTP used OSHPD's data to calculate age-adjusted rates of asthma ED visits for California ZIP codes. These estimates make use of ZIP-code level population estimates from a private vendor (Esri) and the U.S. 2000 Standard Population to derive age-adjusted rates. Age-adjustment takes the age distribution of a population into account and allows for meaningful comparisons between ZIP codes with different age

structures. ZIP code estimates are assigned to 2010 census blocks using areal apportionment. Population-weighted census block estimates are then combined to arrive at a census tract estimate.

http://www.oshpd.ca.gov/HID/Products/EmerDeptData/
http://www.cehtp.org/p/asthma

Rationale

Asthma increases an individual's sensitivity to pollutants. Air pollutants, including particulate matter, ozone, nitrogen dioxide, and diesel exhaust, can trigger symptoms among asthmatics (Meng *et al.*, 2011). Children living near major roadways and traffic corridors in California have been shown to suffer disproportionate rates of asthma (Kim *et al.*, 2004). Particulate matter from diesel engines has been implicated as a cause of new-onset asthma (Pandya *et al*, 2002). A study of low income children who developed asthma found that there was an increase in asthma diagnosis following increases in ambient air pollution (Wendt *et al.,* 2014). Exposure to certain pesticides can also trigger wheezing, coughing, and chest tightness (Hernández *et al.*, 2011).

Asthma can increase susceptibility to respiratory diseases such as pneumonia and influenza (Kloepfer *et al.*, 2012). For example, one study found that when ambient particulate pollution levels are high, persons with asthma have twice the risk of being hospitalized for pneumonia compared to persons without asthma (Zanobetti *et al.*, 2000).

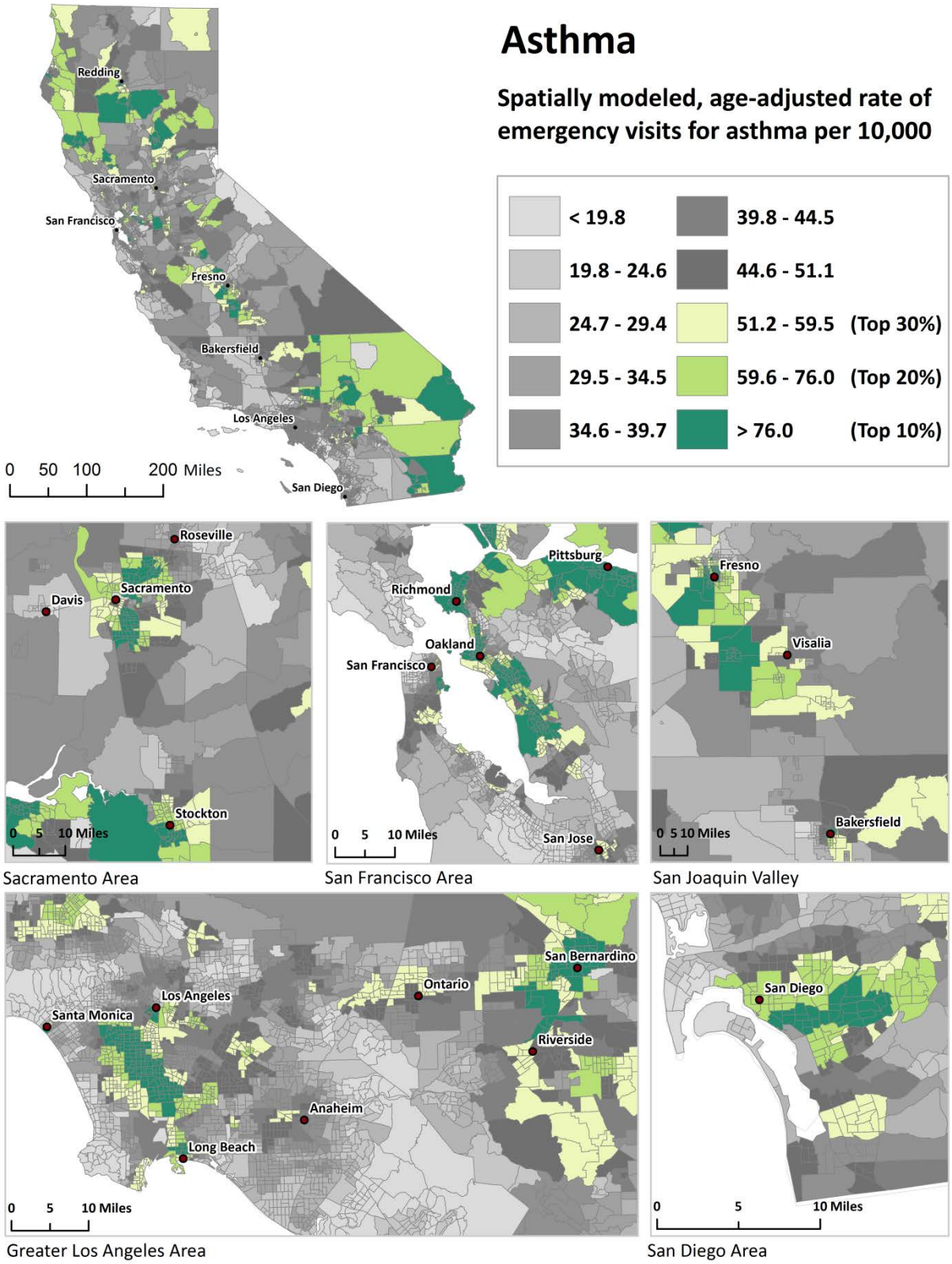
Asthma rates are a good indicator of population sensitivity to environmental stressors because asthma is both caused by and worsened by pollutants (CDPH, 2010). The severity of symptoms and the likelihood of needing hospital care decrease with access to regular medical care and asthma medication (Delfino *et al.*, 1998; Grineski *et al.*, 2010). Asthma-related emergency department visits provide a conservative estimate of total asthma cases because not all cases require emergency care. However, using those cases requiring emergency care as an indicator also captures some aspects of access to care and can be seen as a marker of both environmental and social stressors. Potential biases in using emergency department visits as an indicator of sensitivity include the possibility that lower socioeconomic status or more isolated rural populations may not have access to nearby health care facilities. Conversely, populations without health insurance may turn to emergency departments for care.

Method

- An age-adjusted rate of asthma emergency department (ED) visits was calculated for each ZIP code by CEHTP using data obtained from OSHPD. ZIP code rates were then reapportioned to census tract rates (see below).
- CEHTP obtained records for ED visits occurring during 2007-2009 from OSHPD's Emergency Department and Ambulatory Surgery files if the patient was listed as residing in California and principle diagnostic ICD-9-CM code began with the digits 493 (asthma).
- Population data used for the age-adjustment were obtained from

Esri and rates reported are standardized to the 2000 U.S. population using five-year age groupings (0-4, 5-9, etc.). The rates are per 10,000 residents per year.

- The age-adjusted rates of asthma ED visits per 10,000 residents by ZIP code were then spatially modeled to provide estimates for ZIP codes with fewer than 12 ED visits and to incorporate information about local and statewide averages into the calculations.
- A Bayesian modeling technique was used to calculate the spatially modeled rates (Mollié, 1996).
- ZIP codes without a spatially modeled rate are census ZIP codes that did not correspond to Esri ZIP codes used in the age-adjustment.
- Census blocks were assigned the average rate of the ZIP code they intersected using areal apportionment. Census tract rates were then estimated by the population-weighted average of the rates of the census blocks that it contains.
- Census tracts were ordered by the spatially modeled apportioned rate and were assigned percentiles based on the distribution across all census tracts.


Asthma
Spatially modeled, age-adjusted rate of emergency visits for asthma per 10,000
< 19.8
19.8 - 24.6
24.7 - 29.4
29.5 - 34.5
34.6 - 39.7
39.8 - 44.5
44.6 - 51.1
51.2 - 59.5 (Top 30%)
59.6 - 76.0 (Top 20%)
> 76.0 (Top 10%)
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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LOW BIRTH WEIGHT INFANTS

Sensitive Populations Indicator

Infants born weighing less than 2,500 grams (about 5.5 pounds) are classified as low birth weight (LBW), a condition that is associated with increased risk of later health problems as well as infant mortality. Most LBW infants are small because they were born early. Infants born at full term (after 37 complete weeks of pregnancy) can also be LBW if their growth was restricted during pregnancy. Nutritional status, lack of prenatal care, stress, and maternal smoking are known risk factors for LBW. Studies also suggest links with environmental exposures to lead, air pollution, toxic air contaminants, traffic pollution, pesticides, and polychlorinated biphenyls (PCBs). These children are at risk for chronic health conditions that may make them more sensitive to environmental exposures after birth.

Indicator

Percent low birth weight, spatially modeled (averaged over 2006-2009).

Data Source

California Department of Public Health (CDPH)

The Health Information and Research Section of CDPH is responsible for the stewardship and distribution of birth records in the state. Medical data related to a birth, as well as demographic information related to the infant, mother, and father is collected from birth certificates. Personal identifiers are not released publicly to protect confidentiality.

Information about the geographic location of births was used by OEHHA in compliance with the State of California Committee for the Protection of Human Subjects. The data was analyzed by the California Environmental Health Tracking Program (CEHTP) of CDPH's Environmental Health Investigation Branch.

http://www.cdph.ca.gov/data/dataresources/requests/Pages/BirthandFetalDeathFiles.aspx

Rationale

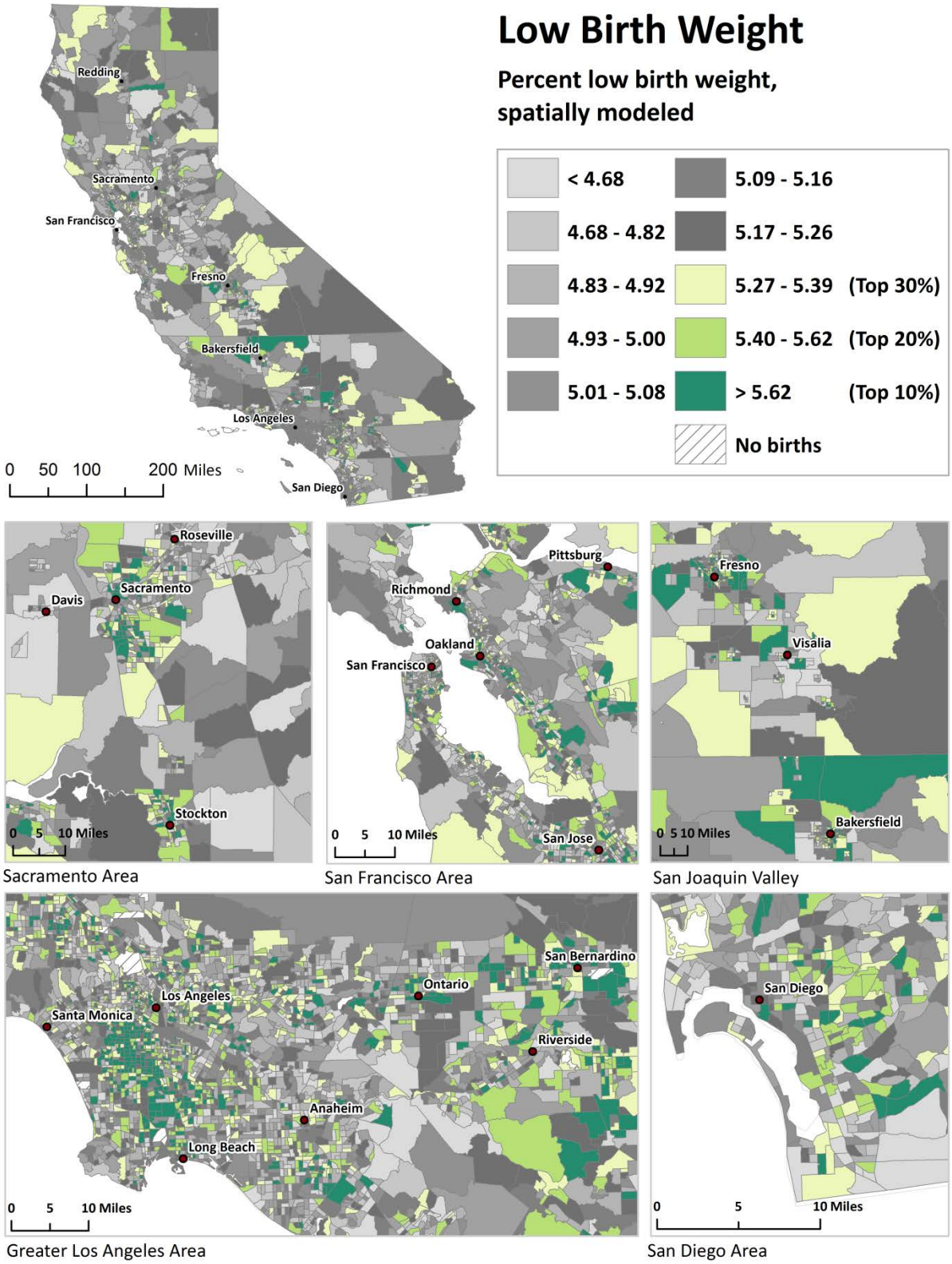
LBW is considered a key marker of overall population health. Being born low weight puts individuals at higher risk of health conditions that can subsequently make them more sensitive to environmental exposures. For example, children born low weight are at increased risk of developing asthma (Nepomnyaschy and Reichman, 2006). Asthma symptoms, in turn, are worsened by exposure to air pollution. LBW can also put one at increased risk of coronary heart disease and type 2 diabetes (Barker *et al.*, 2002). These conditions can predispose one to mortality associated with particulate air pollution or excessive heat (Bateson and Schwartz, 2004; Basu and Samet, 2002). There is also evidence that children born early have lowered cognitive development and more behavioral problems compared to children born at term (Butta *et al.*, 2002), putting them at disadvantage for subsequent opportunities for good health.

