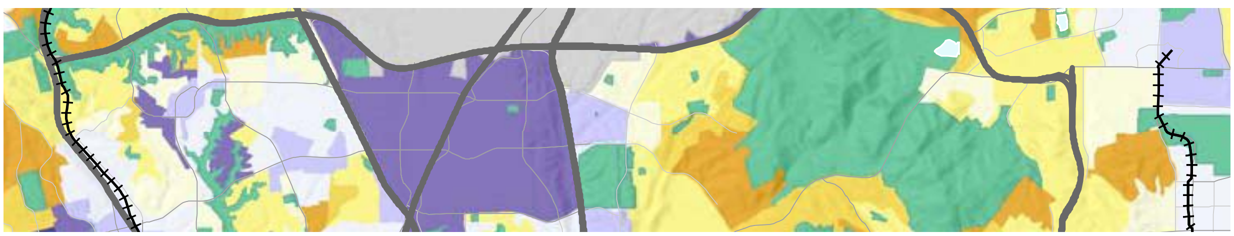
Healthy Communities Atlas



San Diego Region, California

Prepared for the San Diego Association of Governments (SANDAG) by Urban Design 4 Health, Inc.

March, 2012

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Healthy Works[SM] is a countywide initiative making systems and environmental changes by promoting wellness and addressing the nationwide obesity epidemic. Healthy Works[SM], administered by the County of San Diego Health and Human Services Agency, is funded by the American Recovery and Reinvestment Act of 2009 (ARRA) and includes the University of California San Diego, SANDAG, San Diego County Office of Education, Community Health Improvement Partners, and San Diego State University, along with numerous community-based partners. The project is part of the County's "Live Well, San Diego! Building Better Health" initiative, a 10-year vision for healthy communities in the San Diego region.

healthy WORKS
Paths to Healthy Living

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Chapter 1

Introduction

Relationships between the built environment and health have influenced the development of human settlements since cities first came into existence. Removing and disposing of waste, protecting air and water quality, and creating community gathering areas are age-old issues. In the early 19th century, the planning profession evolved largely in reaction to some of the severe urban public health issues of the day—overcrowding, homes in close proximity to highly polluting industries, and lack of access to open space and nature.

We have more recently begun to suffer the consequences of living in post-World War II cities and towns that have had physical activity "designed out" of them. Auto-oriented development and associated sedentary lifestyles contribute to high rates of overweight and obese people. Heart disease and stroke, which are commonly associated with obesity, are the first and third leading causes of death in the United States.[1]

In addition to heart disease and stroke, respiratory conditions, certain types of cancer and type 2 diabetes result in more than 50 percent of all deaths in San Diego County. The human toll and economic costs associated with these diseases are enormous and growing, accounting for nearly a trillion dollars nationally each year and in 2007, $4 billion in San Diego County direct care costs. In July 2010, the County of San Diego Board of Supervisors unanimously adopted *Live Well, San Diego!*, a 10-year health initiative providing a shared vision and goals to collaborate and engage communities and support residents in healthy eating, active living and living tobacco free. Healthy Works is a program of the County of San Diego's Health and Human Services Agency and *Live Well, San Diego!* Initiative.

The purpose of the Healthy Communities Atlas is to compile, visualize, and analyze conditions related to health and wellness in the San Diego region. Existing data were used to develop a variety of health-related indicators at the Census block group level. By presenting this information in an accessible format, the Atlas functions as a guide to San Diego's health landscape. Using Census block groups as a consistent geography allows comparison between indicators. It also allows layering, querying, and mapping of multiple indicators in order to illustrate spatial clustering or convergence.

The Atlas is the first product in a series of evidence-based tools being developed for SANDAG as part of a grant from the Healthy Works program. The Atlas reflects the Healthy Works program's focus on obesity prevention through physical activity and access to healthy foods. A Geographic Information System (GIS) tool accompanies the Atlas, which can be used by SANDAG, the San Diego County Health & Human Services Agency (HHSA), and other regional and local partners to perform customized queries and geographic analyses. The Atlas maps and GIS tool can be used to identify areas that already support health, as well as areas that need further investment in infrastructure, programs, or policies.

[1] Jiaquan Xu et al., "Deaths: Final Data for 2007," *National Vital Statistics Reports* 58, no. 19 (2010).

About the Atlas

There are four main sections of the Healthy Communities Atlas. Each pertains to an issue at the intersection of health and planning:

- Physical Activity and Active Transportation
- Injury Prevention
- Nutrition
- Air Quality

Rather than focusing on health outcomes (for which there are little data available at the sub-county level), the Atlas focuses largely on health determinants,[2] particularly those that are relevant to regional and local planning and decision-making. Most of the maps in the Atlas, therefore, are based on socio-demographic or physical environment data.

There are two types of maps in the Atlas: *base maps* and *composite maps*. Each base map displays a single aspect or measured health indicator for the region. These maps provide an overview of the built environment and health conditions that impact residents of the region. Where multiple factors may influence a health outcome, multiple base maps are combined into composite maps. Composite maps relate directly to health outcomes and are the result of querying across multiple base maps, illustrating the areas of the region where physical or social conditions converge to support or undermine an outcome.

The selection of maps in the Atlas is informed by evidence from peer-reviewed studies. Each base map has been found in peer-reviewed research to be a factor in predicting one or more health outcomes. When multiple base maps are combined into a composite map, the measure in each constituent base map has been found in multiple studies to be a significant predictor of the outcome being examined. Due to differences in data availability, the specific measures used for the base maps may differ slightly from those found in the literature. Additionally, the maps in the Atlas are purely descriptive and have not been subjected to inferential statistical validation in the San Diego region.

Appendix B contains a description of how the measures of accessibility were constructed. The GIS tool contains further documentation of how each indicator, base map, and composite map were developed. Because most of the data sources are standardized and regularly updated, the Atlas can be updated as needed using the documented methods.

[2] Michael Marmot and Richard G. Wilkinson, eds., *Social Determinants of Health: The Solid Facts*, 2nd ed. (New York: Oxford University Press, 2006).

Chapter 2

Regional Context

Planning for healthy communities requires both an understanding of health impacts and the distribution of those impacts among different groups of people. This chapter of the Healthy Communities Atlas provides a demographic overview of the San Diego region, and is the basis for understanding the concentrations, size, and makeup of the population.

Some groups of people such as those with low incomes, those belonging to a racial or ethnic minority, and those with limited mobility may require different or targeted strategies to encourage physical activity or reduce health risks. These populations may also be differently impacted when compared to the population at large. To frame the discussion of these populations, the Atlas relies on SANDAG's analysis of four designated "Communities of Concern." The Communities of Concern designations were used to identify areas with concentrations of low-income households, ethnic minorities, low-mobility households, and households at risk of low community engagement.

Topics discussed in this section include:

- Population Density
- Communities of Concern

Population Density

Population density can tell a great deal about a region. Where and how people choose to locate has a profound impact on the character of the area. Density helps determine what kinds of amenities cities can offer and how efficiently people and goods can move within cities and throughout the region. Economics explains clustering in terms of benefits that stem from increased knowledge sharing, economies of scale, higher wages for workers, larger markets for goods and services, and reduced transportation costs.

Many of these same effects can be seen when looking at health outcomes. For example, as distances to goods and services decrease, people are more likely to engage in physically active forms of transportation such as walking or bicycling. Similarly, where density is higher, better or more frequent public transportation becomes viable. This too encourages physical activity, as most trips to transit are walking trips. In turn, decreased driving reduces injuries and improves the air quality of the region.

Some aspects of density can carry negative health consequences. As density increases, exposure to air pollution may increase even as the per-capita generation of emissions decreases. Prolonged exposure to low-frequency noise, another negative health factor, may also increase with population density. These impacts are often disproportionately borne by youth, lower income households, and the elderly.

About the Map

This map uses year 2010 Census tract level data provided by SANDAG to calculate population density (at the time of publication, Census 2010 block group population data was unavailable). Population density was calculated as a gross measure of density (the population is divided by the area of the Census tract). Tract level population estimates were disaggregated to the Census block group proportionate to land area of each block group. This method assumes an even distribution of population across the Census tract, a potential limitation of the analysis.

Gross population density, as used in this map, is the most common measure of population density. Another measure of density—net residential density—divides an area's population by the residential land area. Net residential density is used in the Walkability Index map on page 14 because it more accurately measures the clustering of people while allowing for other land uses such as commercial or retail.

This map separates Census block groups into eight roughly equal groups (quantiles) ranging from highest density to lowest. Each quantile contains a roughly equal number of block groups. Although this map shows only the western third of the region, the analysis was based on all 1,762 Census block groups in the San Diego region. For clarity, the quantile cut points have been rounded, which causes a slight shift in the number of block groups in each quantile.

Findings

In general, population density increases toward the western and southern parts of the region. Water and steep terrain limit the uniformity of development in the region. Urban centers such as downtown San Diego are clearly visible as areas of highest density, with smaller pockets of higher density emerging in areas such as the cities of El Cajon and Escondido. Figure 2.1 below shows the distribution of Census block groups according to their population density.[1] Although densities reach over 60 people per acre, a large majority of block groups in the region have fewer than 20 people per acre.

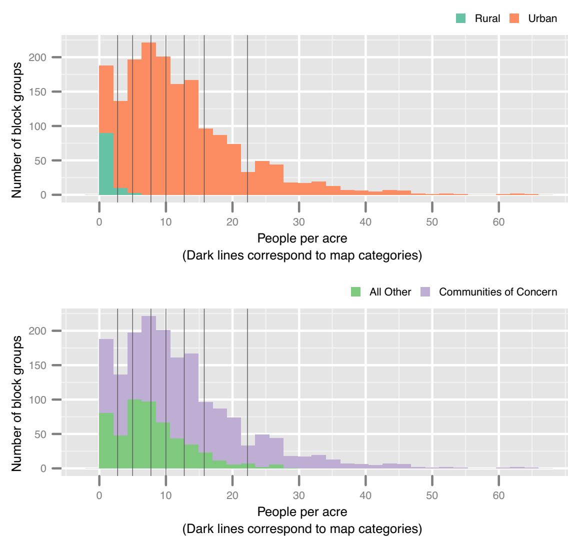
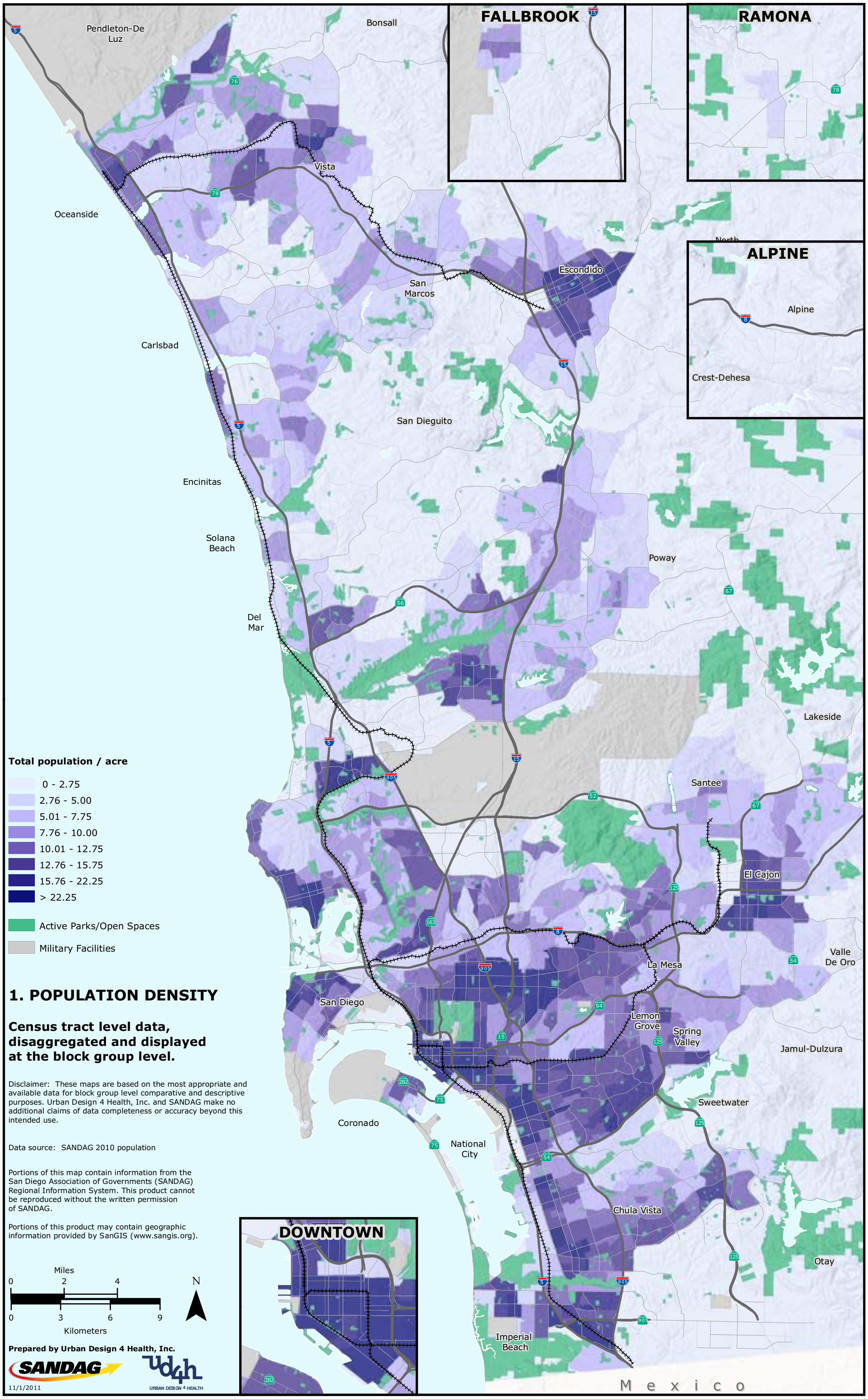


Figure 2.1: Block groups by gross population density

[1] Please refer to Appendix A for a description of the methodology used to distinguish between urban and rural block groups.


FALLBROOK
RAMONA
ALPINE
DOWNTOWN
Pendleton-De Luz
Bonsall
Vista
Oceanside
North
Alpine
Crest-Dehesa
Escondido
San Marcos
Carlsbad
San Dieguito
Encinitas
Solana Beach
Poway
Del Mar
Lakeside
Santee
El Cajon
Valle De Oro
La Mesa
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
Mexico
Total population / acre
0 - 2.75
2.76 - 5.00
5.01 - 7.75
7.76 - 10.00
10.01 - 12.75
12.76 - 15.75
15.76 - 22.25
> 22.25
Active Parks/Open Spaces
Military Facilities
1. POPULATION DENSITY
Census tract level data, disaggregated and displayed at the block group level.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SANDAG 2010 population
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Miles
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Communities of Concern

The impact of the built environment on health varies considerably for different demographic subgroups. Low-income households,[2] minority populations,[3] youth,[4] disabled, and elderly[5] populations are all more likely to be negatively impacted. Additionally, living in a low-income neighborhood is consistently associated with obesity and a higher body mass index (BMI).[6] Identifying potentially vulnerable populations such as those presented in this series of maps is an important step in understanding the distribution of potential health impacts throughout the region.

About the Maps

This series of maps presents the SANDAG-designated Communities of Concern. The Communities of Concern were defined and identified by SANDAG for use in regional planning analyses. These four Communities of Concern include:

1. **Low-income** areas have over one-third of all households earning under $30,000 per year (see Map 2).
2. **Minority** areas have over 65% minority population (see Map 3).
3. **Low-mobility** areas are those in which more than 25% of households do not own a car, 25% of the population has a disability, or 20% of the population is over 65 years of age (see Map 4).
4. **Low community engagement** areas are those in which more than 20% of the population has a disability, 20% of households are non-English speaking, or more than 20% of the population do not have a high school diploma (see Map 5).

The Communities of Concern maps are most useful to pinpoint where disparate conditions may already exist or where investment in infrastructure or programs might relieve health burdens. In the sections of the Atlas that follow, tables summarize the overlap between the conditions found in each map and the Communities of Concern in order to highlight relationships between health outcomes, demographics, and the built environment.

The Communities of Concern data were provided by SANDAG for 2010 Census tracts and disaggregated to the Census block group proportionate to land area of each block group. This method assumes an even distribution of population across the Census tract, a potential limitation of the analysis. Although the maps show only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region.

Findings

Although the Communities of Concern are primarily concentrated in the urban cores, these populations are found throughout the western third of the region. Table 2.1 summarizes the number of block groups meeting the criteria for each Community of Concern. Nearly two-thirds of all Census block groups in the region have one or more Communities of Concern.