Risk of LBW is increased by certain environmental exposures and social factors and can therefore be considered a marker of the combined impact of environmental and social stressors. For example, exposures to fine particulate matter, heavy traffic and to toxic air contaminants such as benzene, xylene, and toluene have been linked to LBW in California (Ghosh *et al*., 2012, Basu *et al.,* 2014). Low weight births are more common among African-American women than they are among Hispanic and non-Hispanic white women, even among those with comparable socioeconomic status, prenatal care, and behavioral risk factors (Lu and Halfon, 2003).

Living in close proximity to freeways has been associated with an increased risk for LBW term infants (Laurent *et al*., 2013). Latina women exposed to pesticides in California in low-income farmworker communities were found to be at risk for LBW infants that were small for gestational age, with smaller than average head circumference, an indicator of brain development (Harley *et al*., 2011).

Method

- The crude low birth weight (LBW) rate was calculated from California birth records as the percent of live, singleton births during the 2006-2009 period weighing less than 2,500 grams.
- Multiple births (non-singletons) and births with an improbable combination of gestational age and birth weight were excluded (Alexander, 1996). Out-of-state births, and births with no known residential address (including P.O. boxes) were also excluded. These exclusions lead to a lower statewide LBW rate than that reported by other organizations who do not apply this criterion.
- Births were geocoded based on the mother's residential address at the time of birth by CEHTP. A small number (less than 1%) of addresses could not be geocoded and were excluded.
- Estimates derived from places with few births are considered unreliable because they often produce extreme values much higher or lower than expected and can vary greatly from year to year. For this reason, spatially-smoothed rather than crude rates were used as the indicator. An Empirical Bayes method was used to spatially smooth the observed crude rates that were based on small counts (Anselin *et al*., 2006a). Empirical Bayes smoothing uses the total number of births in an area as a measure of the confidence that can be placed in an observed LBW rate. LBW estimates for areas with few births (in which we have low confidence) are moved toward the state-wide average, while estimates for areas with many births (in which we have high confidence) are changed very little. The smoothing was performed using GeoDa software version 1.4.6 (Arizona State University, Anselin *et al*., 2006b).
- Each census tract was assigned a percentile based on its relative ranking of spatially modeled LBW compared to all other tracts.



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EDUCATIONAL ATTAINMENT

Socioeconomic Factors Indicator

Educational attainment is an important element of socioeconomic status and a social determinant of health. Numerous studies suggest education can have a protective effect from exposure to environmental pollutants that damage health. Information on educational attainment is collected annually in the U.S. Census Bureau's American Community Survey (ACS). In contrast to the decennial census, the ACS surveys a small sample of the U.S. population to estimate more detailed economic and social information for the country's population.

Indicator

Percent of the population over age 25 with less than a high school education (5-year estimate, 2008-2012).

Data Source

American Community Survey
U.S. Census Bureau

The American Community Survey (ACS) is an ongoing survey of the U.S. population conducted by the U.S. Census Bureau and has replaced the long form of the decennial census. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a sub-sample of the population and includes more detailed information on socioeconomic factors such as educational attainment. Multiple years of data are pooled together to provide more reliable estimates for geographic areas with small population sizes. The most recent results available at the census tract scale are the 5-year estimates for 2008-2012. The data are made available using the American FactFinder website.

http://www.census.gov/acs/www/
http://factfinder2.census.gov/

Rationale

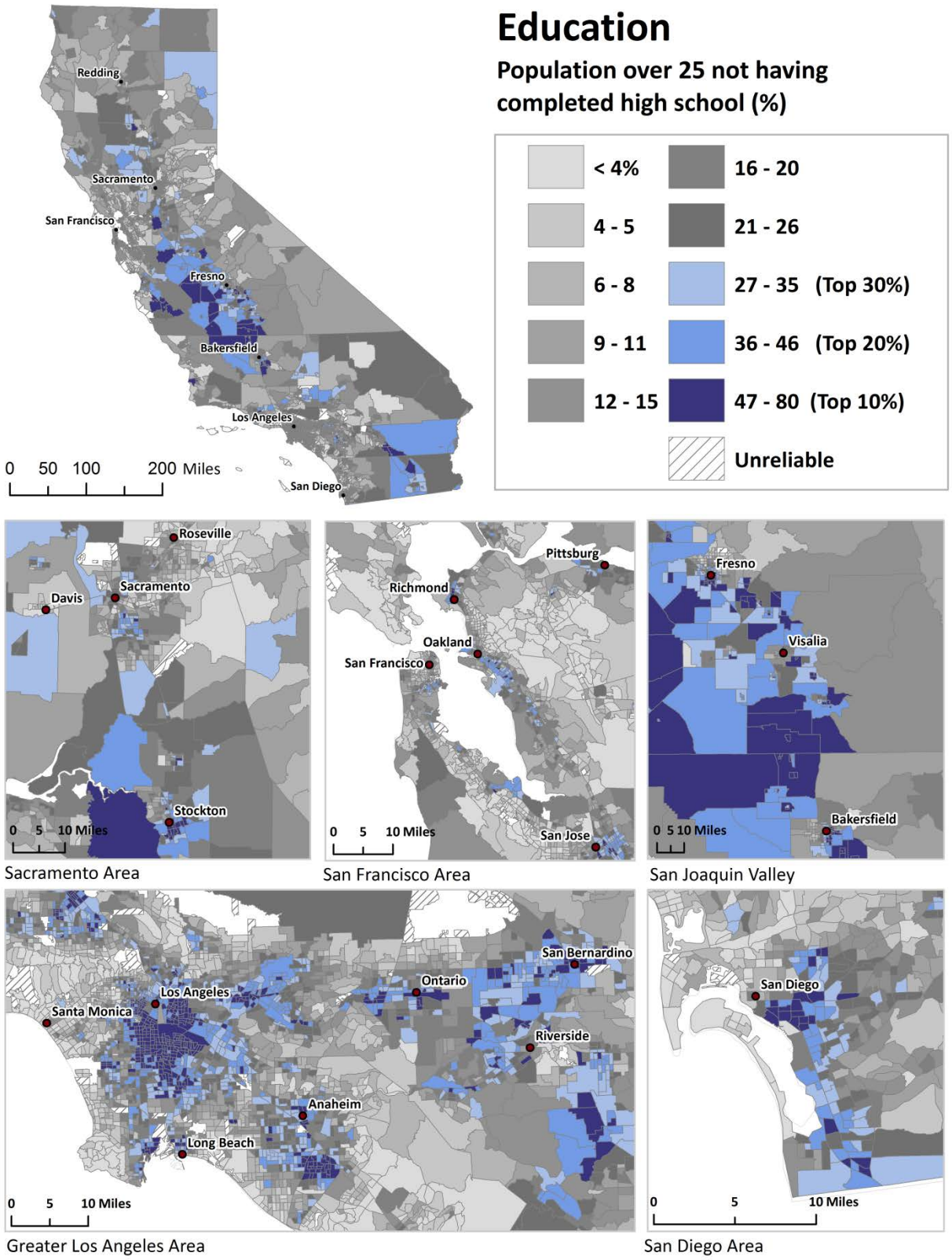
Educational attainment is an important independent predictor of health (Cutler and Lleras-Muney, 2006). As a component of socioeconomic status, education is often inversely related to the degree of exposure to indoor and outdoor pollution. Several studies have associated educational attainment with susceptibility to the health impacts of environmental pollutants. For example, individuals without a high school education appear to be at higher risk of mortality associated with particulate air pollution than those with a high school education (Krewski *et al.*, 2000). There is also evidence that the effects of air and traffic-related pollution on respiratory illness, including childhood asthma, are more severe in communities with lower levels of education (Cakmak *et al.*, 2006; Shankardass *et al.*, 2009; Neidell, 2004).

The ways in which lower educational attainment can decrease health status are not completely understood, but may include economic hardship, stress, fewer occupational opportunities, lack of social support, and reduced access to health-protective resources such as medical care, prevention and wellness initiatives, and nutritious food. In a study of pregnant women in Amsterdam, smoking and exposure to environmental

tobacco smoke were more common among women with less education. These women also were at significantly increased risk of preterm birth, low birth weight and small for gestational age infants (van den Berg *et al.*, 2012). A review of studies tying social stressors with the effects of chemical exposures on health found that level of education was related to mortality and incidence of asthma and respiratory diseases from exposure to particulate air pollution and sulfur dioxide (Lewis *et al.*, 2011). A study of older adults, aged 70 to 79, found that those with less than a high school education had significantly shorter leukocyte telomere length, a genetic marker linked to stress, than those with more education (Adler *et al.*, 2013)

Method

- From the 2008-2012 American Community Survey estimates, a dataset containing the percentage of the population over age 25 with a high school education or higher was downloaded by census tracts for the state of California.
- This percentage was subtracted from 100 to obtain the proportion of the population with less than a high school education.
- Unlike the U.S. Census, ACS estimates come from a sample of the population and may be unreliable if they are based on a small sample or population size. The standard error (SE) and relative standard error (RSE) were used to evaluate the reliability of each estimate.
- The SE was calculated for each census tract by dividing the margin of error (MOE) reported in the ACS by 1.645, a statistical value associated with a 90 percent confidence interval. The MOE is the difference between an estimate and its upper or lower confidence bound. All ACS-published margins of error are based on a 90 percent confidence level.
- The RSE is calculated by dividing a tract's SE by its estimate of educational attainment, and taking the absolute value of the result.
- Census tract estimates that met either of the following criteria were considered reliable and included in the analysis:
  1. RSE less than 50 (meaning the SE was less than half of the estimate) OR
  2. SE was less than the mean SE of all California census tract estimates for education.
- Census tracts that met the inclusion criteria were ordered by the percentage of the population over age 25 with less than a high school education and percentiles were assigned to each based on the distribution across all census tracts.



Sacramento Area

San Francisco Area

San Joaquin Valley

Greater Los Angeles Area

San Diego Area

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LINGUISTIC ISOLATION

Socioeconomic Factors Indicator

According to the most recent U.S. Census Bureau's 2008-2012 American Community Survey (ACS), nearly 43% of Californians speak a language at home other than English, about 20% of the state's population speaks English "not well" or "not at all," and 10% of all households in California are linguistically isolated. The U.S. Census Bureau uses the term "linguistic isolation" to measure households where all members 14 years of age or above have at least some difficulty speaking English. A high degree of linguistic isolation among members of a community raises concerns about access to health information and public services, and effective engagement with regulatory processes. Information on language use is collected annually in the ACS. In contrast to the decennial census, the ACS surveys a small sample of the U.S. population to estimate more detailed economic and social information for the country's population.