Table 2.1: Block groups by Communities of Concern

Communities of Concern	Block Groups Meeting Criteria
Low-Income Areas	252 (14.3%)
Minority Areas	875 (49.7%)
Low-Mobility Areas	433 (24.6%)
Low Community Engagement Areas	574 (32.6%)
Any Community of Concern	1,137 (64.5%)
Total	1,762 (100.0%)

There is a large degree of geographic overlap between low-income, minority, and low community engagement areas, although minority areas account for a larger proportion of the region. Nearly half of all block groups qualify as minority areas, and about a third qualify as low community engagement areas. Large minority areas exist in central San Diego and toward the Mexican border, south of SR 56, and along the SR 78 corridor inland. Low-mobility populations are more widely distributed across the region, in suburban, exurban, and outlying areas, as well as in the urban core. To some extent, low-mobility areas parallel the region's major transit corridors (see Map 8, Access to Transit Stations and Stops in the next chapter).

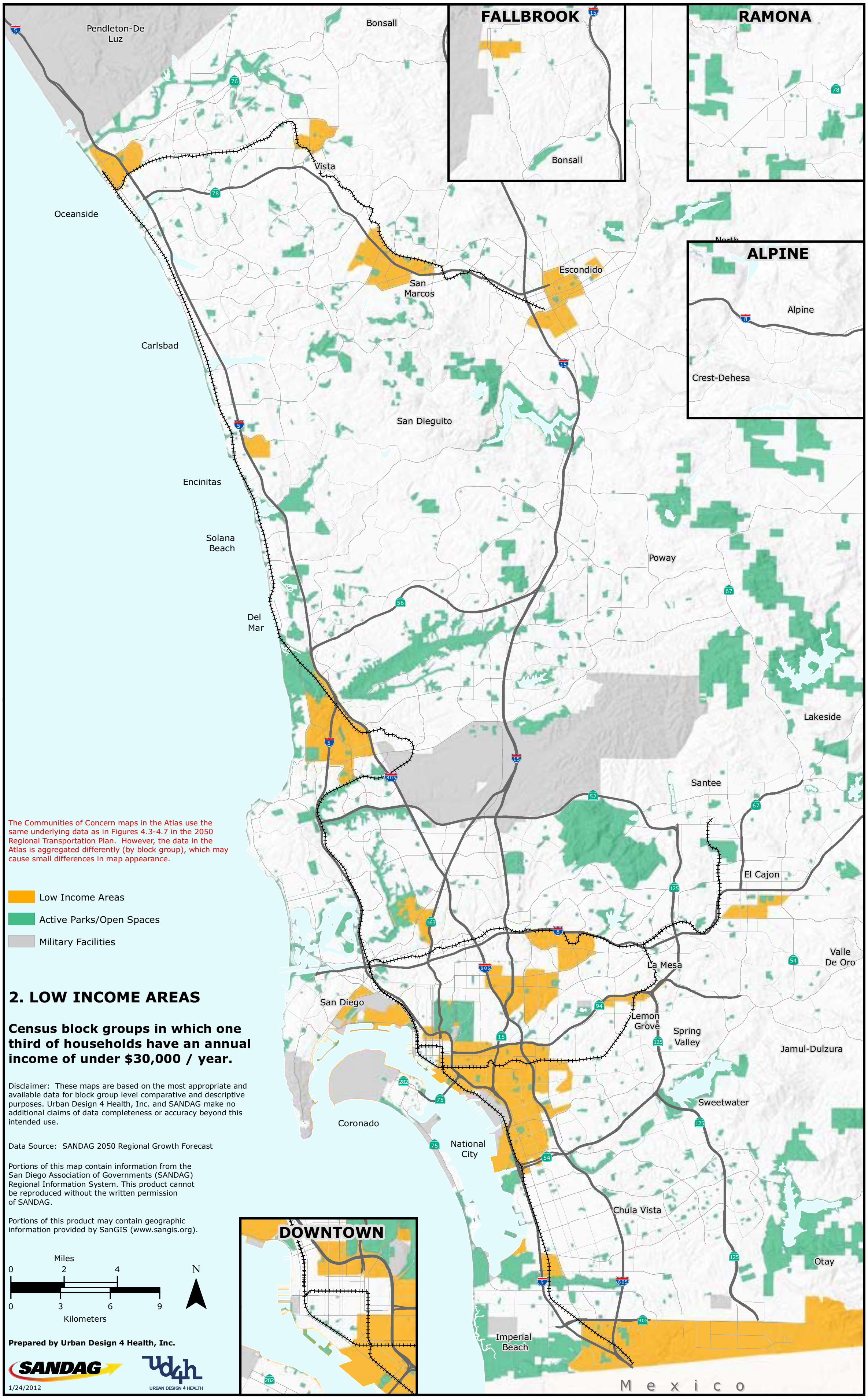
[2]Jennifer L. Black and James Macinko, "Neighborhoods and Obesity," *Nutrition reviews* 66, no. 1 (January 2008): 2–20; Jason P. Block, Richard A. Scribner, and Karen B. DeSalvo, "Fast Food, Race/Ethnicity, and Income: A Geographic Analysis," *American Journal of Preventive Medicine* 27, no. 3 (October 2004): 211–7; Allison A. Hedley et al., "Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002.," *Journal of the American Medical Association* 291, no. 23 (June 2004): 2847–50.

[3]Black and Macinko, "Neighborhoods and Obesity"; Block, Scribner, and DeSalvo, "Fast Food, Race/Ethnicity, and Income: A Geographic Analysis"; Birgitta Berglund, Thomas Lindvall, and Dietrich H. Schwela, eds., *Guidelines for Community Noise* (Geneva: World Health Organization, 2000).

[4]American Academy of Pediatrics, *Pediatric Environmental Health*, 2nd ed., ed. Ruth A. Etzel and Sophie J. Balk (American Academy of Pediatrics, 2003), 721; Berglund, Lindvall, and Schwela, *Guidelines for Community Noise*.

[5]Linda Bailey, *Aging Americans: Stranded Without Options*, April, technical report (Surface Transportation Policy Project, 2004); Howard Frumkin, Lawrence D. Frank, and Richard Jackson, *Urban Sprawl and Public Health* (Washington, D.C.: Island Press, 2004).

[6]Frank J. van Lenthe and Johan P. Mackenbach, "Neighbourhood Deprivation and Overweight: The GLOBE Study," *International Journal of Obesity* 26, no. 2 (February 2002): 234–40; Ian Janssen et al., "Influence of Individual- and Area-Level Measures of Socioeconomic Status on Obesity, Unhealthy Eating, and Physical Inactivity in Canadian Adolescents.," *The American Journal of Clinical Nutrition* 83, no. 1 (January 2006): 139–45; Melissa C. Nelson et al., "Built and Social Environments Associations With Adolescent Overweight and Activity," *American Journal of Preventive Medicine* 31, no. 2 (August 2006): 109–17; Jason D. Boardman et al., "Race Differentials in Obesity: The Impact of Place," *Journal of Health and Social Behavior* 46, no. 3 (September 2005): 229–43; Stephanie A. Robert and Eric N. Reither, "A Multilevel Analysis of Race, Community Disadvantage, and Body Mass Index Among Adults in the US," *Social Science & Medicine* 59, no. 12 (December 2004): 2421–34.



The Communities of Concern maps in the Atlas use the same underlying data as in Figures 4.3-4.7 in the 2050 Regional Transportation Plan. However, the data in the Atlas is aggregated differently (by block group), which may cause small differences in map appearance.

Low Income Areas
Active Parks/Open Spaces
Military Facilities

2. LOW INCOME AREAS

Census block groups in which one third of households have an annual income of under $30,000 / year.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data Source: SANDAG 2050 Regional Growth Forecast

Prepared by Urban Design 4 Health, Inc.

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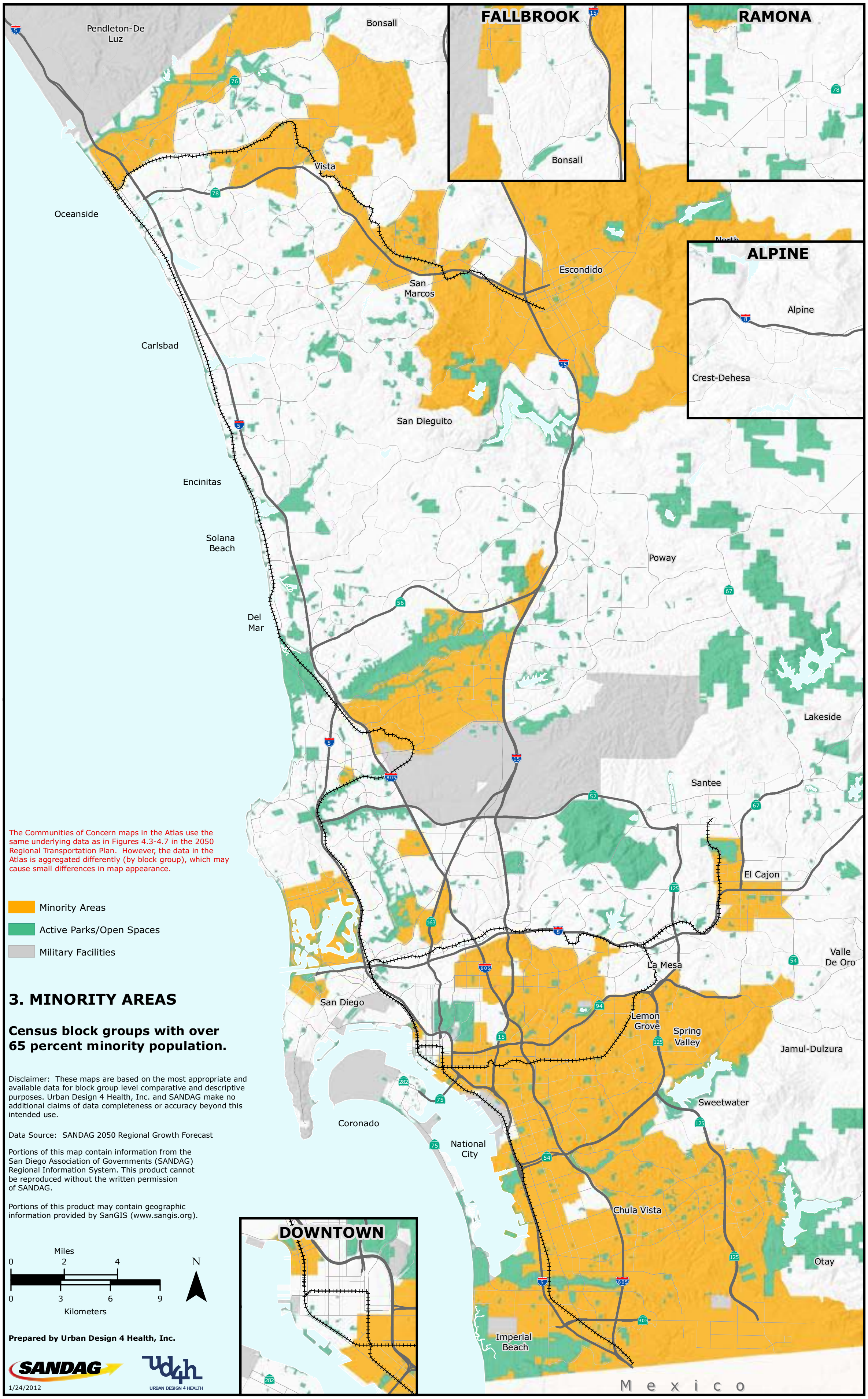

The Communities of Concern maps in the Atlas use the same underlying data as in Figures 4.3-4.7 in the 2050 Regional Transportation Plan. However, the data in the Atlas is aggregated differently (by block group), which may cause small differences in map appearance.

3. MINORITY AREAS

Census block groups with over 65 percent minority population.

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Data Source: SANDAG 2050 Regional Growth Forecast

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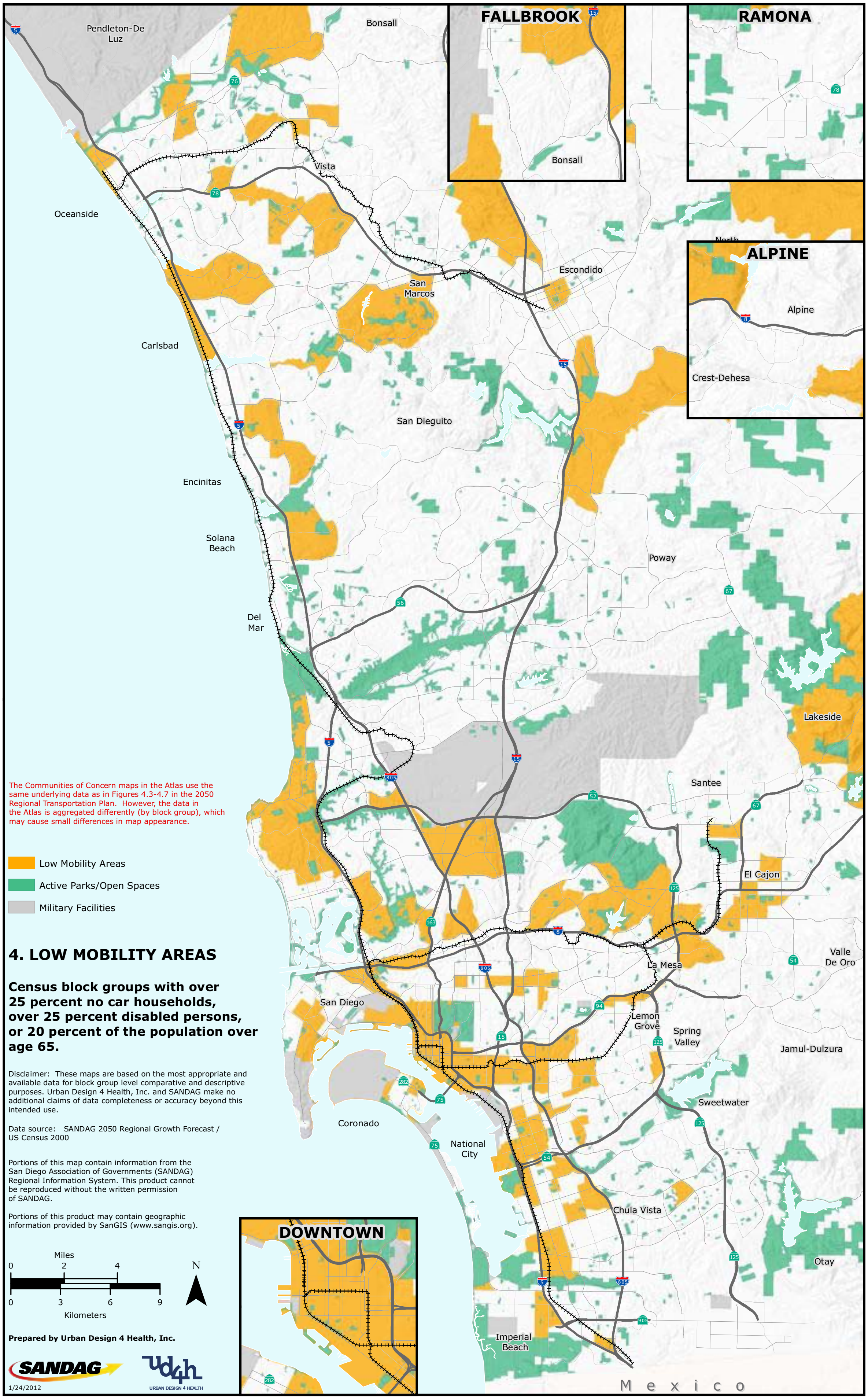
FALLBROOK
RAMONA
ALPINE
DOWNTOWN
Pendleton-De Luz
Bonsall
Vista
Oceanside
Escondido
San Marcos
Carlsbad
San Dieguito
Encinitas
Solana Beach
Poway
Del Mar
Lakeside
Santee
El Cajon
La Mesa
Valle De Oro
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
Alpine
Crest-Dehesa
Mexico
The Communities of Concern maps in the Atlas use the same underlying data as in Figures 4.3-4.7 in the 2050 Regional Transportation Plan. However, the data in the Atlas is aggregated differently (by block group), which may cause small differences in map appearance.
Low Mobility Areas
Active Parks/Open Spaces
Military Facilities
4. LOW MOBILITY AREAS
Census block groups with over 25 percent no car households, over 25 percent disabled persons, or 20 percent of the population over age 65.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SANDAG 2050 Regional Growth Forecast / US Census 2000
Portions of this map contain information from the San Diego Association of Governments (SANDAG) Regional Information System. This product cannot be reproduced without the written permission of SANDAG.
Portions of this product may contain geographic information provided by SanGIS (www.sangis.org).
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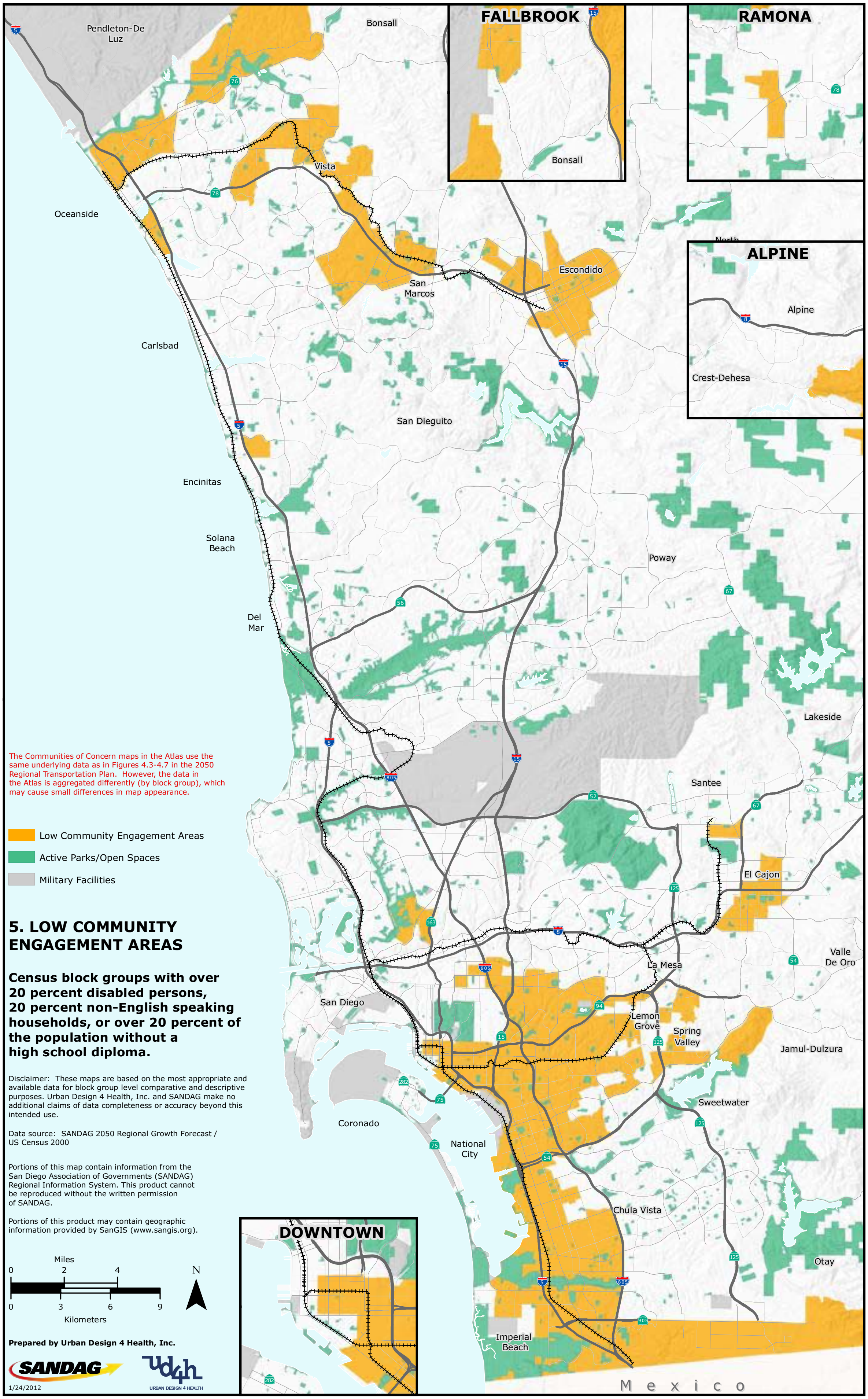
Prepared by Urban Design 4 Health, Inc.
1/24/2012