Indicator

Percentage of households in which no one age 14 and over speaks English "very well" or speaks English only.

Data Source

American Community Survey
U.S. Census Bureau

The American Community Survey (ACS) is an ongoing survey of the U.S. population conducted by the U.S. Census Bureau and has replaced the long form of the decennial census. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a sub-sample of the population and includes more detailed information on socioeconomic factors such as linguistic isolation. Multiple years of data are pooled together to provide more reliable estimates for geographic areas with small population sizes. The most recent results available at the census tract scale are the 5-year estimates for 2008-2012. The data are made available using the American FactFinder website.

http://www.census.gov/acs/www/
http://factfinder2.census.gov/

Rationale

From 1990 to 2000 the number of households in the U.S. defined as "linguistically isolated" rose by almost 50% (Shin and Bruno, 2003). While the percentage of immigrant households in California that are linguistically isolated is comparable to the national percentage, according to the 2009 American Community Survey (Hill, 2011), California has a higher proportion of immigrants than any other state and the immigrant population has increased by 400% since 1970 (Johnson, 2011). The inability to speak English well can affect an individual's communication with service providers and his or her ability to perform daily activities. People with limited English are less likely to have regular medical care and are more likely to report difficulty getting medical information or advice than English speakers. Communication is essential for many steps in the process of obtaining health care, and limited English speakers may delay care because they

lack important information about symptoms and available services (Shi *et al*. 2009). Non-English speakers are also less likely to receive mental health services when needed, and because in California non-English speakers are concentrated in minority ethnic communities, limited English proficiency may contribute to further ethnic and racial disparities in health status and disability (Sentell *et al*. 2007). Linguistic isolation is also an indicator of a community's ability to participate in decision-making processes and the ability to navigate the political system.

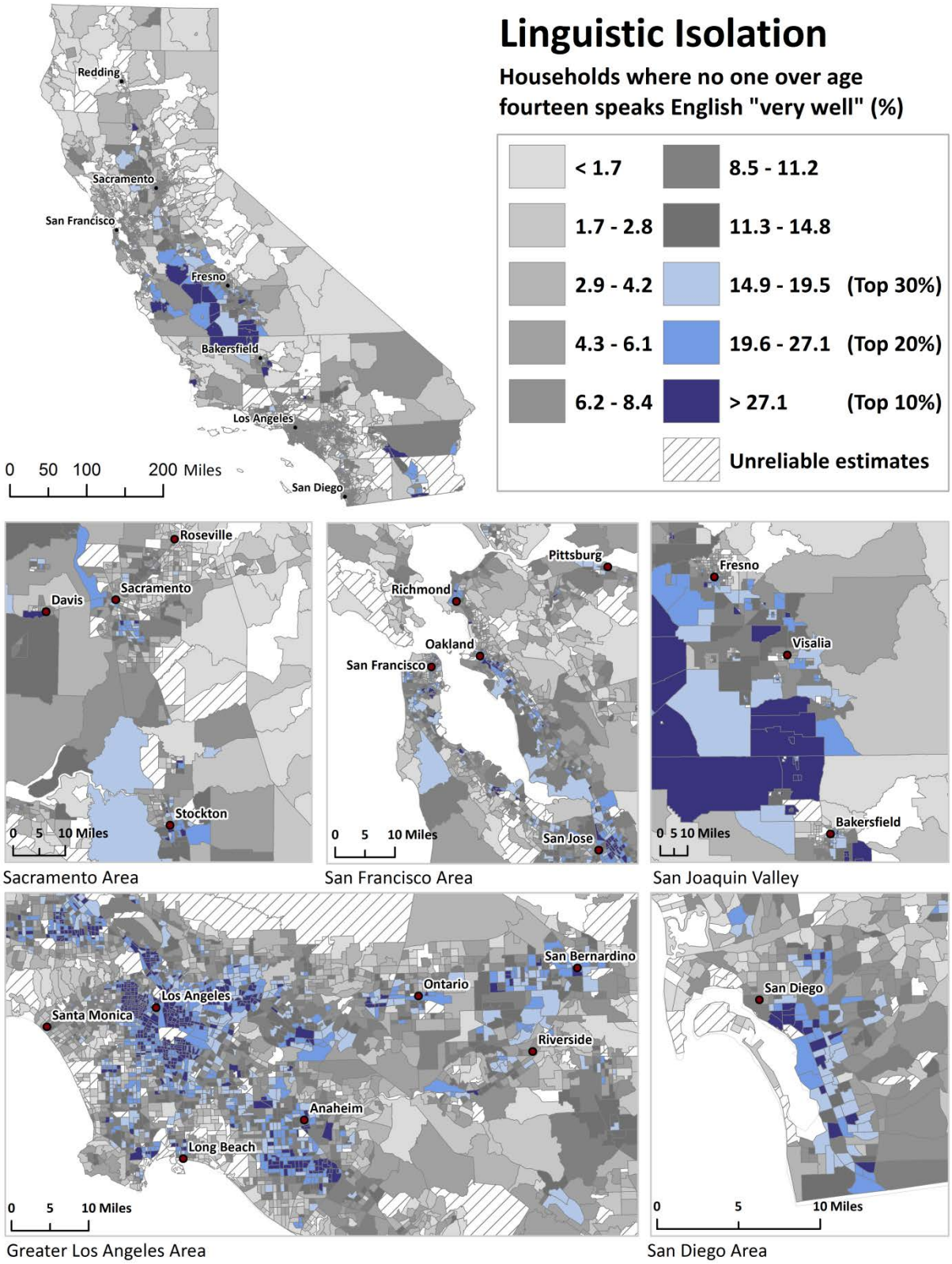
Lack of proficiency in English often results in racial discrimination, and both language difficulties and discrimination are associated with stress, low socioeconomic status and reduced quality of life (Gee and Ponce, 2010). Linguistic isolation hampers the ability of the public health sector to reduce racial and ethnic disparities because non-English-speaking individuals participate in public health surveillance studies at very low rates, even when there is translation available (Link *et al*., 2006).

In the event of an emergency, such as an accidental chemical release or a spill, households that are linguistically isolated may not receive timely information on evacuation or shelter-in-place orders, and may therefore experience health risks that those who speak English can more easily avoid. Additionally, linguistic isolation was independently related to both proximity to a Toxic Release Inventory (TRI) facility and cancer risks by the National-Scale Air Toxics Assessment (NATA) in an analysis of the San Francisco Bay Area, suggesting that linguistically isolated communities may bear a greater share of health risks from air pollution hazards (Pastor *et al*,. 2010).

Method

- From the 2008-2012 American Community Survey, a dataset containing the average percent of household in which no one age 14 and over speaks English "very well" or speaks English only was downloaded by census tracts for the state of California. This variable is referred to as "linguistic isolation" and measures households where no one speaks English well.
- Unlike the U.S. Census, ACS estimates come from a sample of the population and may be unreliable if they are based on a small sample or population size. The standard error (SE) and relative standard error (RSE) were used to evaluate the reliability of each estimate.
- The SE was calculated for each census tract by dividing the margin of error (MOE) reported in the ACS by 1.645, a statistical value associated with a 90 percent confidence interval. The MOE is the difference between an estimate and its upper or lower confidence bound. All ACS-published margins of error are based on a 90 percent confidence level.
- The RSE is calculated by dividing a tract's SE by its estimate of the percent of linguistically isolated households, and taking the absolute value of the result.

- Census tract estimates that met either of the following criteria were considered reliable and included in the analysis:
    1. RSE less than 50 (meaning the SE was less than half of the estimate) OR
    2. SE was less than the mean SE of all California census tract estimates for linguistic isolation.
- Census tracts that met the inclusion criteria were ordered by the percent linguistically isolated and percentiles were assigned to each based on the distribution across all tracts.


Linguistic Isolation
Households where no one over age fourteen speaks English "very well" (%)
< 1.7
1.7 - 2.8
2.9 - 4.2
4.3 - 6.1
6.2 - 8.4
8.5 - 11.2
11.3 - 14.8
14.9 - 19.5 (Top 30%)
19.6 - 27.1 (Top 20%)
> 27.1 (Top 10%)
Unreliable estimates
Redding
Sacramento
San Francisco
Fresno
Bakersfield
Los Angeles
San Diego
0 50 100 200 Miles
Roseville
Davis
Sacramento
Stockton
0 5 10 Miles
Sacramento Area
Pittsburg
Richmond
Oakland
San Francisco
San Jose
0 5 10 Miles
San Francisco Area
Fresno
Visalia
Bakersfield
0 5 10 Miles
San Joaquin Valley
San Bernardino
Ontario
Los Angeles
Santa Monica
Riverside
Anaheim
Long Beach
0 5 10 Miles
Greater Los Angeles Area
San Diego
0 5 10 Miles
San Diego Area

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POVERTY

Socioeconomic Factors Indicator

Poverty is an important social determinant of health. Numerous studies have suggested that impoverished populations are more likely than wealthier populations to experience adverse health outcomes when exposed to environmental pollution. Information on poverty is collected annually in the U.S. Census Bureau's American Community Survey (ACS). In contrast to the decennial census, the ACS surveys a small sample of the U.S. population to estimate more detailed economic and social information for the country's population.

Indicator

Percent of the population living below two times the federal poverty level (5-year estimate, 2008-2012).

Data Source

American Community Survey
U.S. Census Bureau

The American Community Survey (ACS) is an ongoing survey of the U.S. population conducted by the U.S. Census Bureau and has replaced the long form of the decennial census. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a sub-sample of the population and includes more detailed information on socioeconomic factors such as poverty. Multiple years of data are pooled together to provide more reliable estimates for geographic areas with small population sizes. The most recent results available at the census tract scale are the 5-year estimates for 2008-2012. The data are made available using the American FactFinder website.

The Census Bureau uses income thresholds that are dependent on family size to determine a person's poverty status during the previous year. For example, if a family of four with two children has a total income less than $21,938 during 2010, everyone in that family is considered to live below the federal poverty line. A threshold of twice the federal poverty level was used in this analysis because the federal poverty thresholds have not changed since the 1980s despite increases in the cost of living, and because California's cost of living is higher than many other parts of the country.

http://www.census.gov/acs/www/
http://factfinder2.census.gov/

Rationale

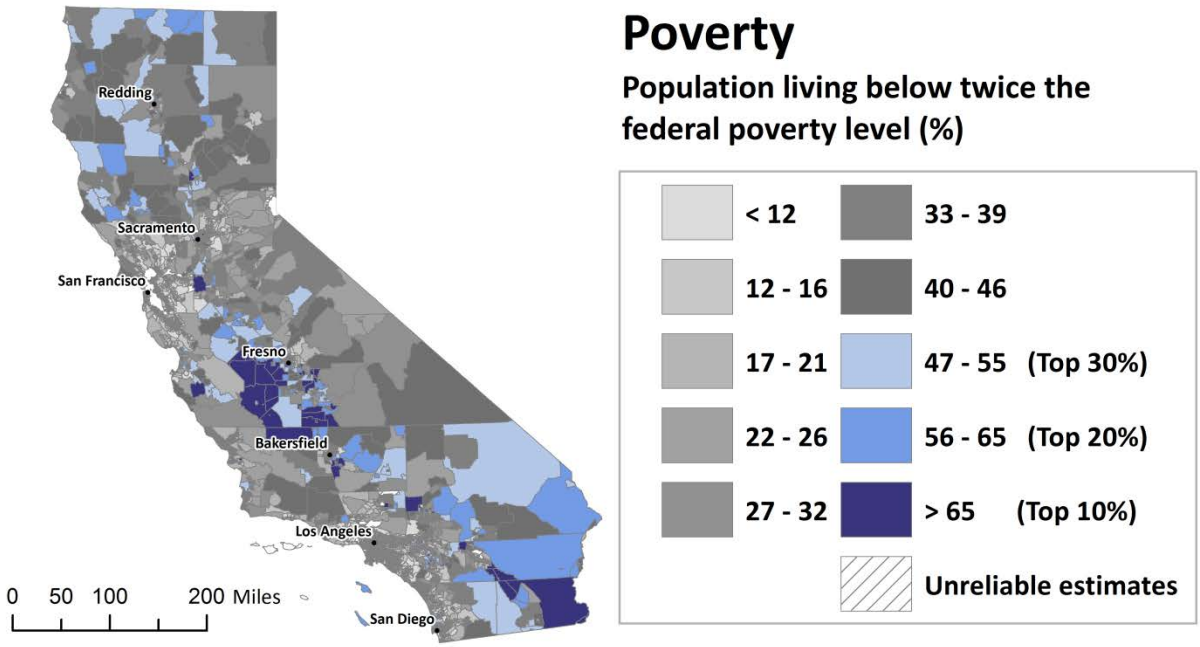
Wealth influences health because it helps determine one's living conditions, nutrition, occupation, and access to health care and other health-promoting resources. For example, studies have shown a stronger effect of air pollution on mortality (Forastiere *et al.*, 2007) and childhood asthma (Lin *et al.*, 2004, Meng *et al.*, 2011) among low income communities. A multi-city study in Canada found that the effect of nitrogen dioxide on respiratory hospitalizations was increased among lower income households compared to those with higher incomes (Cakmak *et al.*, 2006). Other studies have found that neighborhood-level

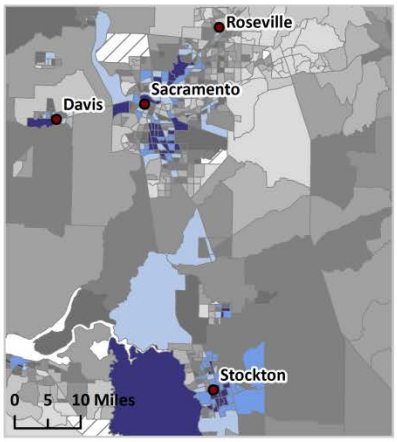
income modifies the relationship between particulate air pollution and preterm birth (Yi *et al.,* 2010) as well as traffic and low birth weight (Zeka *et al.,* 2008), with mothers living in low income neighborhoods having higher risk of both outcomes.

One way by which poverty may lead to greater susceptibility is from the effects of chronic stress on the body (Wright *et al.*, 1999; Brunner and Marmot, 2006). Differential underlying burdens of pre-existing illness and co-exposure to multiple pollutants are other possible factors (O'Neill *et al.,* 2003).

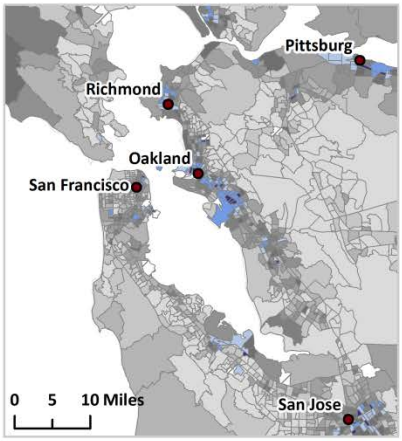
Method

- From the 2008-2012 American Community Survey, a dataset containing the number of individuals below 200 percent of the federal poverty level was downloaded by census tracts for the state of California.
- The number of individuals below the poverty level was divided by the total population for whom poverty status was determined to obtain a percent.
- Unlike the U.S. Census, ACS estimates come from a sample of the population and may be unreliable if they are based on a small sample or population size. The standard error (SE) and relative standard error (RSE) were used to evaluate the reliability of each estimate.
- The SE was calculated for each census tract using the formula for approximating the SE of proportions provided by the ACS (American Community Survey Office, 2013, pg. 13, equation 4). When this approximation could not be used, the formula for approximating the SE of ratios (equation 3) was used instead.
- The RSE is calculated by dividing a tract's SE by its estimate of the percentage of the population living below twice the federal poverty level, and taking the absolute value of the result.
- Census tract estimates that met either of the following criteria were considered reliable and included in the analysis:
    1. RSE less than 50 (meaning the SE was less than half of the estimate) OR
    2. SE was less than the mean SE of all California census tract estimates for poverty.
- Census tracts that met the inclusion criteria were ordered by the percentage of the population below twice the federal poverty level. A percentile score for a census tract was determined by its place in the distribution of all census tracts.

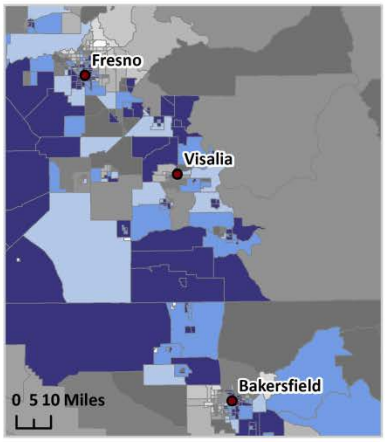




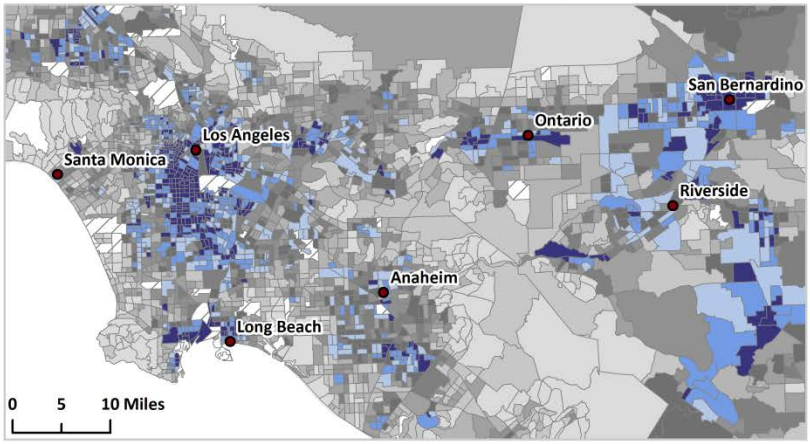
Sacramento Area



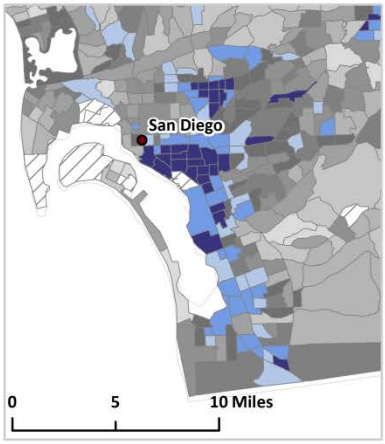
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

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UNEMPLOYMENT

Socioeconomic Factors Indicator

Because low socioeconomic status often goes hand-in-hand with high unemployment, the rate of unemployment is a factor commonly used in describing disadvantaged communities. On an individual level, unemployment is a source of stress, which is implicated in poor health reported by residents of such communities. Lack of employment and resulting low income often oblige people to live in neighborhoods with higher levels of pollution and environmental degradation.

Indicator

Percent of the population over the age of 16 that is unemployed and eligible for the labor force. Excludes retirees, students, homemakers, institutionalized persons except prisoners, those not looking for work, and military personnel on active duty (5-year estimate, 2008-2012).

Data Source

American Community Survey
U.S. Census Bureau

The American Community Survey (ACS) is an ongoing survey of the U.S. population conducted by the U.S. Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a sub-sample of the population and includes more detailed information on socioeconomic factors such as unemployment. Multiple years of data are pooled together to provide more reliable estimates for geographic areas with small population sizes. The most recent results available at the census tract level are the 5-year estimates for 2008-2012. The data are available on the American FactFinder website.

http://www.census.gov/acs/www/
http://factfinder2.census.gov/

Rationale

There is evidence that an individual's health is at least partly determined by neighborhood and regional factors. Unemployment is frequently used as a surrogate for neighborhood deprivation, which is associated with pollution exposure as well as poor health (Voigtlander *et al.*, 2010). Studies of neighborhood socioeconomic factors have found stress to be a major factor in reported poor health among residents of disadvantaged communities, and both financial and emotional stress are direct results of unemployment (Turner, 1995).

The unemployed tend to have higher annual illness rates, lack health insurance and access to health care, and have an increased risk of death compared to those who are employed. In addition, poor health also affects a person's ability to obtain and retain employment (Athar *et al.* 2013). Unemployment, along with low income and low educational attainment, has been associated with increased incidence of irritable bowel syndrome (Farzaneh *et al.*, 2013), childhood asthma (Hafkamp-de Groen *et al.*, 2013), poor mental health (Kan, 2013), and decreased quality of life among cervical cancer survivors (Yoo *et al.*, 2013). A study of 4301 men and women in 3 cities in Germany found that men living in

high-unemployment neighborhoods were at higher risk of emergent coronary artery disease than men living in areas of low unemployment (Dragano *et al.,* 2009). In a study of unemployment and mortality, the authors found that job loss was associated with an increased hazard of death compared to that of employed individuals, equivalent to aging 10 years (Tapia Granados *et al*., 2014). Unemployment has been shown to be associated with the biological effects of stress. Stress resulting from early-life experiences and current domestic stress are linked with shorter leukocyte telomere length (LTL). Among men, long-term unemployment (more than 500 days during three years) in early adulthood was associated with having shorter LTL, compared to being continuously employed (Ala-Mursula *et al.,* 2013). Stress, in turn, may lead to poor health, increased susceptibility to toxic effects of pollution, and reduced capacity to cope and recover from adverse effect of environmental exposures (Defur *et al*., 2007).

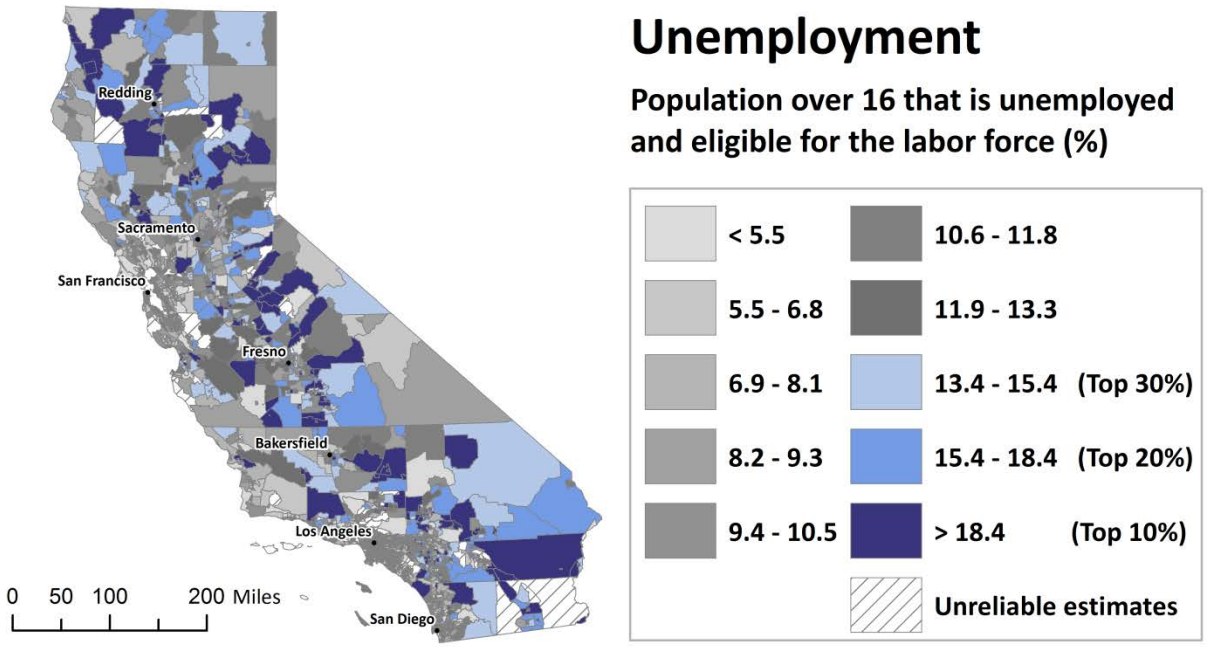
Premji *et al*. (2007) studied the relationship between pollutant emissions and socioeconomic variables in 27 Canadian communities and found that pollution levels were positively associated with the unemployment rate. In a study of statewide unemployment levels as well as trucking industry data in New Jersey, Davis *et al*. (2010) found that high unemployment was associated with high coefficient of haze, a measure of diesel particulate pollution.