The Communities of Concern maps in the Atlas use the same underlying data as in Figures 4.3-4.7 in the 2050 Regional Transportation Plan. However, the data in the Atlas is aggregated differently (by block group), which may cause small differences in map appearance.

- Low Community Engagement Areas
- Active Parks/Open Spaces
- Military Facilities

5. LOW COMMUNITY ENGAGEMENT AREAS

Census block groups with over 20 percent disabled persons, 20 percent non-English speaking households, or over 20 percent of the population without a high school diploma.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: SANDAG 2050 Regional Growth Forecast / US Census 2000

Prepared by Urban Design 4 Health, Inc.

Chapter 3

Physical Activity and Active Transportation

This section of the Healthy Communities Atlas examines the physical and social factors in the region that are most closely connected to the promotion of physical activity and the use of active transportation. Because even modest increases in physical activity tend to reduce mortality rates,[1] encouraging utilitarian walking or bicycling—for errands, to work, or to school—can be an important part of an integrated regional strategy to reduce obesity rates. The walkability of a neighborhood, whether it has a convenient and efficient transit system and whether there are destinations within walking distance will all influence whether the travel choices people make are active or sedentary. Walkable, transit-supportive built environment patterns have been associated with higher amounts of active transport (bicycling and walking) as well as more overall physical activity.[2] Less walkable, auto-dependent built environments have been correlated with higher body weights, obesity, and associated chronic diseases.[3] In this section, we seek to examine which parts of the region are in need of investment, enforcement, or policy changes in order to better support walkable neighborhoods and utilitarian physical activity, which areas are already supportive, and which areas do or do not support physical activity for youth.

Topics discussed in this chapter include:

- Utilitarian Walkability
- Access to Transit Stations and Stops
- Parks and Open Space Access
- Non-motorized Trails Access
- Transportation Infrastructure Support (composite map)
- Access to Social Support and Amenities
- Complete Neighborhoods and Community Support (composite map)
- Youth and Physical Activity Support (composite map)
- Physical Disorder and Crime
- Road Design
- Physical Activity Inhibitors (composite map)

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[1] James F. Sallis et al., "Active Transportation and Physical Activity: Opportunities for Collaboration on Transportation and Public Health Research," *Transportation Research Part A: Policy and Practice* 38, no. 4 (May 2004): 249–268.

[2] Russ Lopez, "Urban Sprawl and Risk for Being Overweight or Obese," *American Journal of Public Health* 94, no. 9 (September 2004): 1574–9; Wendy C. King et al., "The Relationship Between Convenience of Destinations and Walking Levels in Older Women," *American Journal of Health Promotion* (2003): 74–82; Brian E. Saelens, James F. Sallis, and Lawrence D. Frank, "Environmental Correlates of Walking and Cycling: Findings From the Transportation, Urban Design, and Planning Literatures," *Annals of Behavioral Medicine* 25, no. 2 (January 2003): 80–91.

[3] Reid Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity," *American Journal of Health Promotion* 18, no. 1 (2003): 47–57; Lawrence D. Frank, Martin A. Andresen, and Thomas L. Schmid, "Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars," *American Journal of Preventive Medicine* 27, no. 2 (2004): 87–96; Lawrence D. Frank et al., "Linking Objectively Measured Physical Activity With Objectively Measured Urban Form: Findings From SMARTRAQ," *American Journal of Preventive Medicine* 28, no. 2 Suppl 2 (February 2005): 117–25; Billie Giles-Corti et al., "Environmental and Lifestyle Factors Associated with Overweight and Obesity in Perth, Australia," *American Journal of Health Promotion* 18, no. 1 (2003): 93–102; Brian E. Saelens et al., "Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation," *American Journal of Public Health* 93, no. 9 (September 2003): 1552–8.

Utilitarian Walkability

Recent research has shown that walkable neighborhoods are important predictors of physical activity and body weight.[4] Walkable neighborhoods support utilitarian physical activity through active transportation (walking and cycling) in lieu of, or in addition to, sedentary forms of transportation such as driving or riding in a car. Pedestrian friendly, walkable neighborhoods have also been associated with higher *overall* levels of physical activity, as they can contribute to recreational physical activity—for example, a stroll around the neighborhood after dinner.

About the Map

This map shows the relative walkability of each Census block group in the region. The measure of walkability, the Walkability Index, has been shown to predict walking, physical activity, body weights and health-related outcomes in other regions, and has been vetted in over 20 peer-reviewed articles.[5]

The Walkability Index is made up of four components of urban form: Net Residential Density, Intersection Density, Retail Floor Area Ratio and Land Use Mix. Because mode choice preferences are complex, multi-factor, and context sensitive, these four components are not the sole determinants of walking. However, they do represent the best available science with respect to predicting physical activity and active transportation outcomes. The four components of the Walkability Index are described below.

1. **Retail Floor Area Ratio (FAR)** is used to assess whether individual sites are pedestrian-oriented. FAR is defined as the ratio of building area (total square footage) to the parcel area for all retail and food-related parcels. Auto-oriented retail buildings are surrounded by parking lots and therefore have low FARs—typically below 0.3—and are less welcoming to pedestrians. By contrast, multi-story buildings with no dedicated parking, small parking lots, or underground parking will generally have FARs of 1 or above and are generally more pedestrian friendly.
2. **Intersection density** measures street-network connectivity. Fine-grained street networks with short blocks and many intersections allow for more direct routing for all travel modes. By contrast, street networks with long blocks or disconnected cul-de-sacs offer less efficient routes. Intersection density is especially important for pedestrians because walking travel times are more dramatically impacted by inefficient routes.

   Intersection density is calculated as the number of intersections with three legs or more in the block group divided by the land area of the block group, not including street segments not accessible to pedestrians (such as highway on-ramps).
3. **Net residential density** is a measure of residential compactness. Higher-density residential areas are an important determinant of walkability, as they allow a critical mass of people to access shops, services, jobs, and transit. Net residential density is calculated by dividing the total number of dwelling units within the block group by the residential land area in that block group.
4. **Land use mix** measures whether different land use types, such as homes, shops, and employment uses, are in close proximity to one another. This proximity is important for walking trips, as well as for transit trips. This measure of land use mix is based on a concept originally tested by Cervero and Kockelman,[6] and measures the evenness of the distribution of land in different uses. The result is a value between 0 and 1, with 1 being a perfectly even distribution of the land use types. Land use mix is defined by the following formula:

$$M = \frac{(H/A * ln(H/A)) + (O/A * ln(O/A)) + (C/A * ln(C/A))}{-ln(6)}$$

$M : Land\ use\ mix$
$A : Total\ area,\ all\ uses\ (ft^2)$
$H : Residential\ area\ (ft^2)$
$O : Office\ area\ (ft^2)$
$C : Commercial/Retail\ area\ (ft^2)$

The final Walkability Index represents the combination of each of the previous four components. To calculate the index, the standardized values (z-scores) for each of the four components are added. Intersection density is weighted twice that of the other components.

Parcel data from 2006 were used to develop the Walkability Index. These data include land use categories, parcel boundaries, area of land dedicated to each land use, and the number of housing units per parcel. These data were updated to account for five census tracts in which the number of housing units changed substantially between 2006 and 2010.

Census block groups were separated into eight roughly equal groups (quantiles) based on their Walkability Index score. The median score (-0.25) separates the upper four quantiles from the four less-walkable quantiles. This map shows only the western third of the region; however, the analysis was based on all 1,762 block groups in the San Diego region. For clarity, the quantile divisions have been rounded, causing a small shift in the number of block groups per quantile.

[4] James F. Sallis et al., "Neighborhood Environments and Physical Activity Among Adults in 11 Countries," *American Journal of Preventive Medicine* 36, no. 6 (June 2009): 484–90; Mia A. Papas et al., "The built environment and obesity.," *Epidemiologic reviews* 29, no. 27 (January 2007): 129–43; Lopez, "Urban Sprawl and Risk for Being Overweight or Obese"; Saelens et al., "Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation"; R. Sturm and D. Cohen, "Suburban Sprawl and Physical and Mental Health," *Public Health* 118, no. 7 (October 2004): 488–96; Ewing et al., "Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity"; Ethan M. Berke et al., "Association of the Built Environment With Physical Activity and Obesity in Older Persons," *American Journal of Public Health* 97, no. 3 (March 2007): 486–92.

[5] Lawrence D. Frank et al., "The Development of a Walkability Index: Application to the Neighborhood Quality of Life Study," *British Journal of Sports Medicine* 44, no. 13 (October 2010): 924–33; Lawrence D. Frank et al., "Many Pathways From Land Use to Health: Associations Between Neighborhood Walkability and Active Transportation, Body Mass Index, and Air Quality," *Journal of the American Planning Association* 72, no. 1 (March 2006): 75–87; Frank et al., "Linking Objectively Measured Physical Activity With Objectively Measured Urban Form: Findings From SMARTRAQ."

[6] Robert Cervero and Kara Kockelman, "Travel Demand and the 3 Ds: Density, Diversity, and Design," *Transportation Research Part D: Transport and Environment* 2, no. 3 (1997): 199–219.

Findings

The distribution of block groups according to their Walkability Index is shown in Figure 3.1. The urban core of San Diego forms the region's largest contiguous high-walkability area. Much of San Diego's urban core is in the highest walkability class, and is surrounded by a smaller ring of block groups in the next-highest classes.

The core zone of high walkability extends out to La Mesa in the east and to the southern edge of downtown San Diego. There are also a number of smaller walkable areas outside the urban core, largely the downtowns and pre-World War II neighborhoods found in many of the region's cities. These areas include San Diego's coastal neighborhoods (La Jolla and Pacific Beach) and the coastal cities of Del Mar, Solana Beach, Encinitas, and Oceanside. A similar pattern exists along SR 78 heading inland through the cities of Vista, San Marcos, and Escondido, and inland from the urban core to the city of El Cajon. South of central San Diego along I-5, National City, and Imperial Beach make up another contiguous zone of high and medium-high walkability areas.

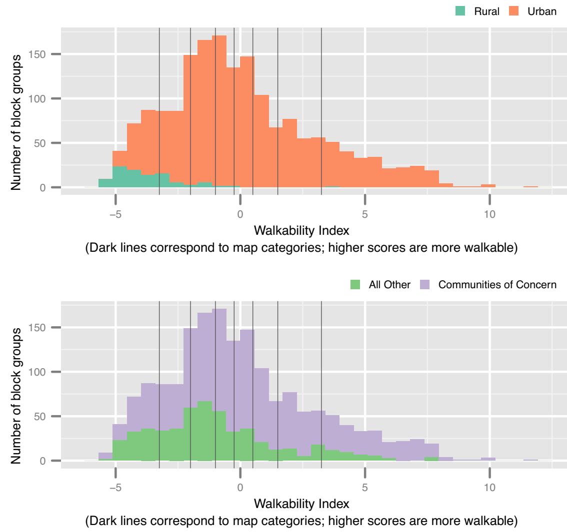
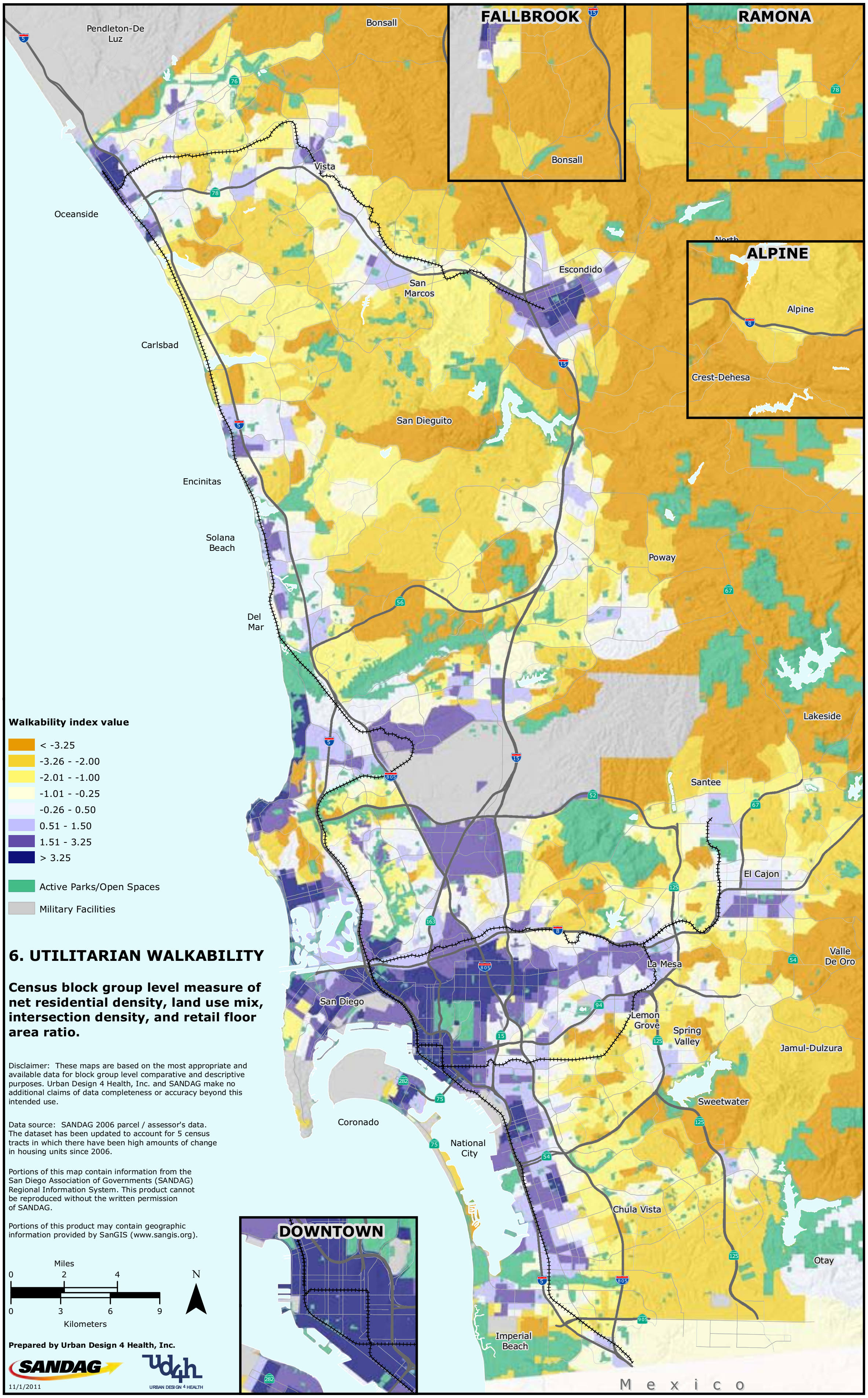


Figure 3.1: Block groups by Walkability Index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Solana Beach
Del Mar
Poway
Lakeside
Santee
El Cajon
La Mesa
Valle De Oro
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
Alpine
Crest-Dehesa
Mexico
Walkability index value
< -3.25
-3.26 - -2.00
-2.01 - -1.00
-1.01 - -0.25
-0.26 - 0.50
0.51 - 1.50
1.51 - 3.25
> 3.25
Active Parks/Open Spaces
Military Facilities
6. UTILITARIAN WALKABILITY
Census block group level measure of net residential density, land use mix, intersection density, and retail floor area ratio.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SANDAG 2006 parcel / assessor's data. The dataset has been updated to account for 5 census tracts in which there have been high amounts of change in housing units since 2006.
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Sidewalks

Sidewalks are the enabling infrastructure for walking trips, and as such are one of the important factors influencing the decision to walk. Areas with complete sidewalk networks tend to draw more pedestrians than areas with incomplete sidewalks.[7] In areas with incomplete sidewalk networks, pedestrians prefer streets with sidewalks.[8] Preference for sidewalks is borne out in measured health outcomes as well. Sidewalk presence—including the *perceived* presence of sidewalks—has been associated with lower rates of overweight status.[9]

Sidewalks also contribute to better pedestrian safety and decreased injury from traffic crashes.[10] In turn, areas that are safe for pedestrians encourage physical activity by increasing the perception of safety.

About the Map

The map shows the relative completeness of the sidewalk network in each block group, using a 2011 regional sidewalk inventory of the urban area completed as part of this project. The sidewalk inventory was limited to the designated urban area, so block groups outside the urban area boundary were classified as "insufficient data" on the map (38 block groups were fully outside the urban area). A number of block groups (109) were partially outside the urban area boundary. Of those block groups, 25 had 75 percent or more of their acreage within the urban area boundary, and so the sidewalk coverage calculation was assumed to be accurate as displayed on the map. The rest, which had less than 75 percent of their acreage within the urban area were also classified as "insufficient data."

The analysis examines the ratio of total sidewalk miles to the number of total roadway miles in each Census block. An area with a 100 percent complete sidewalk network will have twice as many miles of sidewalks as miles of roadway—or a ratio of two to one. A limitation of this measure is that it does not show whether the sidewalk segments are connected, or whether all sidewalks are in good condition. The analysis also calculated more than 100 percent sidewalk coverage in a small number of block groups. Upon closer examination, it was found that in these instances, roadways running along the edge of a block group were on one side of the block group boundary, while the sidewalk was "captured" in the adjacent block group. Although this boundary problem is unavoidable (and in some cases, inflates the sidewalk coverage measure substantially) it was only found in a few isolated block groups. The larger pattern of sidewalk development within the region remains accurate.

The map divides the Census block groups into eight roughly equal groups (quantiles) by sidewalk coverage. This map shows only the western third of the region; however the analysis was based on all 1,762 block groups in the San Diego region. For clarity, the quantile divisions have been rounded, which causes a small shift in the number of block groups per quantile.

Findings

Sidewalk coverage is high over much of the urban core—as Figure 3.2 shows; most of the region's urban Census block groups have complete or nearly complete sidewalk networks. Many of these block groups are also home to one or more of SANDAG's Communities of Concern, as also seen in Figure 3.2. Half of all block groups have sidewalk networks that are 73 percent complete or more. The areas with complete or nearly complete sidewalk networks largely overlap with the region's high-walkability areas. Rural block groups and block groups with insufficient data are not included in 3.2.

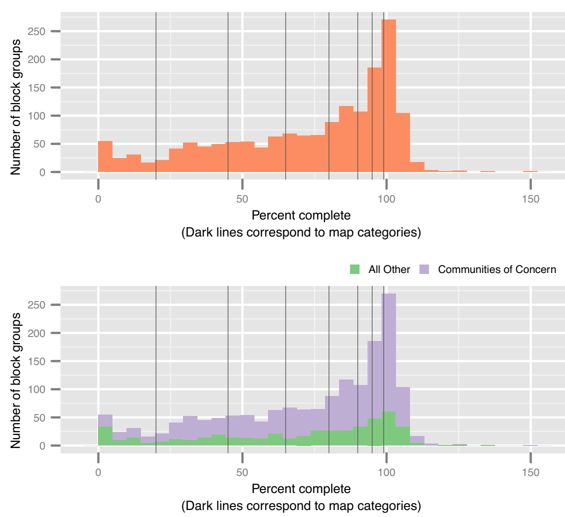


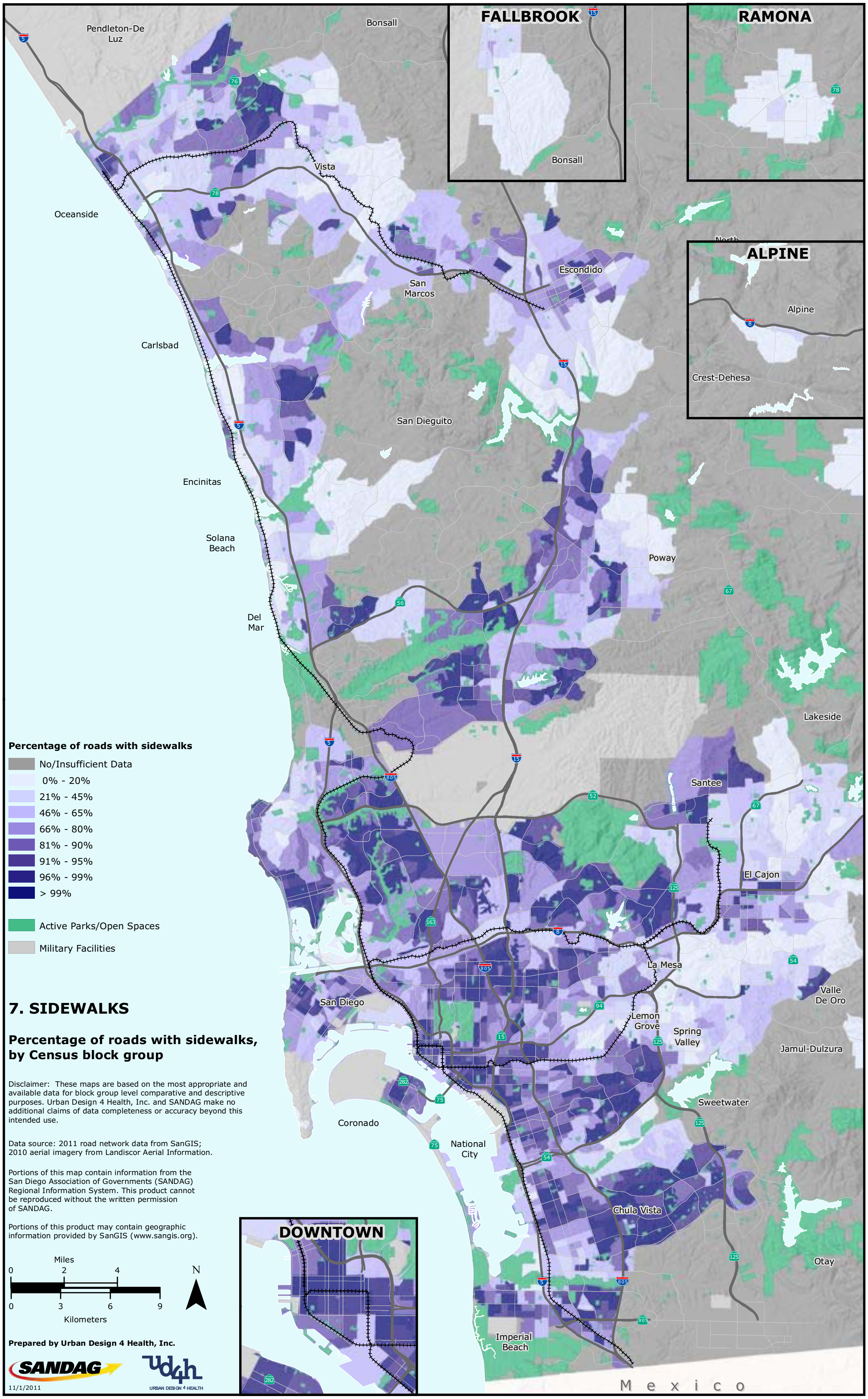
Figure 3.2: Urban block groups by sidewalk coverage

[7] Paul Hess et al., "Site Design and Pedestrian Travel," *Transportation Research Record* 1674, no. 1 (January 1999): 9–19.

[8] Ibid.

[9] Giles-Corti et al., "Environmental and Lifestyle Factors Associated with Overweight and Obesity in Perth, Australia"; James F. Sallis et al., "Evaluating a Brief Self-Report Measure of Neighborhood Environments for Physical Activity Research and Surveillance: Physical Activity Neighborhood Environment Scale (PANES).," *Journal of physical activity & health* 7, no. 4 (July 2010): 533–40.

[10] Patrick McMahon et al., "Analysis of Factors Contributing to "Walking Along Roadway" Crashes," *Transportation Research Record* 1674, no. 1 (January 1999): 41–48; Richard Knoblauch et al., *Investigation of Exposure Based Pedestrian Accident Areas: Crosswalks, Sidewalks, Local Streets and Major Arterials*, technical report (McLean Va.: Federal Highway Administration, 1988).



7. SIDEWALKS

Percentage of roads with sidewalks, by Census block group

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: 2011 road network data from SanGIS; 2010 aerial imagery from Landiscor Aerial Information.

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Access to Transit Stations and Stops

Transit and walking are complementary activities. Access to transit has been linked to increased physical activity, largely because most transit users walk to the transit stop.[11] In addition, high-quality transit service supports access to jobs and healthcare, while fostering community support networks. This is especially true for low-income households, the elderly, youth, and people with disabilities, as they are less likely to own a vehicle.

About the Map

This map illustrates the proportion of households within each block group that are within walking distance (0.6 miles,1 km, or a 6 to 8 minute walk) of “high-quality” transit. Rather than being calculated based as a straight line distance (as the crow flies), distances are calculated along the street network, which more accurately represents actual walking distances. SANDAG transit service data from 2010 and pre-established SANDAG transit service criteria were used to identify high-quality transit locations. SANDAG’s definition of high-quality transit includes major transit stops or major transit corridors, satisfying one or both of the following criteria:

- All rail stops
- All bus stops along bus routes with 15-minute peak headways

While proximity to high-quality transit facilities is an important predictor of walking to transit, this map could be improved by incorporating transit travel times to major destinations in the region. Evidence shows that transit travel time is a key predictor of whether people choose to use transit.

Findings

Figure 3.3 summarizes the distribution of block groups according to the percentage of households with access to transit. The distribution of transit-accessible block groups in the San Diego region is bimodal—access to transit either tends to be very good, or very limited. Few block groups fall into the middle categories. This is largely due to the concentration of transit service along the region’s major rail corridors. Table 3.1, which summarizes regional access to transit at the household level, underscores this point. In total, nearly 40 percent of households in the region—and over half of all multi-family households—are within walking distance of high-quality transit service.

Figure 3.3 also shows the distribution of block groups containing one or more Communities of Concern. Although a large number of the Communities of Concern are in block groups with the highest level of transit access, a substantial portion also exists in the lowest category of access. For these populations, mobility may already present challenges, and the lack of transit access will exacerbate those challenges.

Although the maps show only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region.

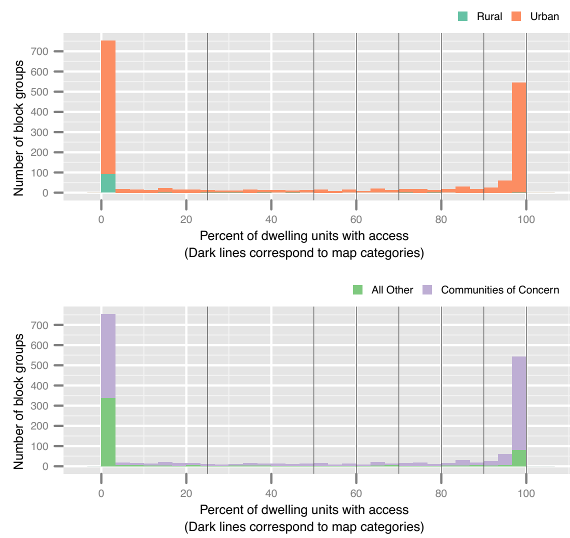
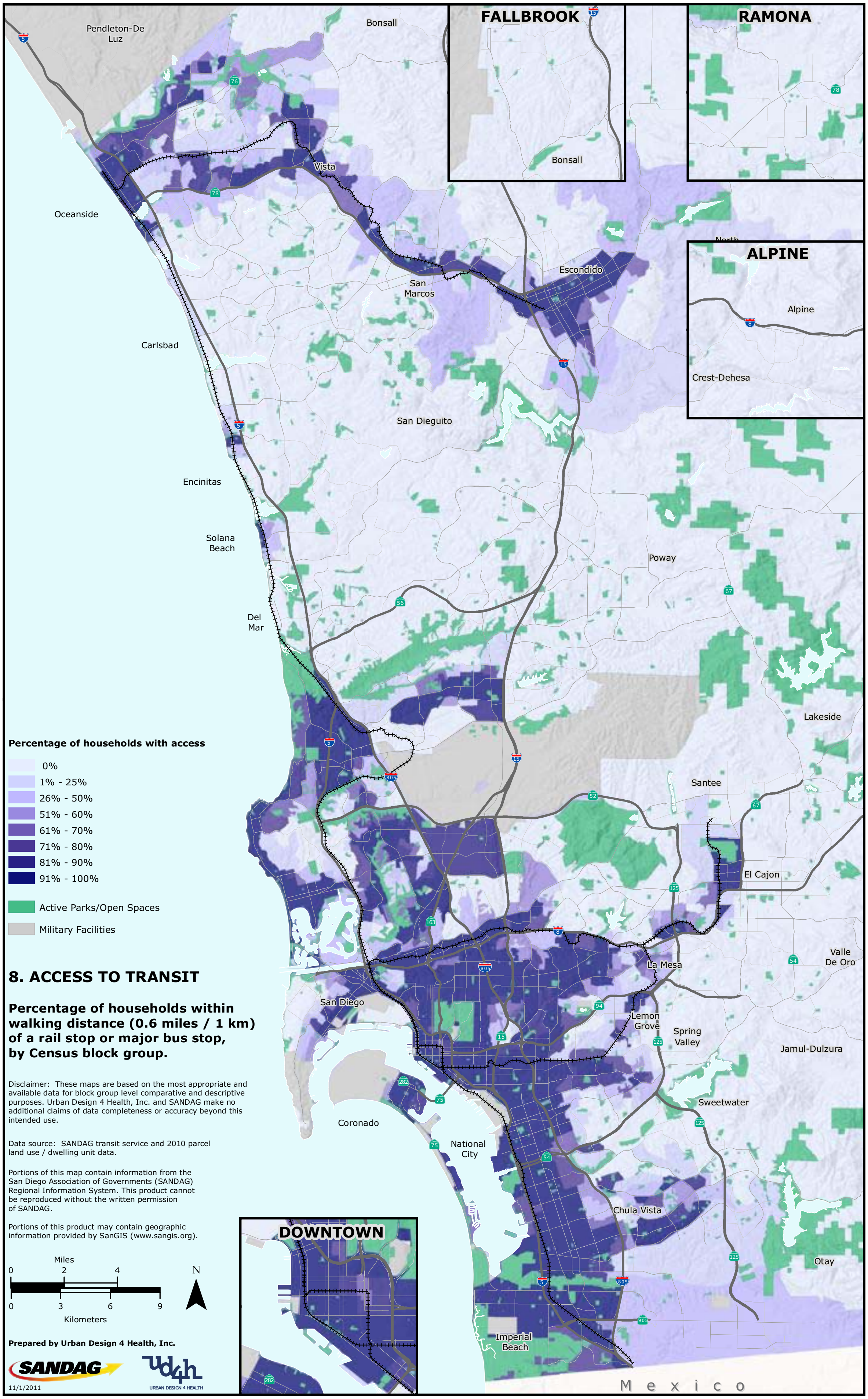