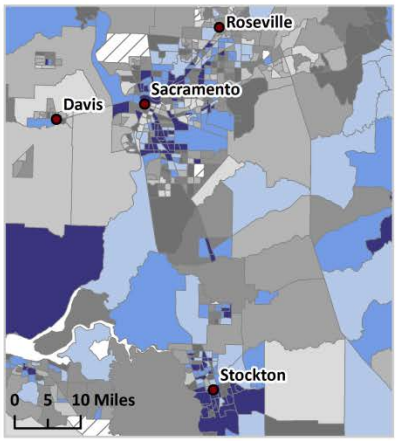
Method

- From the 2008-2012 American Community Survey, a dataset containing the unemployment rate was downloaded by census tracts for the state of California.
- The Census Bureau calculates an unemployment rate by dividing the 'Population Unemployed in the Civilian Labor Force' by 'Population in the Civilian Labor Force' and then converting to a percentage.
- Unlike the U.S. Census, ACS estimates come from a sample of the population and may be unreliable if they are based on a small sample or population size. The standard error (SE) and relative standard error (RSE) were used to evaluate the reliability of each estimate.
- The SE was calculated for each census tract using the formula for approximating the SE of proportions provided by the ACS (American Community Survey Office, 2013, pg. 13, equation 4). When this approximation could not be used, the formula for approximating the SE of ratios (equation 3) was used instead.
- The RSE is calculated by dividing a tract's SE by its estimate of unemployment rate, and taking the absolute value of the result.
- Census tract estimates that met either of the following criteria were considered reliable and included in the analysis:
    1. RSE less than 50 (meaning the SE was less than half of the estimate) OR

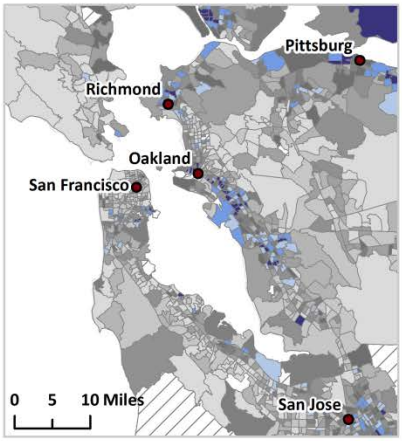
2. SE was less than the mean SE of all California census tract estimates for unemployment rate.

- Census tracts that met the inclusion criteria were ordered by unemployment rate. A percentile score for a census tract was determined by its place in the distribution of all census tracts.

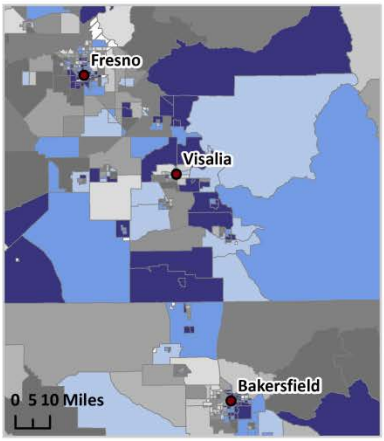




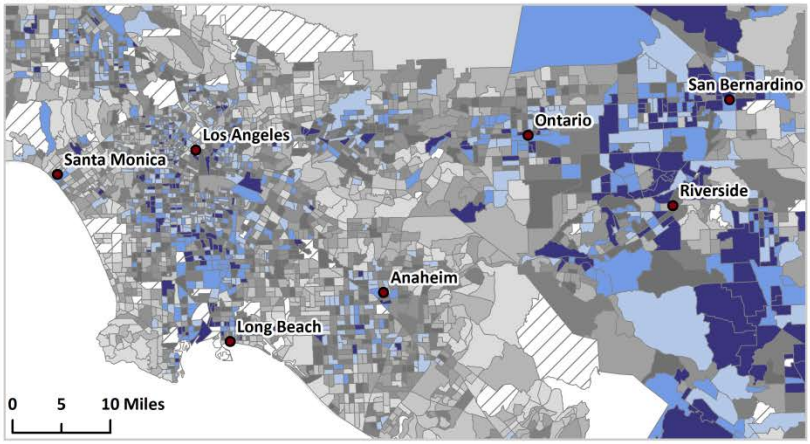
Sacramento Area



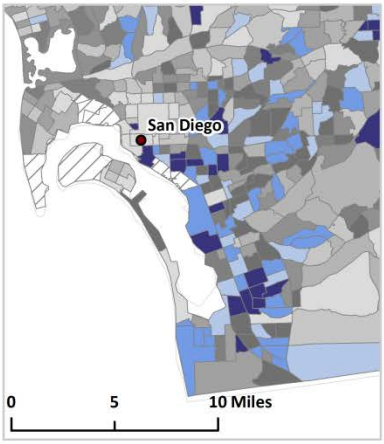
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

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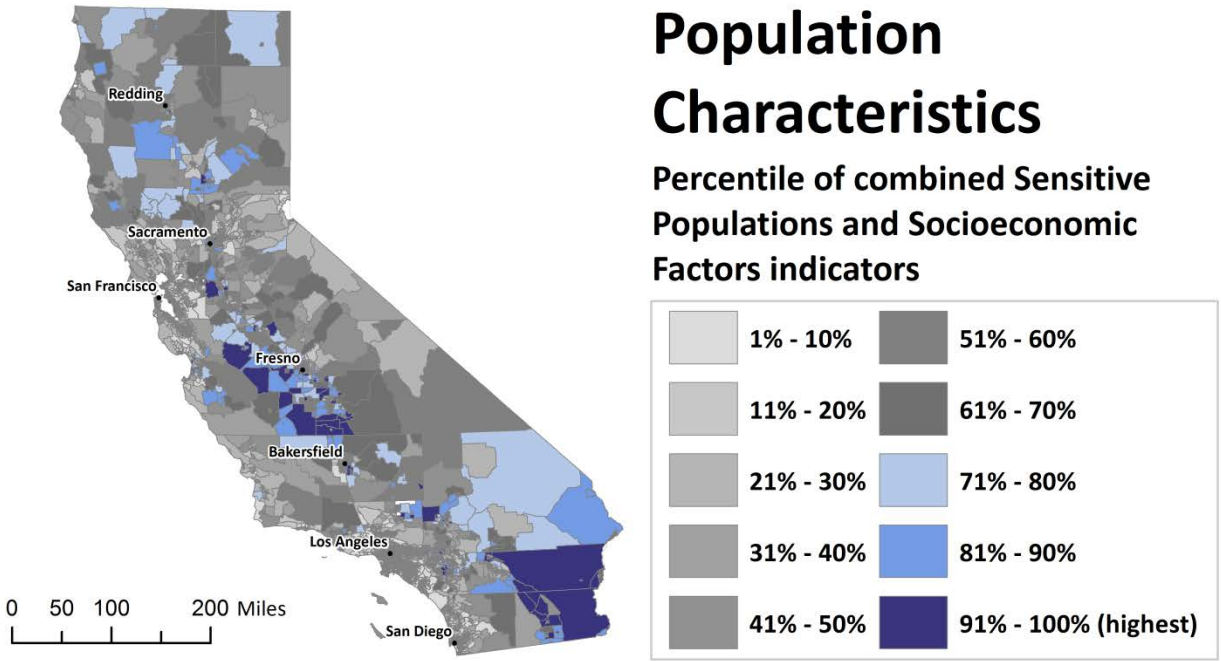
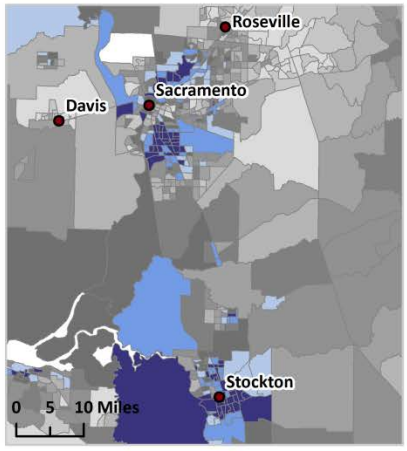
SCORES FOR POPULATION CHARACTERISTICS (RANGE OF POSSIBLE SCORES: 0.1 TO 10)

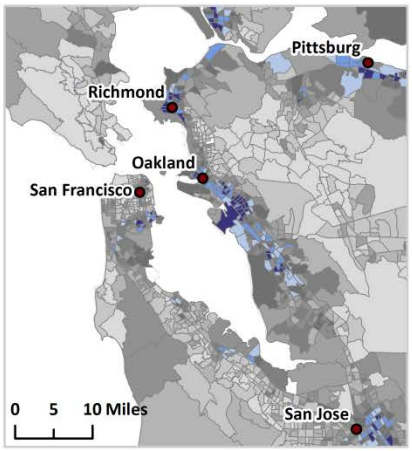
Population Characteristics scores for each census tract are derived from the average percentiles for the three Sensitive Populations indicators (children/elderly, low birth weight, and asthma) and the three Socioeconomic Factors indicators (educational attainment, linguistic isolation, and poverty). The calculated average percentile divided by 10 for a Population Characteristic score ranging from 0.1 -10.

Note: The map on the following page shows population characteristic scores divided into deciles.

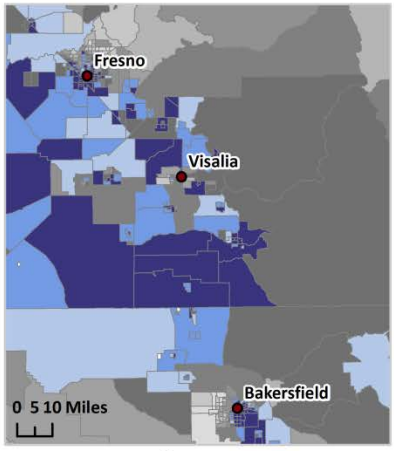




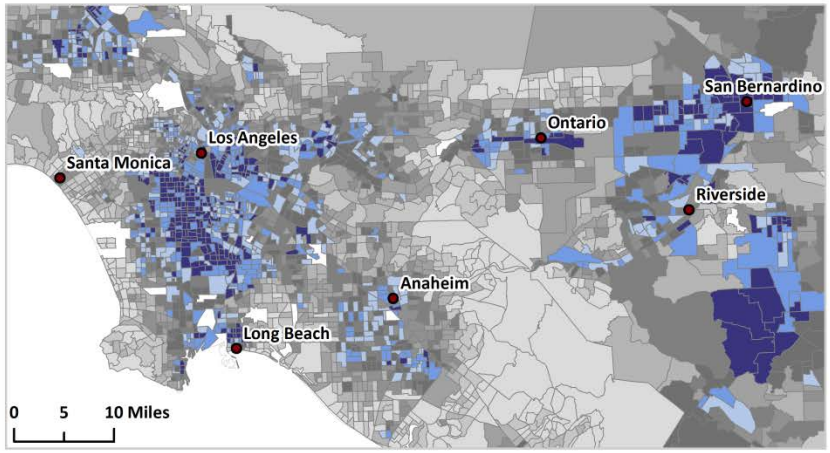
Sacramento Area



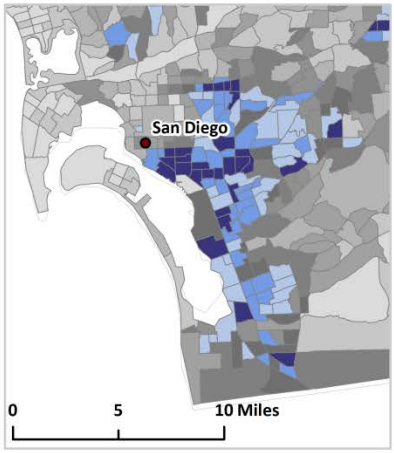
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