Figure 3.3: Block groups by access to transit

Table 3.1: Access to high-quality transit

Household Type	Households With Access
Multi-family	251,858 (56.07%)
Single-family	205,750 (29.62%)
All household types	457,608 (39.81%)

[11] Ugo Lachapelle and Lawrence D. Frank, “Transit and Health: Mode of Transport, Employer-Sponsored Public Transit Pass Programs, and Physical Activity,” *Journal of Public Health Policy* 30 Suppl 1, no. 1 (January 2009): S73–94; Lilah M. Besser and Andrew L. Dannenberg, “Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations,” *American Journal of Preventive Medicine* 29, no. 4 (2005): 273–280.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Jamul-Dulzura
San Diego
Coronado
National City
Sweetwater
Chula Vista
Otay
Imperial Beach
Alpine
Crest-Dehesa
Mexico
Percentage of households with access
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1% - 25%
26% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%
Active Parks/Open Spaces
Military Facilities
8. ACCESS TO TRANSIT
Percentage of households within walking distance (0.6 miles / 1 km) of a rail stop or major bus stop, by Census block group.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SANDAG transit service and 2010 parcel land use / dwelling unit data.
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Parks and Open Space Access

Parks, open space, playfields, and other recreational facilities play both a social and a functional role in promoting physical activity. Location of parks and recreation within walking distance has been consistently associated with higher levels of physical activity,[12] especially for children and youth.[13] Participation in sports and outdoor recreation can also contribute to social capital and cohesion,[14] which can in turn help people to become more active.[15]

About the Maps

This map measures the percentage of households in each Census block group within walking distance (0.6 miles, or 1 km) of a park or open space. This map compiles parks data developed for the Neighborhood Quality of Life Study,[16] along with 2004–2005 parks and open space data provided by SANDAG. The final analysis includes 985 parks, open spaces, public beaches, and shoreline areas.

A range of park types, from small, in-city plazas to large wilderness spaces is reflected in this map. The map does does not attempt to assess the character of access or to distinguish between informal open spaces, formal parks, and small pocket parks. However, research indicates that even small pockets of green space can be beneficial to health.[17]

To avoid overestimating access to parks, this map identifies the number of housing units within walking distance of park entrance points, rather than to park edges. However, many parks do have permeable edges with many potential formal and informal entry points. Therefore, all park access points within 250 feet of the road network were included in the analysis. Where parks have adjacent sidewalks, roadways, or parking lots, these were also assumed to be entrances.

Findings

Figure 3.4 below shows the distribution of Census block groups according to household access to parks and open space. Many people in the the San Diego region have access to parks and open space. Access to parks appears to be either very high or very low in urban areas, with few block groups falling in between. Only rarely do households in rural areas have park access within walking distance. While residents in outlying areas have less access to parks within walking distance, more of those households are likely to have some amount of private outdoor space.

Figure 3.4 also shows the distribution of block groups containing one or more Communities of Concern. Close to half of the block groups designated as Communities of Concern have the highest level of park access. However, a significant portion of Communities of Concern block groups have low levels of park access.

Although the map shows only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region.

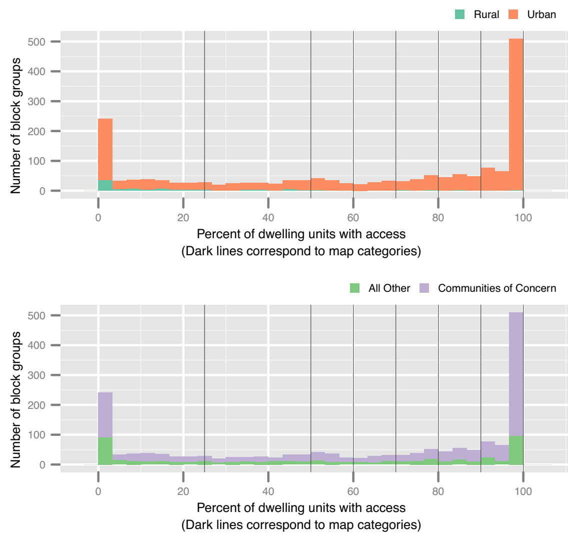


Figure 3.4: Block groups by access to parks or open space

Table 3.2 summarizes household parks and open space accessibility at the household level. Nearly 60 percent of households in the region are within walking distance (0.6 miles, or 1 km) of a park or open space. In higher-density urban areas, parks access is particularly important as residents are less likely to have their own private outdoor space. In the San Diego region, nearly 70 percent of all multi-family households have access to a park within walking distance.

Table 3.2: Access to parks by household type

Household Type	Households with Access
Multi-family	311,241 (69.29%)
Single-family	364,342 (52.46%)
All residential types	675,583 (58.78%)

[12] A. Rütten et al., "Self Reported Physical Activity, Public Health, and Perceived Environment: Results From a Comparative European Study," *Journal of Epidemiology and Community Health* 55, no. 2 (February 2001): 139–46; Philip J. Troped et al., "Associations Between Self-Reported and Objective Physical Environmental Factors and Use of a Community Rail-Trail," *Preventive medicine* 32, no. 2 (February 2001): 191–200; Kenneth E. Powell, Linda M. Martin, and Pranesh P. Chowdhury, "Places to Walk: Convenience and Regular Physical Activity," *American Journal of Public Health* 93, no. 9 (September 2003): 1519–21.

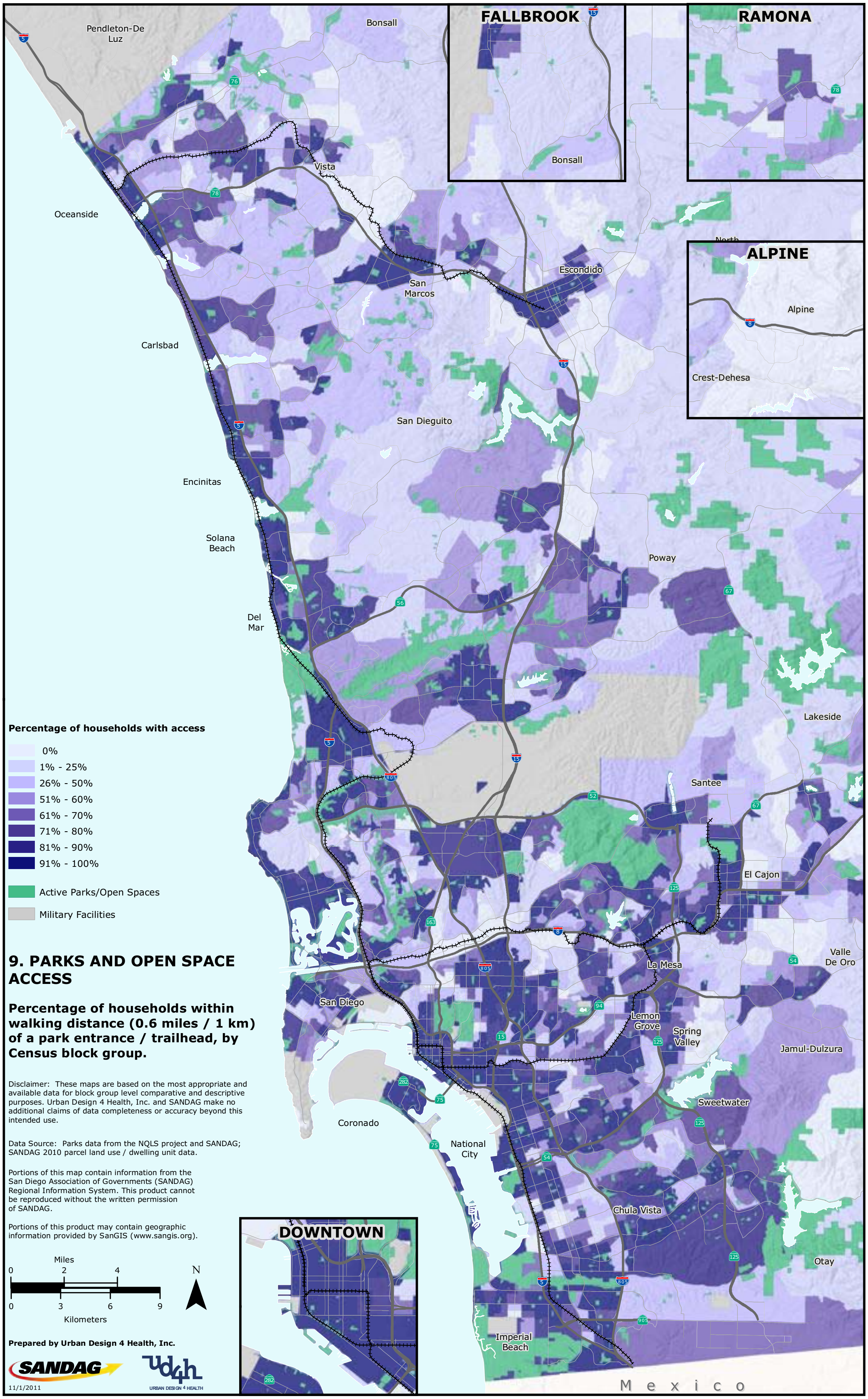
[13] Susan H. Babey, Richard E. Brown, and Theresa A. Hastert, *Access to Safe Parks Helps Increase Physical Activity Among Teenagers*, technical report (Los Angeles: UCLA Center for Health Policy Research, 2005); Lawrence D. Frank et al., "Urban Form Relationships with Walk Trip Frequency and Distance Among Youth," *American Journal of Health Promotion* 21, no. 4 Suppl (2007): 305–11.

[14] Social Exclusion Unit, *A New Commitment to Neighbourhood Renewal: National Strategy Action Plan*, technical report (London: Crown Cabinet Office of England, 2001); Neighborhood Renewal Unit, *Sport, physical activity, and renewal*, technical report (London, 2006).

[15] E. B. Kahn et al., "The Effectiveness of Interventions to Increase Physical Activity," *American Journal of Preventive Medicine* 22, no. 4S (2002): 73–107.

[16] The Neighborhood Quality of Life Study (NQLS) is a research project developed by James Sallis and other researchers at San Diego State University in collaboration with the consultant team, Urban Design 4 Health, Inc. http://www.nqls.org

[17] Rachel Kaplan, Stephen Kaplan, and Robert L. Ryan, *With People in Mind: Design and Management of Everyday Nature* (Washington, D.C.: Island Press, 1998).



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Solana Beach
Del Mar
Poway
Alpine
Crest-Dehesa
Lakeside
Santee
El Cajon
La Mesa
Valle De Oro
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
Mexico
Percentage of households with access
0%
1% - 25%
26% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%
Active Parks/Open Spaces
Military Facilities
9. PARKS AND OPEN SPACE ACCESS
Percentage of households within walking distance (0.6 miles / 1 km) of a park entrance / trailhead, by Census block group.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data Source: Parks data from the NQLS project and SANDAG; SANDAG 2010 parcel land use / dwelling unit data.
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Non-motorized Trails Access

Non-motorized trails serve multiple functions in a region. They provide recreational opportunities for cyclists, walkers, joggers, and others. In urban settings, trails serve as active transportation corridors, with some regional trails connecting urban centers together over longer distances.

Trails are the backbone of regional non-motorized transportation networks. Evidence shows that some cyclists will use non-motorized trails even when doing so increases their travel time.[18] Because trails are separated from vehicles, they can attract users (such as those with children) who might not otherwise choose to bicycle.[19]

About the Map

This map measures the percentage of housing units within 1.2 miles (2 km) of non-motorized trails identified by SANDAG 2009 bicycle-network data. The 1.2 mile street-network distance reflects a 12-20 minute walk, or a 6-10 minute bike ride.

Access to a trail does not guarantee access to important travel destinations. While trails are often themselves a destination, trails that connect to complementary uses—and to a larger trail network—will attract more numerous and diverse types of users. A limitation of this analysis is that it does not consider these connections from trails to other uses or to other trails. In addition, this analysis may slightly overestimate access to trails because it includes very short non-motorized trail segments, such as highway overpasses.

Findings

Access to trails is largely focused in linear zones distributed throughout the region. A few larger pockets of access along the coast illustrate that these areas—particularly San Diego's waterfront—are more consistently served by regional waterfront trails. Overall, however, access to trails is low, with only about one-fifth of the region's households having nearby access to a non-motorized trail, as Table 3.3 shows.

Figure 3.5 shows the distribution of Census block groups according to non-motorized trail access. Nearly two-thirds of block groups have no nearby access to trails, while about 10 percent of block groups have very good access. In these high-access block groups, over 90 percent of households have trail access.

Figure 3.5 also shows the distribution of block groups containing one or more Communities of Concern. The Communities of Concern block groups follow a similar pattern as the region as a whole—most block groups have either very high or very low levels of access, with little in between.

The map shows only the western third of the region, however the analysis was based on all 1,762 block groups in the San Diego region.