RESULTS

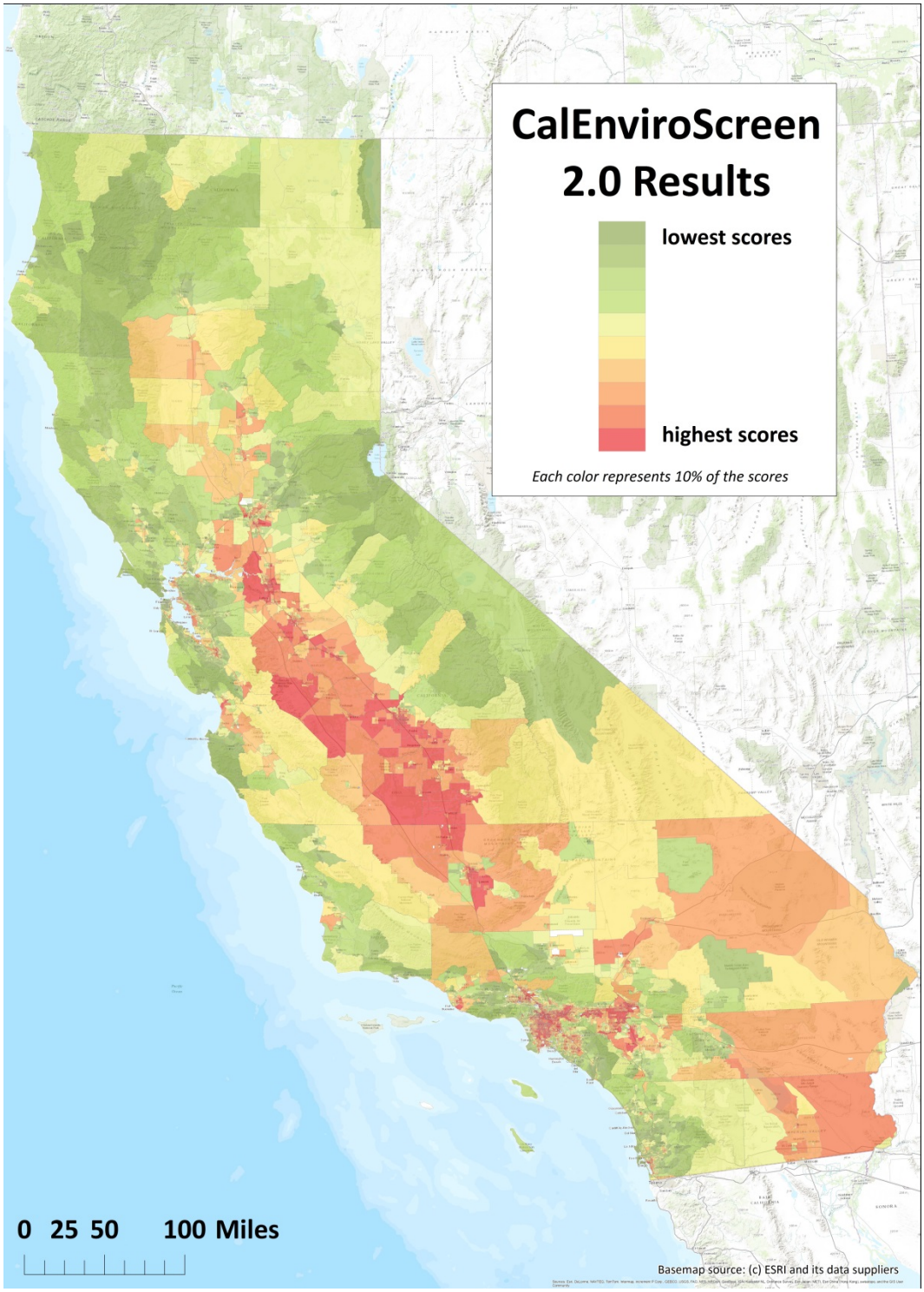
CALENVIROSCREEN STATEWIDE RESULTS

The maps on the following pages depict the relative scoring of California's census tracts using the CalEnviroScreen methodology described in this report. Census tracts with darker red colors have the higher CalEnviroScreen scores and therefore have relatively high pollution burdens and population sensitivities. Census tracts with lighter green colors have lower scores, and correspondingly lower pollution burdens and sensitivities.

The maps of specific regions of the state (Los Angeles, San Francisco, San Diego, San Joaquin Valley, Sacramento and the Coachella and Imperial Region) are "close-ups" of the statewide map and are intended to provide greater clarity on the relative scoring of census tracts in those regions. Colors on these maps reflect the relative statewide scoring of individual census tracts.

Numerical scores for each census tract, as well as the individual indicator scores for each census tract, may be found online at OEHHA's web site at (http://www.oehha.ca.gov/ej/ces2). The information is available both in a Microsoft Excel spreadsheet format and as an online mapping application.

CALENVIROSCREEN STATEWIDE RESULTS

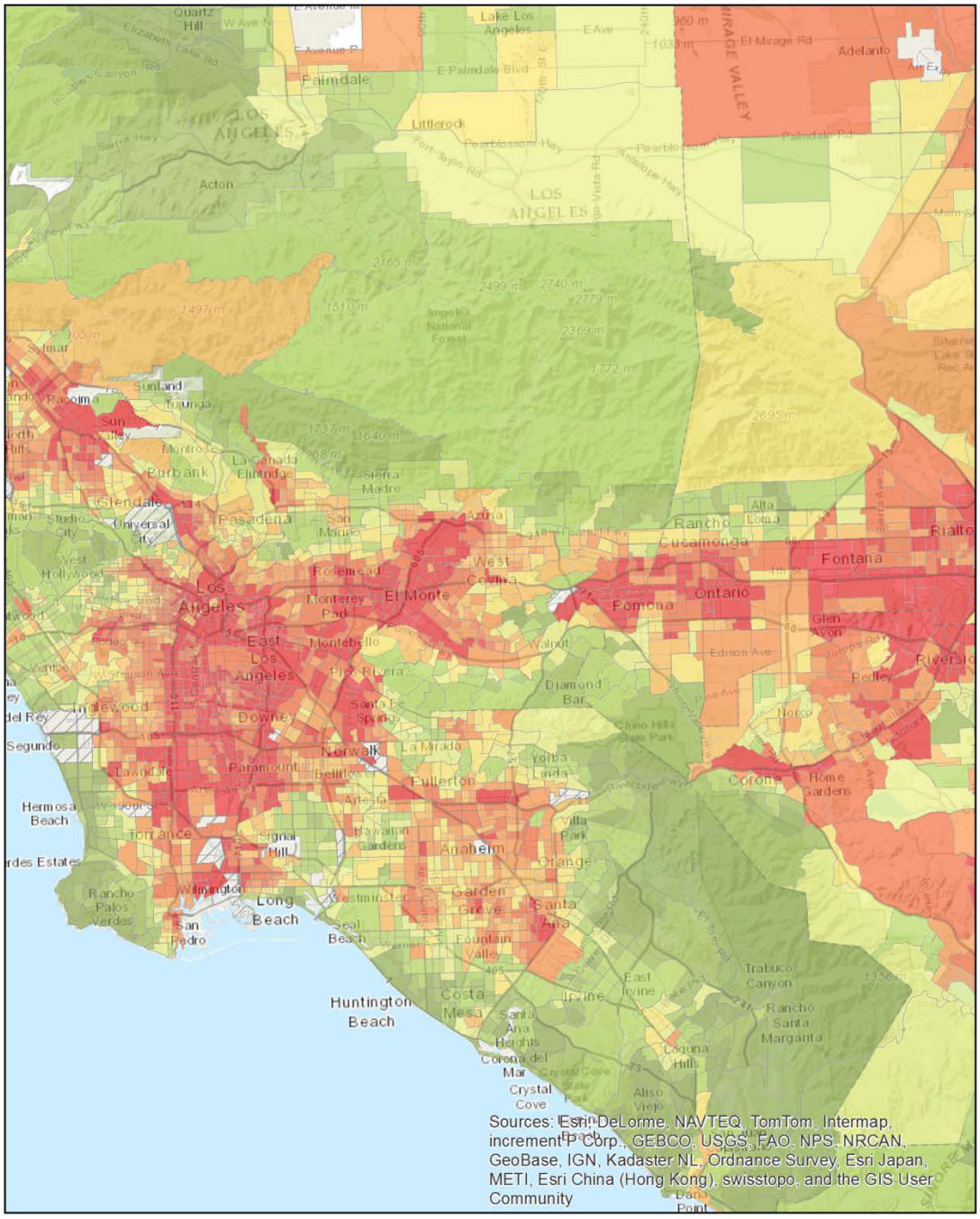


CalEnviroScreen 2.0 Results

Top 20% pollution, low population

lowest scores — highest scores

Each color represents 10% of the scores

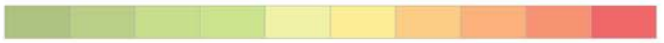


Los Angeles Area

0 5 10 20 Miles

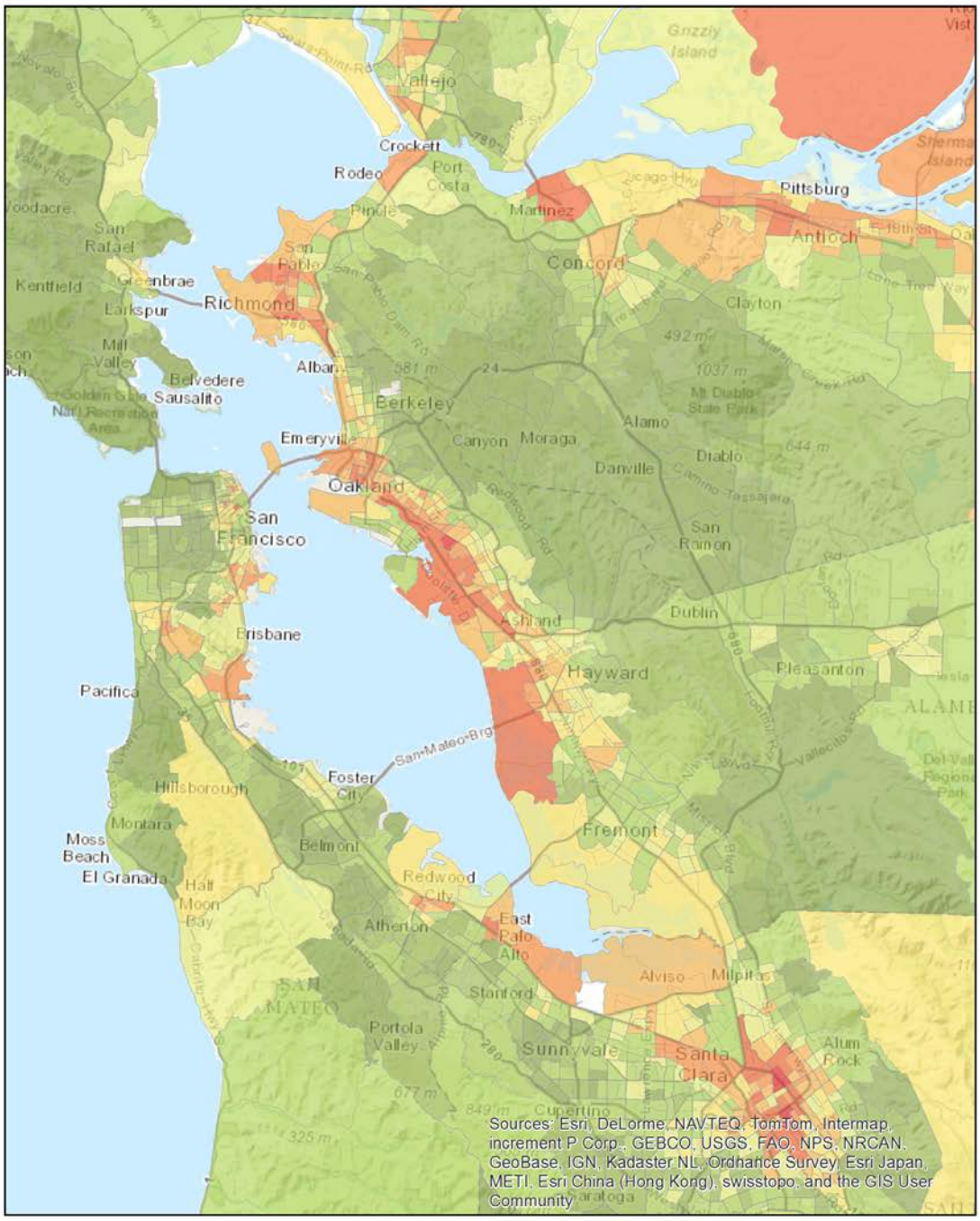
Basemap source: (c) ESRI and its data suppliers

CalEnviroScreen 2.0 Results



lowest scores — highest scores

Each color represents 10% of the scores



San Francisco Area

Basemap source: (c) ESRI and its data suppliers

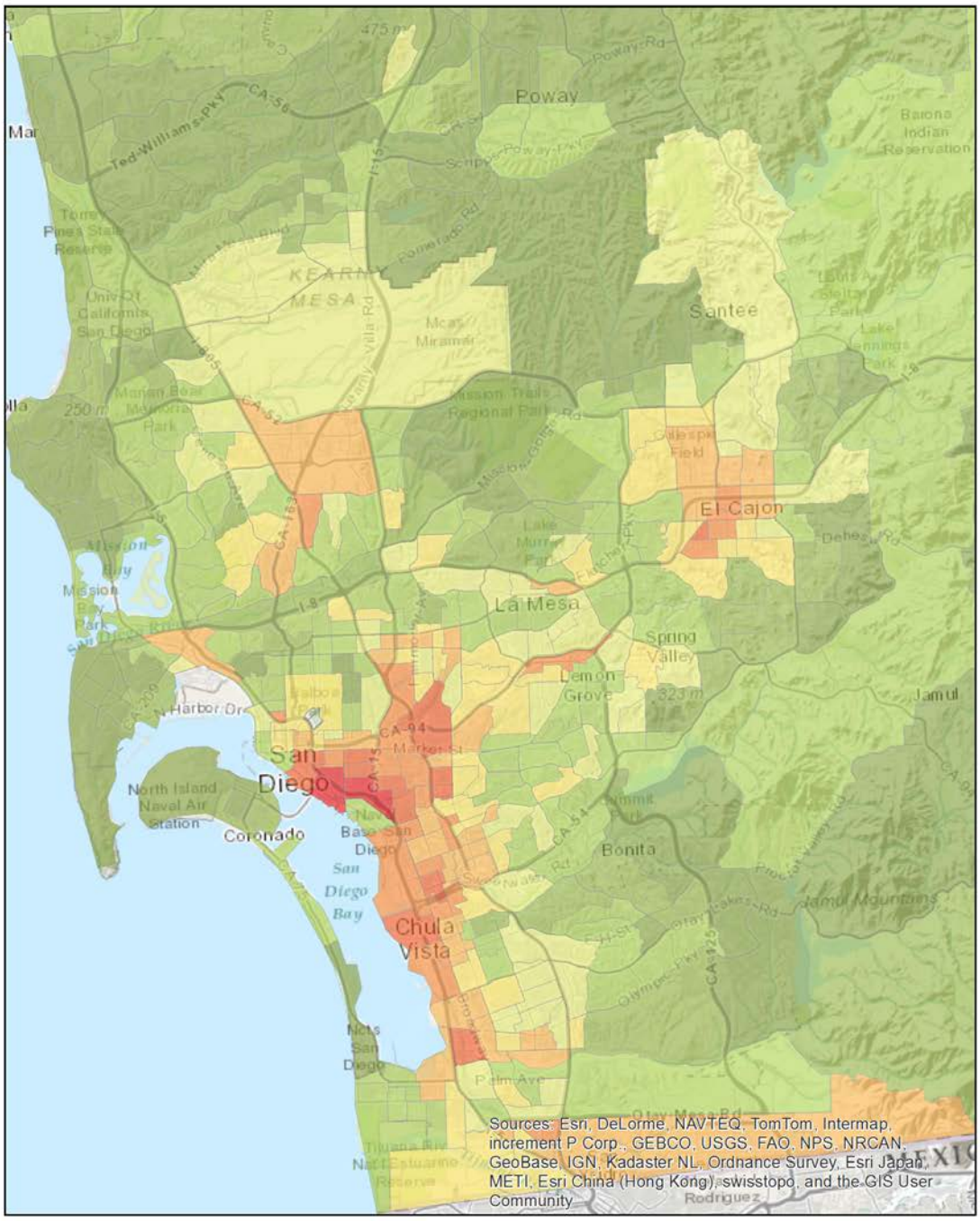
0 2.5 5 10 Miles

CalEnviroScreen 2.0 Results

Top 20% pollution, low population

lowest scores — highest scores

Each color represents 10% of the scores



San Diego Area

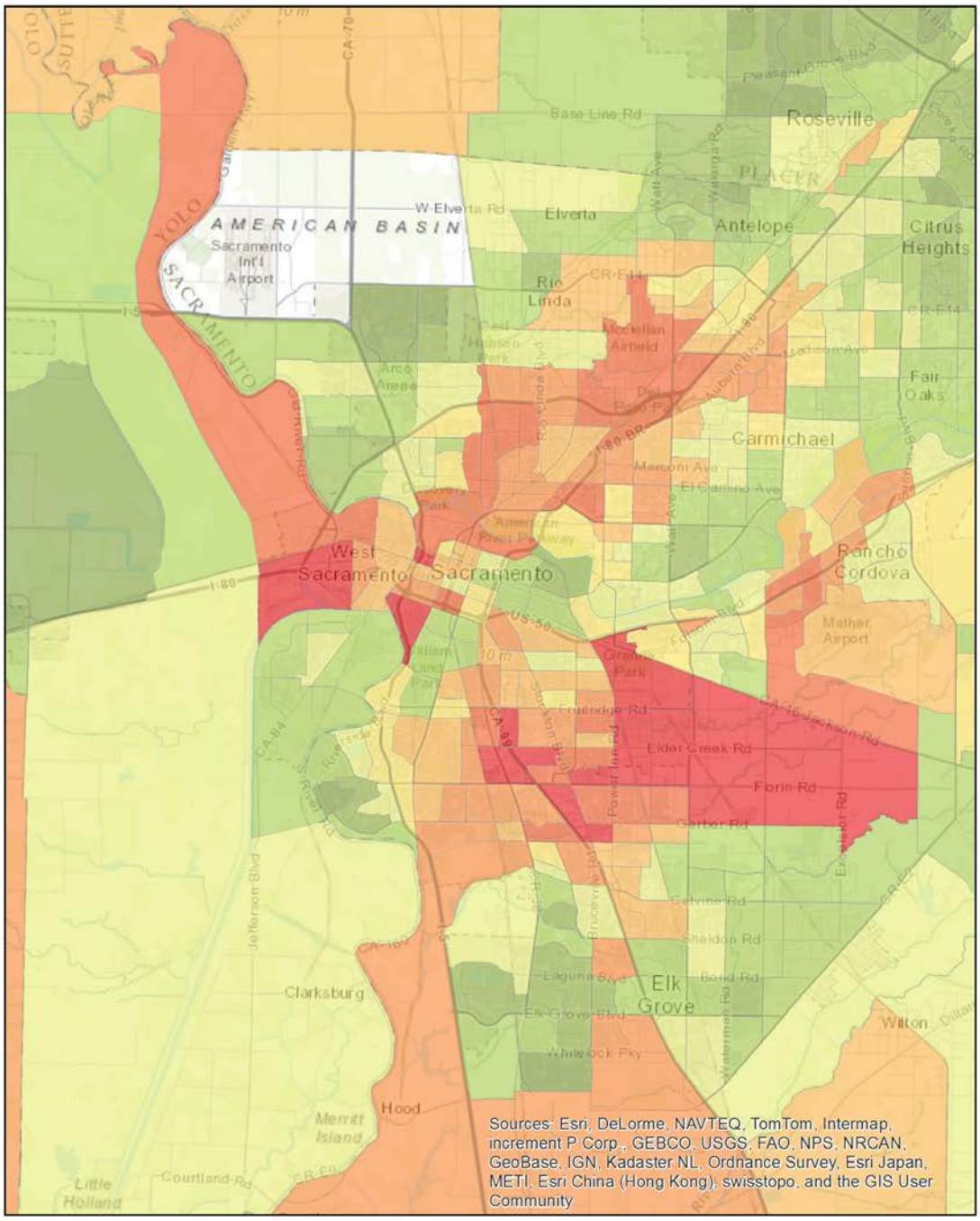
0 2.5 5 10 Miles

Basemap source: (c) ESRI and its data suppliers

CalEnviroScreen 2.0 Results

lowest scores — highest scores

Each color represents 10% of the scores

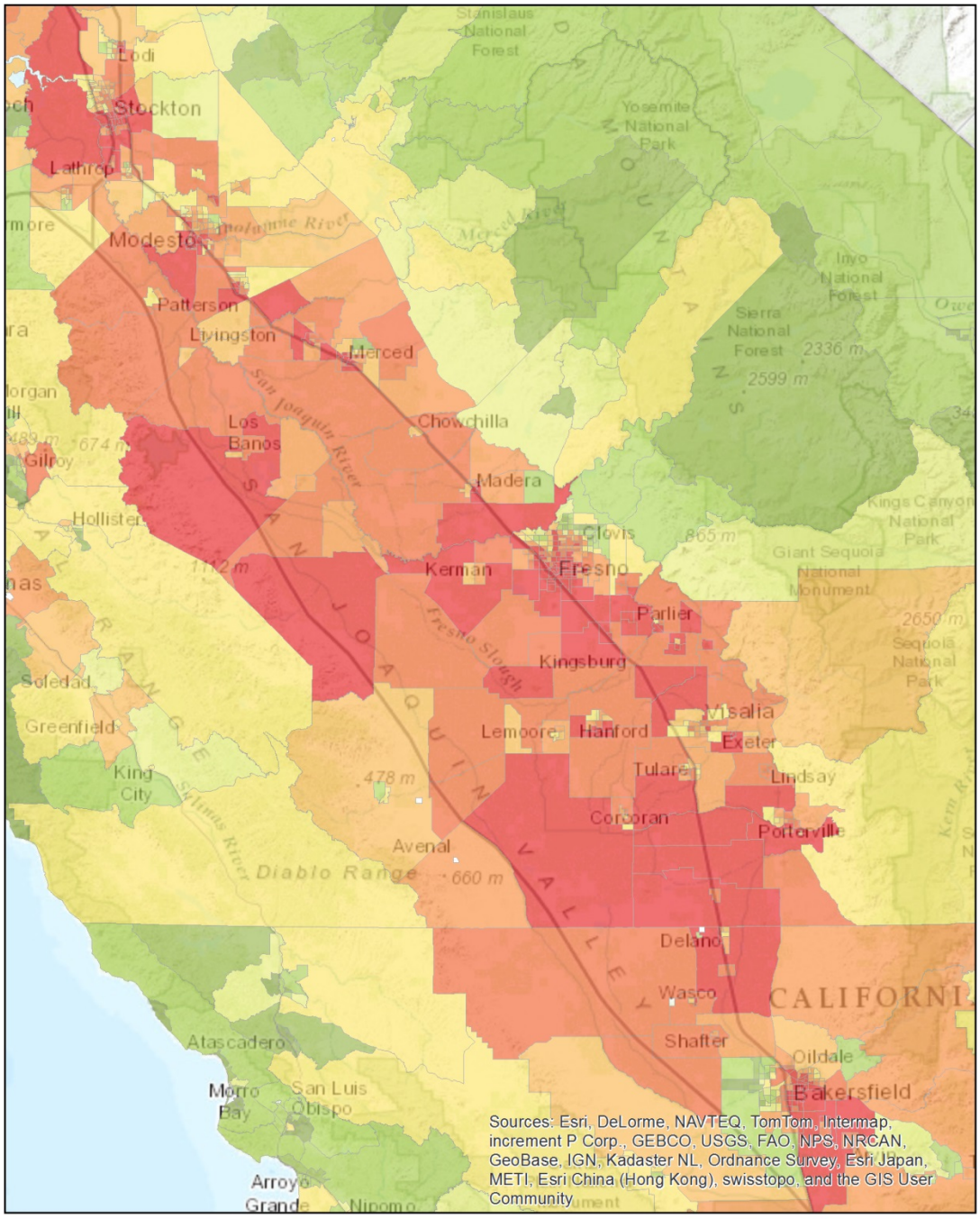


Sacramento Area

0 2.5 5 10 Miles

Basemap source: (c) ESRI and its data suppliers

CalEnviroScreen 2.0 Results

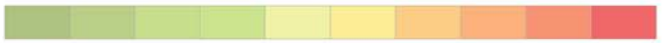


San Joaquin Valley

0 10 20 40 Miles

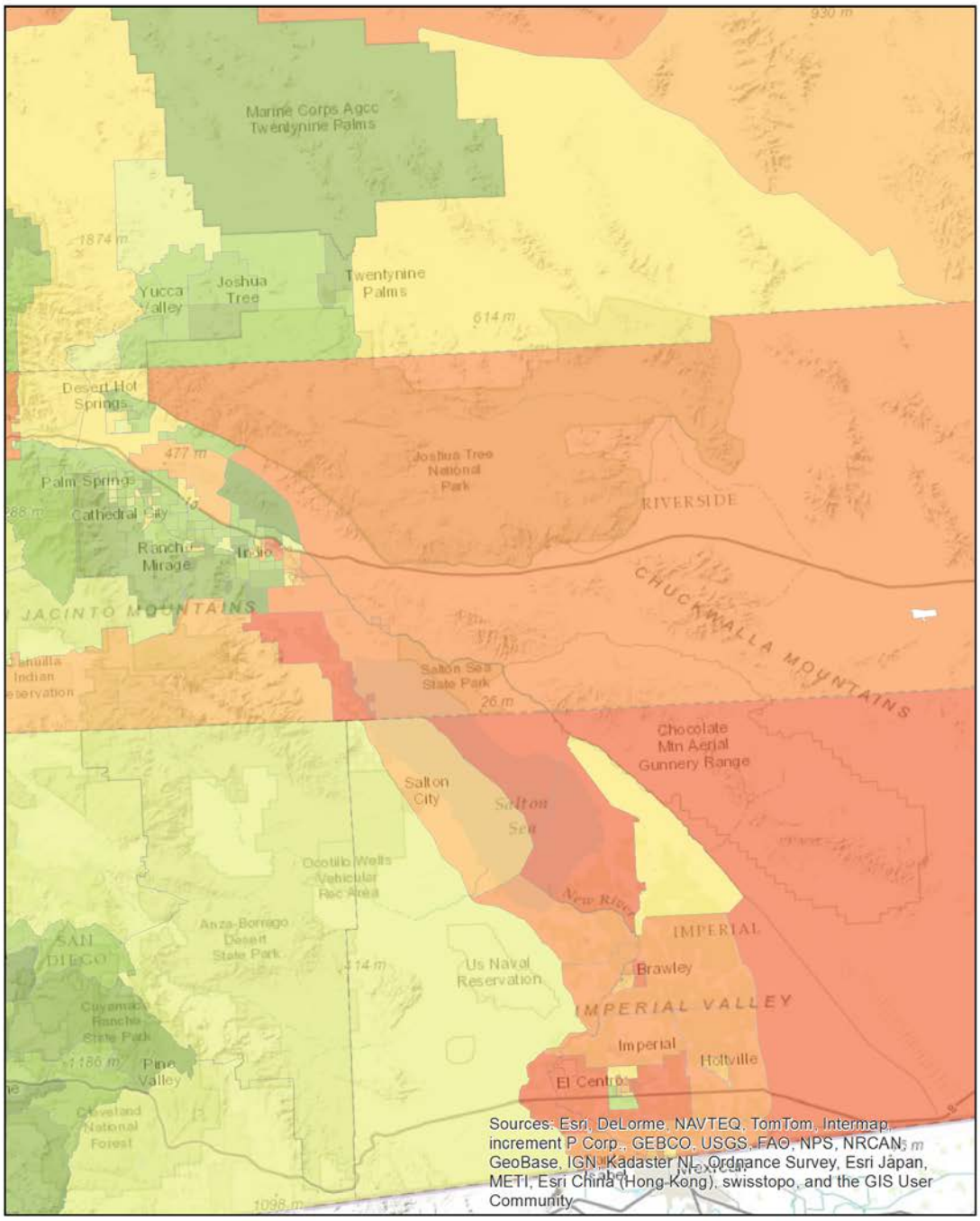
Basemap source: (c) ESRI and its data suppliers

CalEnviroScreen 2.0 Results



lowest scores — highest scores

Each color represents 10% of the scores



Coachella & Imperial Region

0 5 10 20 Miles

Basemap source: (c) ESRI and its data suppliers

Exhibit C
Fresno Bee Cal Enviro Screen

FresnoBee.com

Previous Story
Next Story

Health hazard: West Fresno the riskiest place to live in California

By Mark Grossi

The Fresno BeeMarch 16, 2013

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From the Hyde Park mound in West Fresno, you can see the city landscape quickly go from residential to industrial park. You can smell it, too.

Across the street, there is an animal rendering plant, a poultry facility, a meat distributor and a PG&E substation. The Hyde Park mound itself is a converted garbage landfill.

But there is more: high asthma rates, widespread poverty and low birth weights that scientists link to dirty air, chemical exposures and a host of other problems.

RELATED: Read other stories in Mark Grossi's Toxic Land series

The California Environmental Protection Agency takes it a step further. EPA says people in West Fresno live with higher health risks than anyone in California -- higher than any part of Los Angeles, Oakland or any place else you can name.

Life expectancy in West Fresno is more than 20 years lower than in northeast Fresno, according to a 2012 study done by a team of researchers including the Central Valley Health Policy Institute at Fresno State.

West Fresno and many parts of the Valley soon will be known as the riskiest places in California to live. Financial help appears to be headed this way, but there is controversy surrounding it.

The state EPA is expected to designate the most environmentally burdened areas in the next few weeks. West Fresno is at the top of the list, and several other Valley ZIP codes are not far behind. **(Update: On Tuesday, April 23, the state released the CalEnviroScreen mapping tool.)**

The state EPA's draft documents show the Valley has nine of the 12 worst places in California, including four in Fresno County and three in Stockton. The map of California's worst 10% shows mostly Valley ZIP codes. **(Update: The final state list released Tuesday shows the Valley has eight of the 12 worst places in California.)**

The state's designations will be part of a program called California Communities Environmental Health Screening Tool, or CalEnviroScreen.

RELATED STORIES: Toxic Land in the Valley

Businesses and industries worry that the science is vague and might be misused by government agencies. State leaders say the tool is not intended to replace project analysis, laws or planning.

The tool will fulfill part of the 2006 state greenhouse gas law, Senate Bill 535, by identifying such high-risk places, known as disadvantaged communities.

Funds will be raised from auctions of greenhouse gas allowances for California companies. Disadvantaged communities will be favored to get that money to address their problems.

Disadvantaged community is a good description of West Fresno. Mary Curry of the activist group Concerned Citizens of West Fresno says it has been this way for decades.

"We ask for help," she said. "Nobody has been listening."

The San Joaquin Valley has nine of the 12 most environmentally burdened places in California, including four in Fresno County and three in Stockton.

The map of California's worst 5% shows many Valley ZIP codes. The state's designations will be part of a program called California Communities Environmental Health Screening Tool, or CalEnviroScreen.

Source: California Environmental Protection Agency

But state EPA is paying attention. And it's no surprise the state recognizes the multiple layers of risks in West Fresno and the Valley above other places in the state, says Jonathan London of the University of California at Davis.

He worked on a 2011 study about Valley pollution and health risks, including West Fresno and the Kings County community of Kettleman City, which is just a few miles from a hazardous waste landfill.

London said, "People with low income and people of color are disproportionately located in those places with high concentrations of factors that can lead to poor health conditions."

Place your bets

If you live in West Fresno, will you really die younger? Will you actually get asthma, cancer, heart disease or other serious health problems?

The science is not intended to make such individual predictions, says John Capitman, executive director of the Central Valley Health Policy Institute at Fresno State. It is not a health assessment, which goes into far more depth and history of a patient.

"I'm looking at the big shape of the iceberg," he said, "not little pieces of it."