Table 3.3: Access to trails

Household Type	Households with Access
Multi-family	139,492 (31.05%)
Single-family	93,799 (13.51%)
All residential types	233,291 (20.30%)

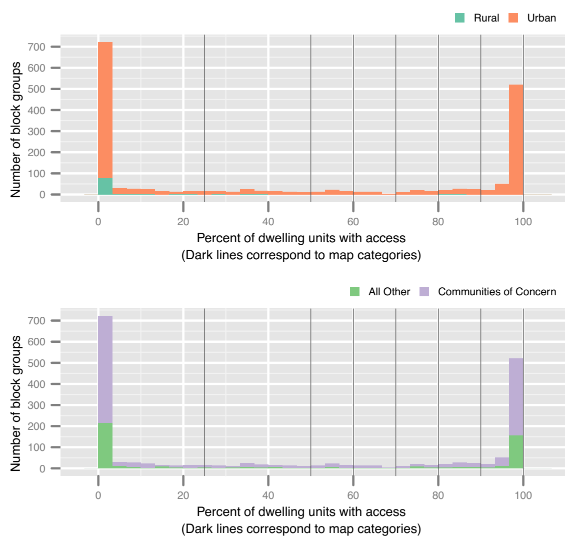
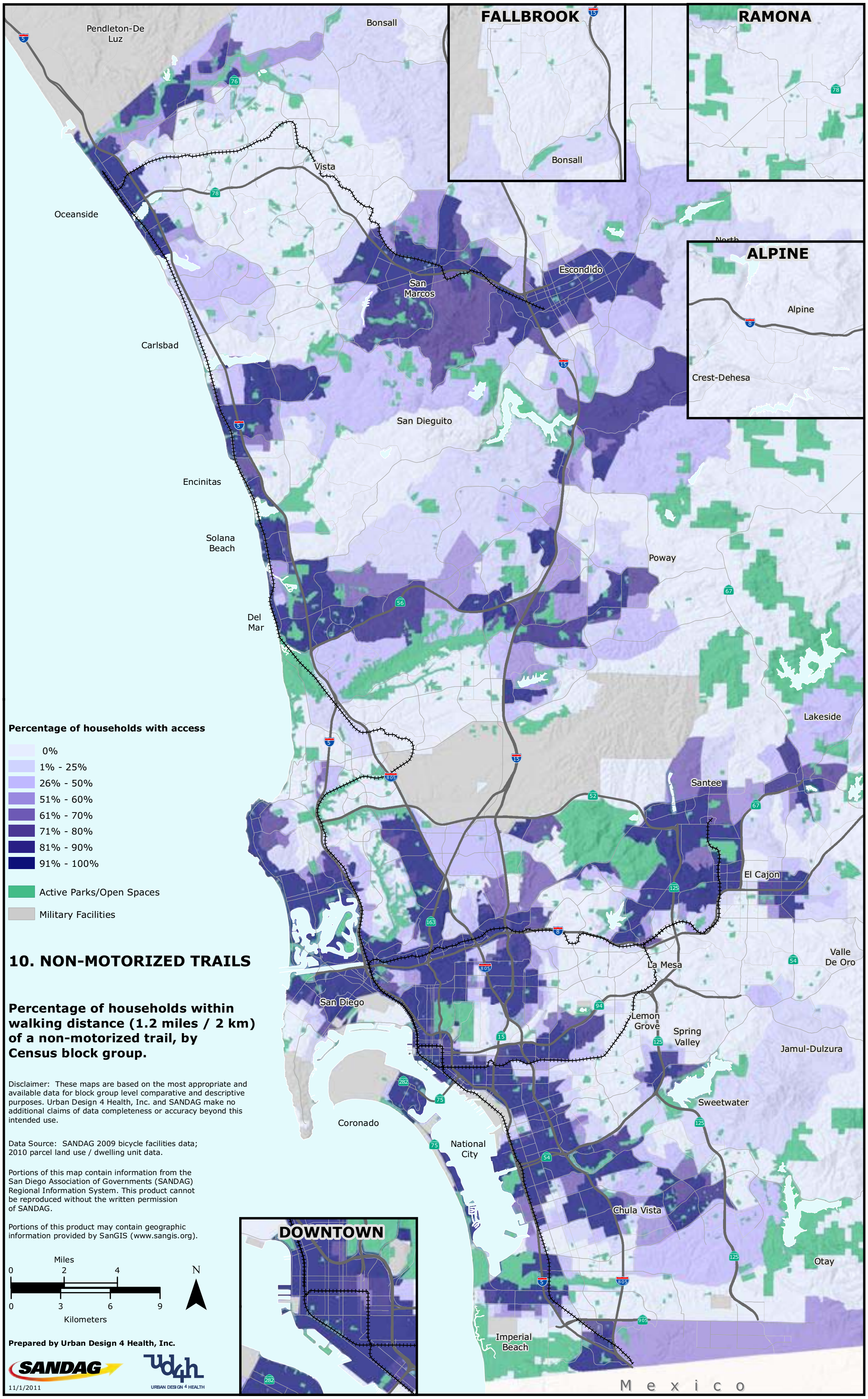


Figure 3.5: Block groups by access to non-motorized trails

[18]Kevin J. Krizek, Ahmed El-Geneidy, and Kristin Thompson, "A Detailed Analysis of How an Urban Trail System Affects Cyclists' Travel," *Transportation* 34, no. 5 (July 2007): 611–624.

[19]Jennifer Dill and John Gliebe, *Understanding and Measuring Bicycling Behavior: A Focus on Travel Time and Route Choice*, technical report (Portland: Oregon Transportation Research and Education Consortium, 2008).



10. NON-MOTORIZED TRAILS

Percentage of households within walking distance (1.2 miles / 2 km) of a non-motorized trail, by Census block group.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data Source: SANDAG 2009 bicycle facilities data; 2010 parcel land use / dwelling unit data.

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Transportation Infrastructure Support

This map combines three measures to identify where the region's network of transportation infrastructure supports physical activity, or where an infrastructure deficit could inhibit physical activity. The three base maps incorporated into this composite map include: Access to Transit Stations and Stops (Map 8), Sidewalk Completeness (Map 7), and Non-motorized Trails Access (Map 10).

The analysis divides Census block groups into five categories (very high, high, neutral, low, and very low) according to their composite transportation infrastructure support score. To calculate the composite score, each of the base map measures was first given a standardized value (z-score) for each block group. The final composite score per block group is the average of the base map z-scores. To create the five categories, the Census block groups were separated into five roughly equal groups (quantiles) based on their composite score. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

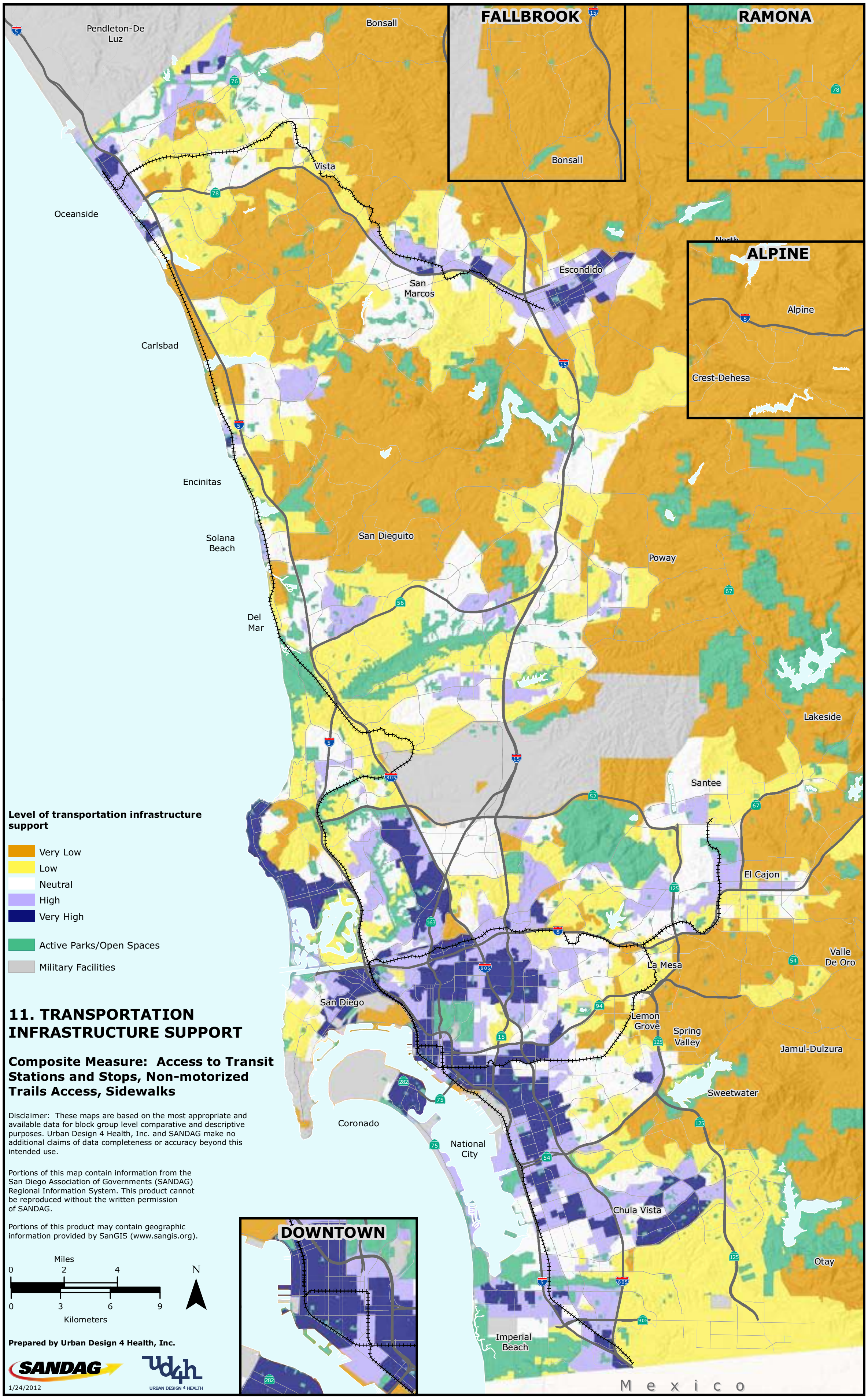
Findings

Areas with the highest levels of transportation infrastructure support are in the region's core neighborhoods—across much of San Diego and south into Chula Vista, west of I-805. In the northern part of the County, pockets of supportive transportation infrastructure emerge in Oceanside, San Marcos, and Escondido, largely mirroring the Sprinter light rail corridor along I-78. The lack of non-motorized trail coverage reduces the overall level of transportation infrastructure support in urban areas; other elements, including a fairly complete sidewalk network and access to transit, are generally present in the urban areas. Many of the region's outlying communities have transportation systems that are largely auto-oriented and therefore less supportive of transportation-related physical activity.

Table 3.4 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. The largest number of block groups designated Communities of Concern are found in block groups with very high and high levels of transportation infrastructure support. This indicates that there is a reasonable level of transportation infrastructure support in many areas with vulnerable populations, and therefore opportunities to support transportation-related physical activity in these areas. Additional investigation may be warranted to identify barriers to physical activity that may exist, as well as targeted programs and investment to encourage physical activity in these communities.

Table 3.4: Block groups by level of transportation infrastructure support

Level of Support	All Block Groups	Communities of Concern Block Groups
Very High	353 (20%)	286 (16%)
High	352 (20%)	265 (15%)
Neutral	352 (20%)	244 (14%)
Low	352 (20%)	228 (13%)
Very Low	353 (20%)	210 (12%)
All categories	1,762 (100%)	1,233 (70%)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San Marcos
Alpine
Carlsbad
Crest-Dehesa
Encinitas
Solana Beach
San Dieguito
Poway
Del Mar
Lakeside
Santee
El Cajon
Valle De Oro
La Mesa
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
M e x i c o
Level of transportation infrastructure support
Very Low
Low
Neutral
High
Very High
Active Parks/Open Spaces
Military Facilities
11. TRANSPORTATION INFRASTRUCTURE SUPPORT
Composite Measure: Access to Transit Stations and Stops, Non-motorized Trails Access, Sidewalks
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Access to Social Support and Amenities

Public amenities and social support are important contributors to health and overall wellbeing. For single-parent households and households with two working adults, access to daycare is a major factor in being able to retain employment. Libraries and elementary schools provide access to learning and can be important centers of community activity by hosting events, public meetings, and other civic functions such as voting. Further, amenities and destinations such as these help make for walkable and complete communities—places that encourage physical activity with a diversity of services, destinations, and transportation options.

In addition to social and civic infrastructure, access to healthcare is important both in emergencies as well as for routine care. With nearby access to healthcare facilities, vulnerable populations such as the elderly may be more likely to engage in preventive care, or to seek treatment for ailments more quickly. Other populations with limited access to transportation may also be more likely to seek treatment for minor ailments when healthcare facilities are more proximate.

About the Maps

These maps depict the proportion of households within each block group that is within walking distance (0.6 miles, or 1 km on the street network) to each type of amenity. The maps show four types of amenities:

- Daycare Facility Access (Map 12)
- Library Access (Map 13)
- Elementary School Access (Map 14)
- Healthcare Facility Access (hospitals and clinics; Map 15)

SANDAG 2010 parcel-level land use and dwelling-unit data were used to determine household counts. Data for day care facilities, libraries, hospitals, and clinics come from SanGIS (2007). Elementary school locations were provided by Urban Design 4 Health (2010). Although only the western third of the region is shown on the map, the analysis was based on all 1,762 block groups in the region.

Findings

Figures 3.6, 3.7, 3.8, and 3.9 show the distribution of Census block groups according to household access to each social support or amenity. Access to daycare facilities is good within San Diego's urban core, and in the centers of the other towns and cities. In the case of libraries, with fewer libraries, access is much lower, yet distributed more evenly across the region's urban areas. With hospitals and clinics located predominantly in urbanized areas, very few people outside of urban centers are within walking distance of these destinations, and access is generally low. Finally, block groups with high levels of access to elementary schools are found throughout the region, but are more prevalent in the urban and close-in suburban areas.

Table 3.5 summarizes access at the household level to the four amenities of interest. Nearly 60 percent of households have access to a daycare center within walking distance. Just over 40 percent of households—and nearly half of all multi-family households—have access to an elementary school. Access to healthcare facilities and libraries is much lower—around 15 percent of the region's households, and about a quarter of multifamily households, have access to each.

Finally, Figures 3.6, 3.7, 3.8, and 3.9 also show the distribution of block groups containing one or more Communities of Concern. For all of the amenities included in this set of maps, the distribution of Communities of Concern across the map categories generally mirrors the distribution of the region's population as a whole. Further statistical testing would be necessary to identify whether significant differences exist. Layering individual Communities of Concern maps over each of the accessibility maps would also provide further insight.

Table 3.5: Access to amenities by type

Household Type	Households with Access to Daycare	Households with Access to Libraries	Households with Access to Elementary Schools	Households with Access to Healthcare
Multi-family	335,811 (74.76%)	104,108 (23.18%)	216,965 (48.30%)	116,178 (25.86%)
Single-family	342,616 (49.33%)	71,969 (10.36%)	274,876 (39.58%)	54,854 (7.90%)
All residential	678,427 (59.02%)	176,077 (15.32%)	491,841 (42.79%)	171,032 (14.88%)

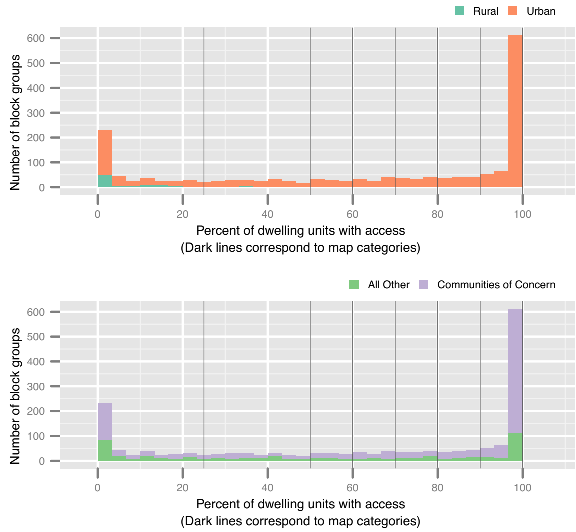


Figure 3.6: Block groups by access to daycare

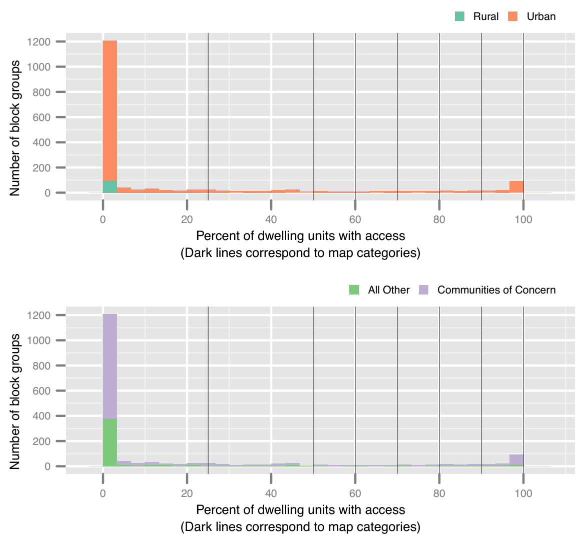


Figure 3.7: Block groups by access to libraries

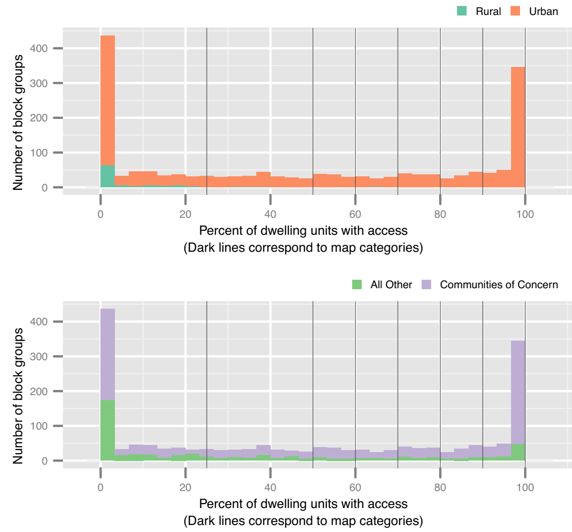


Figure 3.8: Block groups by access to elementary schools

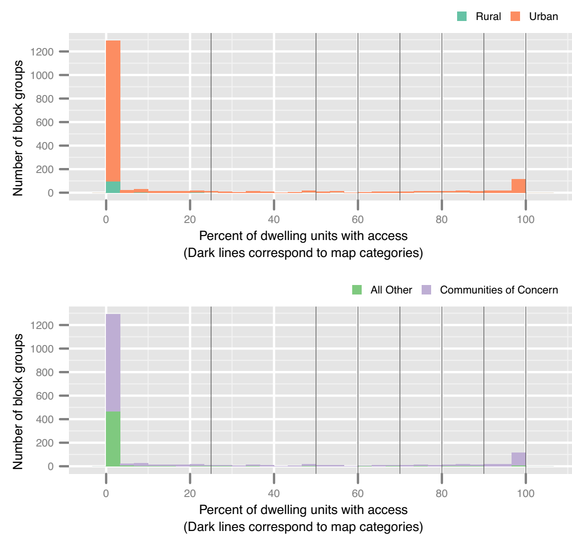
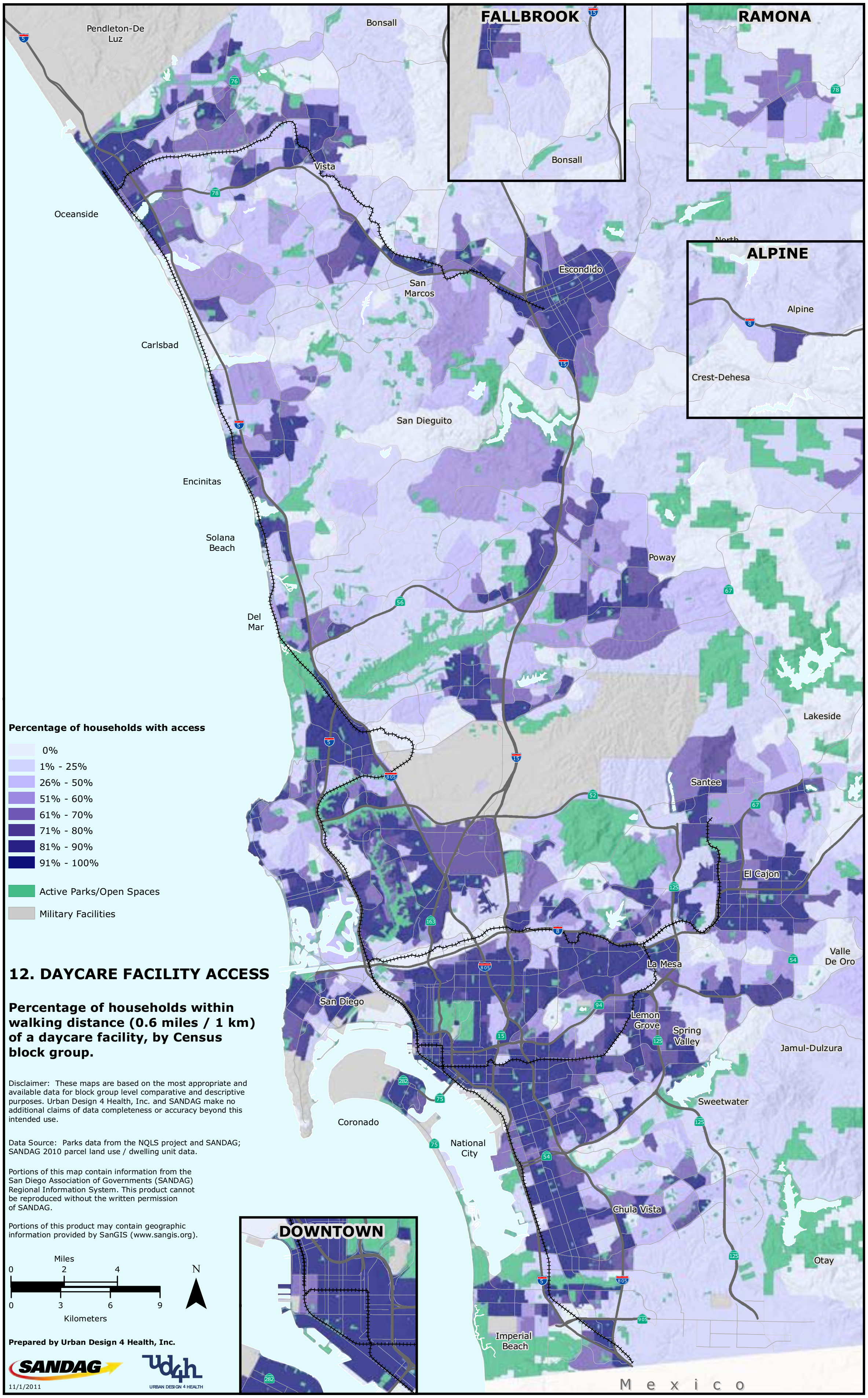


Figure 3.9: Block groups by access to healthcare



12. DAYCARE FACILITY ACCESS

Percentage of households within walking distance (0.6 miles / 1 km) of a daycare facility, by Census block group.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data Source: Parks data from the NQLS project and SANDAG; SANDAG 2010 parcel land use / dwelling unit data.

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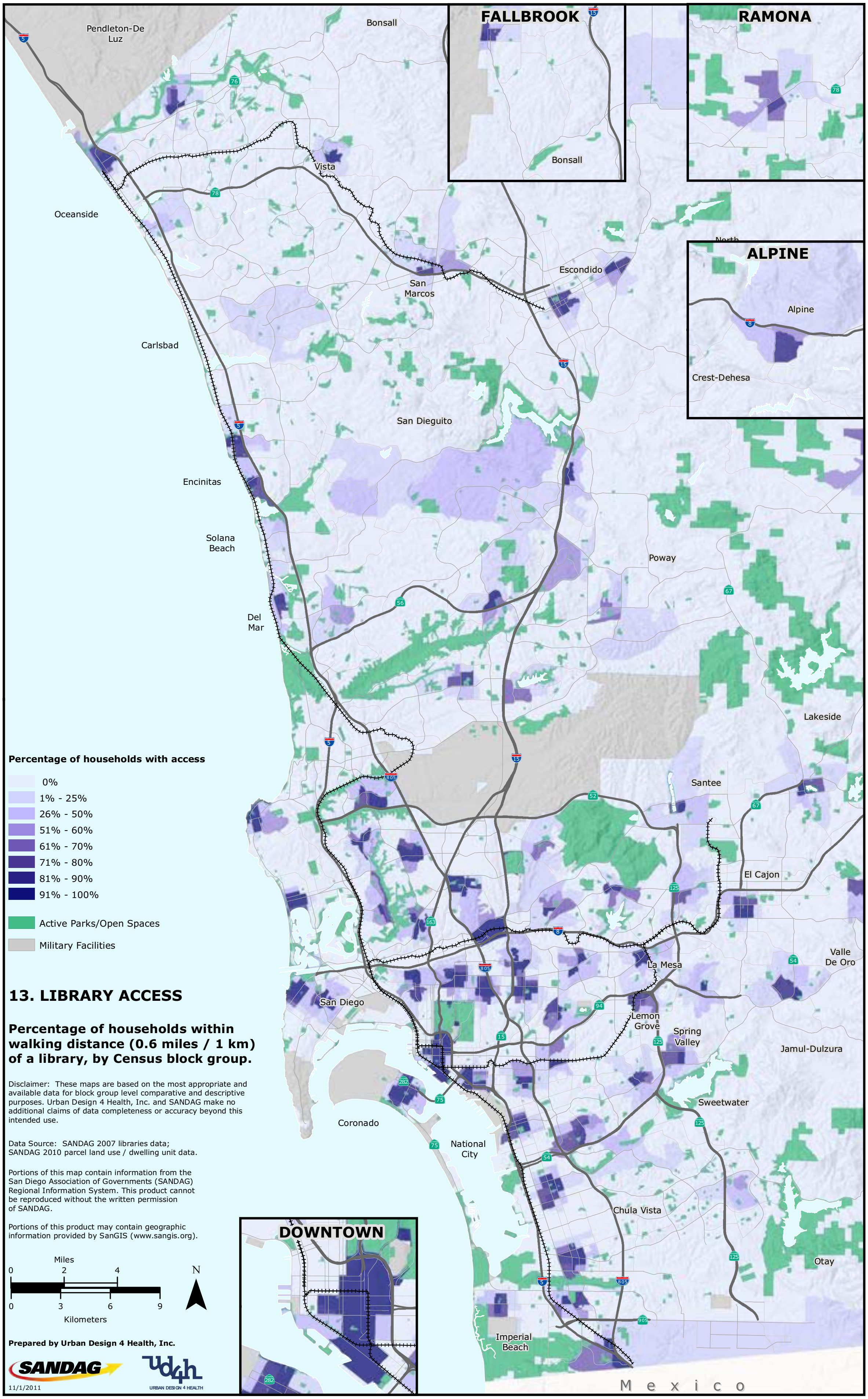

13. LIBRARY ACCESS

Percentage of households within walking distance (0.6 miles / 1 km) of a library, by Census block group.

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Data Source: SANDAG 2007 libraries data; SANDAG 2010 parcel land use / dwelling unit data.

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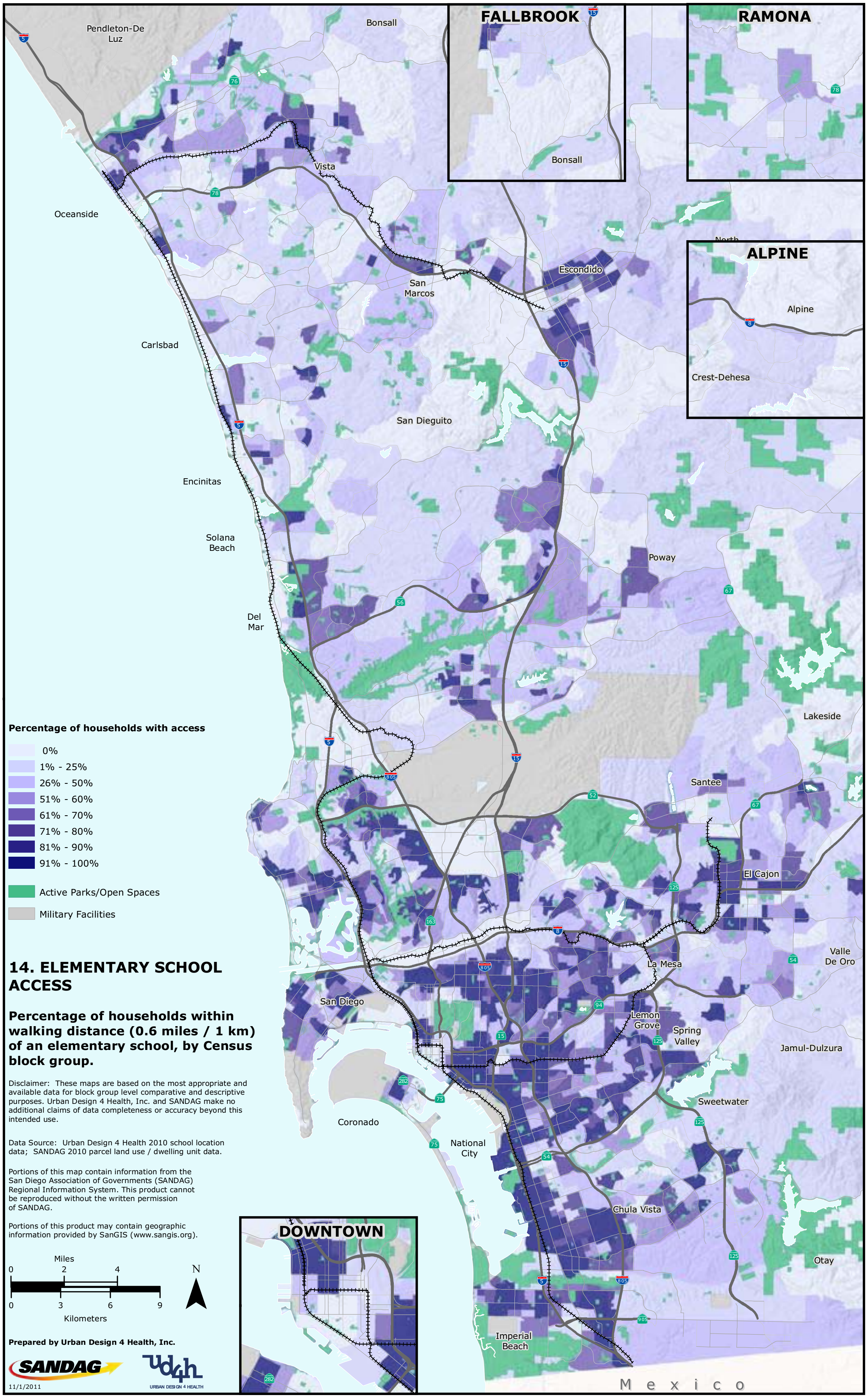

14. ELEMENTARY SCHOOL ACCESS

Percentage of households within walking distance (0.6 miles / 1 km) of an elementary school, by Census block group.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data Source: Urban Design 4 Health 2010 school location data; SANDAG 2010 parcel land use / dwelling unit data.

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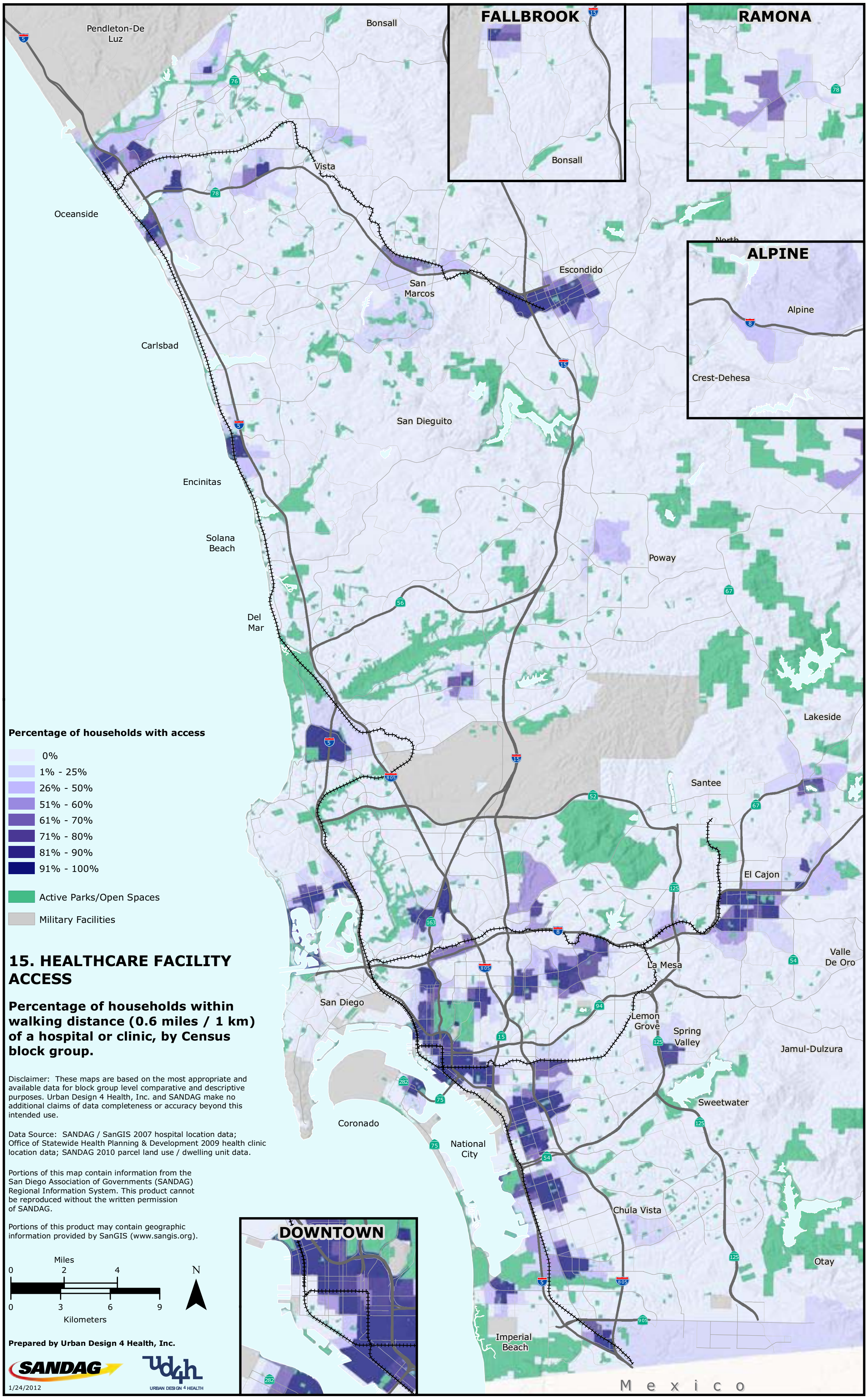
15. HEALTHCARE FACILITY ACCESS
Percentage of households within walking distance (0.6 miles / 1 km) of a hospital or clinic, by Census block group.
Percentage of households with access
0%
1% - 25%
26% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%
Active Parks/Open Spaces
Military Facilities
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data Source: SANDAG / SanGIS 2007 hospital location data; Office of Statewide Health Planning & Development 2009 health clinic location data; SANDAG 2010 parcel land use / dwelling unit data.
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Complete Neighborhoods and Community Support

Communities that encourage active transportation provide more than infrastructure. Complete neighborhoods provide a variety of destinations and amenities that can be reached on foot or by bicycle, and when people need to access goods, services, or employment farther away, complete neighborhoods facilitate the use of public transit. This map shows the areas in the region that have the best access to different types of destinations within walking distance of households.