Scientists say they are looking at risk -- the odds that something may happen. The risks are higher in places such as West Fresno and Kettleman City, but lower in the Woodward Park area of Fresno.

In his 2012 "Place Matters" study, Capitman said he calculated mortality rates in each Valley ZIP code. He also included such details as income, ethnicity, education and pollution exposure.

But what if some aspect of lifestyle, such as diet, could account for the early mortality?

Capitman said it would be hard to make that case. The repeating patterns in the places with the highest early mortality suggest something more than lifestyle problems.

"We saw communities of color, immigrants, low income, high exposure to air pollution, clusters along Highway 99, asthma," he said. "So are they all eating the wrong things? I don't think so."

Life expectancy in West Fresno's ZIP code is 69 years old or less, according to Capitman's study. Life expectancy in the more affluent Woodward Park ZIP code is up to 90 years old.

In the state's CalEnviroScreen document, the contrasts between the two are just as striking. The pollution burden in West Fresno is rated more than three times higher.

The populations are near the same size -- 41,087 in West Fresno and 45,191 in Woodward Park, state EPA shows. But there are vast differences in education, birth weights, poverty, ethnicity and asthma rates.

One dramatic example of the differences: pesticide applications. Located in an urban-farming transition area, West Fresno ranks in the 90th percentile for such chemicals statewide. Amid rows of suburban homes around northeast Fresno, the Woodward Park ZIP code ranks in the 23rd percentile.

There are objections and doubts about the way the state is presenting this information, especially about pesticides.

The California Farm Bureau Federation last month wrote a letter to the state EPA, saying the screening tool makes it look as though pesticide use equates to 100% exposure.

"These pesticides have the strictest application and use regulations (buffer zones, worker safety clothing requirements, restricted entry intervals, etc.) of any pesticide applications nationwide," wrote Cynthia Cory, the Farm Bureau group's director of environmental affairs.

But the tool is intended only as a screening device, said John Faust, of the state EPA's Office of Environmental Health Hazard Assessment. The EPA is not assessing blame or indicating the level of exposure, he said.

The agency does not have complete information on exposures to such chemicals, Faust said. But the screening is important because it shows where people might be vulnerable to such chemicals.

"We're finding out where people use chemicals as a way to get at the question of where exposures are taking place," said Faust.

West Fresno's fight

Mary Curry says everyone in West Fresno knows someone in the community with asthma. She has it. The CalEnviroScreen draft document shows West Fresno's emergency room visits for asthma rank in the 98th percentile -- among the highest in the state.

Curry says the Concerned Citizens of West Fresno will fight for health, adding that the animal rendering plant is at the top of the list.

But is the rendering plant part of the risk?

The plant on West Belgravia Avenue, owned by Texas-based Darling International Inc., has operated nearly 60 years. The company has spent millions of dollars in the last decade upgrading its operation.

The plant is not among the four companies identified in the U.S. Environmental Protection Agency's Toxics Release Program for the 93706 ZIP code.

One company on the list is Cargill Meat Solutions Corp. on South Fig Avenue. Its chemical releases are basically ammonia, according to federal EPA.

But Curry says the stench of the Darling rendering plant makes life miserable for people. Ask any West Fresnan who has asthma, she says.

"The wind knows no boundaries," she said.

Curry says it's just one more layer of stress on an overburdened West Fresno where the battle for health seems endless.

The 81-year-old Curry is no stranger to public battles. In 1985, she was the first African-American woman elected to the Fresno Unified School District board before being recalled in 1990 during her second term.

She and the Concerned Citizens of West Fresno sued the city of Fresno last year over the rendering plant.

The group says the owners should apply for a conditional-use permit to process the 850,000 pounds of animal carcasses and animal parts into such products as poultry feed and tallow. A hearing is scheduled May

21 in Fresno County Superior Court.

West Fresno and the rendering plant are not high political agendas around Fresno, says the Rev. Chris Breedlove, pastor of College Community Congregational Church. He says Fresnans need to help their neighbor.

Breedlove last year wrote a Fresno Bee Valley Voices opinion about the rendering plant. He says he has heard people say: Why don't they just move from West Fresno?

"Many people don't have that luxury," Breedlove said. "That's where they are stuck."

Resources

Rating California environmental quality by ZIP code (Excel spreadsheet)

Read more about the state program CalEnviroScreen

Study: "Place Matters for Health in the San Joaquin Valley"

Study: "Land of Risk, Land of Opportunity"

To print the document, click the "Original Document" link to open the original PDF. At this time it is not possible to print the document with annotations.

The reporter can be reached at (559) 441-6316, mgrossi@fresnobee.com or @markgrossi on Twitter. Read his Earth Log blog at news.fresnobeehive.com/earth-log.

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