Eight base maps (listed in Table 3.6) were combined to highlight those areas in which 50 percent or more of the households in each block group have access to at least four or more of the selected destinations. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

Table 3.6: Components of Complete Neighborhoods composite map

Type of Amenity	Definition of Accessibility
Daycare Facilities	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Libraries	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Parks and Open Space	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Elementary Schools	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Healthcare Facilities	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Healthy Food	More than 50% of households within 0.6 miles (1 km) walking distance of destination.
Transit Station or Stop	More than 50% of households within 0.6 miles (1 km) walking distance of a major transit stop / major transit corridor.
Non-motorized Trails	More than 50% of households within 1.2 miles (2 km) street network distance of a trail.

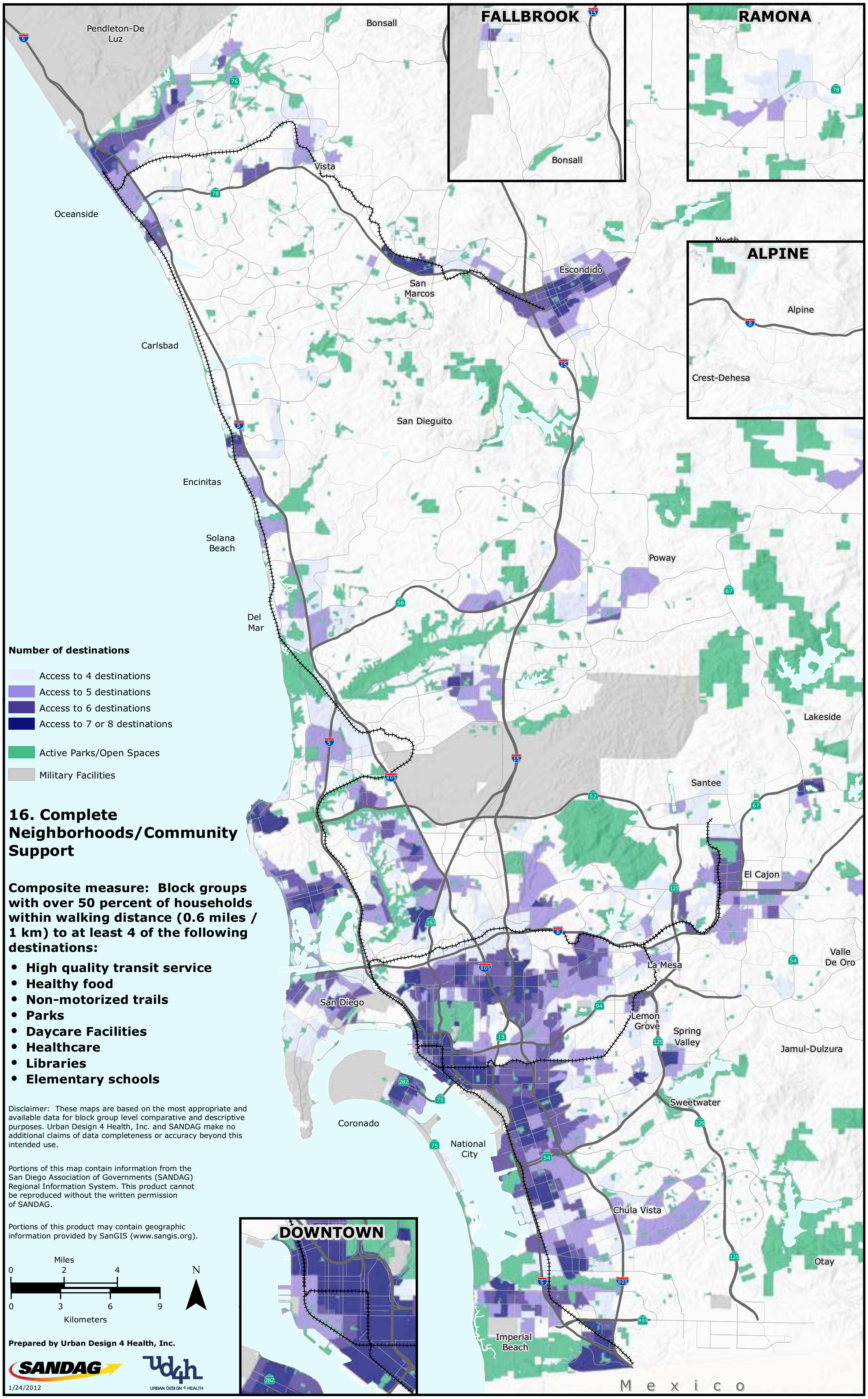
Findings

Generally, access to multiple destinations is much higher in the southern part of the urban area, reflecting the region's historical development patterns and the location of major population centers. Many of the region's smaller cities and towns are also well-served with multiple amenities and community support networks, often in or near the town centers. Few outlying areas have multiple amenities within walking distance.

Table 3.7 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. In general, there is a fair degree of overlap between the Communities of Concern and areas with substantial community support. Areas where Communities of Concern and Complete Communities do not overlap may warrant further attention in terms of investment and/or programs. This is particularly the case in the northern edge of the region, where large swaths of area are designated as Communities of Concern, without proximate access to amenities.

Table 3.7: Block groups by number of amenties

Number of Amenities	All Block Groups	Communities of Concern Block Groups
>4	912 (52%)	543 (31%)
4	258 (15%)	186 (11%)
5	297 (17%)	240 (14%)
6	189 (11%)	164 (9%)
7 or 8	106 (6%)	100 (6%)
All categories	1,762 (100%)	1,233 (70%)


16. Complete Neighborhoods/Community Support
Composite measure: Block groups with over 50 percent of households within walking distance (0.6 miles / 1 km) to at least 4 of the following destinations:
• High quality transit service
• Healthy food
• Non-motorized trails
• Parks
• Daycare Facilities
• Healthcare
• Libraries
• Elementary schools
Number of destinations
Access to 4 destinations
Access to 5 destinations
Access to 6 destinations
Access to 7 or 8 destinations
Active Parks/Open Spaces
Military Facilities
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Youth Physical Activity Support

Research has found that youth and adults respond differently to the built environment. Urban design factors that are associated with adult walking trips are less consistent predictors of walking or physical activity in youth. Apart from going to school, youth have few regular travel requirements; routine errands such as grocery shopping are not typical destinations. Other destinations, such recreation or parks, are better predictors of physical activity for youth than for adults.[20] Youth, especially young children, are also strongly impacted by their parents' perceptions and preferences.

The Youth Physical Activity Support map combines several measures associated with youth physical activity. This composite map incorporates the following base maps: Sidewalk Completeness (Map 7), Parks and Open Space Access (Map 9), Non-motorized Trails Access (Map 10), and Elementary School Access (Map 14).

To calculate each block group's composite score, the base map measures were first given a standardized value (z-score), which were then averaged together to create the final composite score. The five map categories were generated by dividing the Census block groups into five roughly equal groups (quantiles) based on their composite score. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

Findings

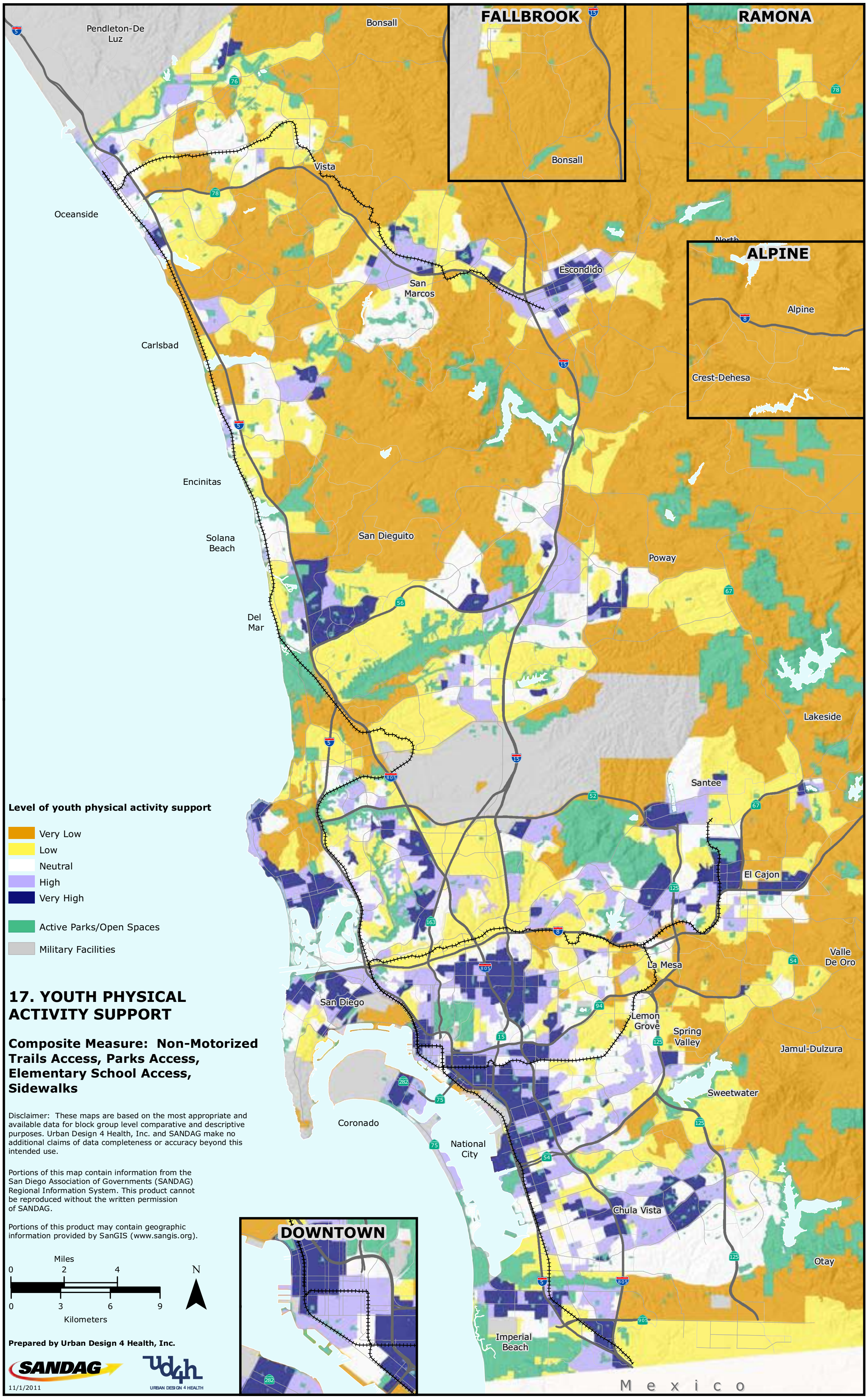
The areas most supportive of youth physical activity are largely concentrated in the southern part of the region. The component base maps all show concentrations (of sidewalks, parks and open space, elementary schools, and non-motorized trails) in the southern half, reflecting the predominant development pattern and major population concentrations. The outlying parts of the urban area generally lack support for youth physical activity, although the rural or large lot, single-family development patterns in these areas may provide opportunities for physical activity that are not reflected in this map.

Table 3.8 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. The "high" and "very high" map categories contain the most block groups with Communities of Concern.

Table 3.8: Block groups by level of youth physical activity support

Level of Support	All Block Groups	Communities of Concern Block Groups
Very High	353 (20%)	286 (16%)
High	352 (20%)	257 (15%)
Neutral	352 (20%)	248 (14%)
Low	352 (20%)	236 (13%)
Very Low	353 (20%)	206 (12%)
All categories	1,762 (100%)	1,233 (70%)

[20] Frank et al., "Urban Form Relationships with Walk Trip Frequency and Distance Among Youth"; Jacqueline Kerr et al., "Urban Form Correlates of Pedestrian Travel in Youth: Differences by Cender, Race-Ethnicity and Household Attributes," *Transportation Research Part D: Transport and Environment* 12, no. 3 (May 2007): 177–182; Susan H. Babey et al., "Physical Activity Among Adolescents. When Do Parks Matter?" *American Journal of Preventive Medicine* 34, no. 4 (April 2008): 345–8; Babey, Brown, and Hastert, *Access to Safe Parks Helps Increase Physical Activity Among Teenagers*; James N. Roemmich et al., "Association of Access to Parks and Recreational Facilities with the Physical Activity of Young Children," *Preventive Medicine* 43, no. 6 (December 2006): 437–41.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Level of youth physical activity support
Very Low
Low
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High
Very High
Active Parks/Open Spaces
Military Facilities
17. YOUTH PHYSICAL ACTIVITY SUPPORT
Composite Measure: Non-Motorized Trails Access, Parks Access, Elementary School Access, Sidewalks
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Physical Disorder and Crime

Feeling safe in one's environment reduces stress, helps preserve mental health, and increases one's comfort with moving about on foot, bicycle, or transit. Conversely, the presence or evidence of physical disorder and crime can discourage outdoor physical activity, walking and bicycling. Physical disorder, including vandalism, garbage on the streets, and large numbers of vacant parcels in a neighborhood can create an environment that is intimidating to pedestrians or bicyclists. Violent crime can similarly have a chilling effect on walking, bicycling, and other community interactions. These factors have in turn been associated with obesity[21] and decreased physical activity, particularly for women[22] and children.[23] In addition to objective measures of physical disorder and crime, *perceptions* of safety and security can have a bearing on physical health.[24]

About the Maps

The Physical Disorder and Crime maps were developed using data from the Automated Regional Justice Information System (ARJIS). The following categories of crime were used in the analysis:

- Vandalism and malicious mischief—both crimes of property destruction—were used as indicators of physical disorder.
- Robbery, homicide, rape, simple assault and aggravated assault were used as indicators of violent crime.

The arrest data used in the Violent Crime and Physical Disorder maps span a three-year period (2007-2010), with arrest locations reported at the 100-address level in order to anonymize the data. For this analysis, arrest locations were further aggregated to the Census block group level. These data reflect the location of arrest *reports*, which are frequently—but not always—the location of the actual arrests. Where multiple charges resulted from a single arrest, data only exists for the most severe criminal charge. For each type of crime, the crime rate is calculated as the yearly average crime rate per 1,000 residents.

The Physical Disorder and Violent Crime maps present crime rates according to eight groupings (quantiles). Each quantile contains a roughly equal number of block groups. For clarity in presentation, divisions between quantiles have been rounded, which causes a slight shift in the number of block groups in each quantile.

The Vacant Parcels map reports vacant and undeveloped parcels as a percentage per block group. Individual vacant parcels were identified using 2010 parcel and land use data produced by SANDAG. The Vacant Parcels map presents data using manually created classes in order to reveal variation that is otherwise hidden by a skewed data distribution. In this data, more than 90 percent of block groups contain very few vacant parcels, while a small number of the remaining block groups have very high numbers of vacant parcels. One limitation in this dataset is that SANDAG's land use classifications do not differentiate between vacant (undeveloped land within the urban area) and undeveloped (undeveloped land within the rural area). Vacant land in urban areas is more strongly associated with physical disorder than undeveloped rural land. It is therefore likely that this map has the effect of overestimating the potential impact to physical activity in rural areas.

Findings

Figures 3.10, 3.11, and 3.12 show the distribution of Census block groups according to the percentage of parcels that are vacant, rates of physical disorder, and rates of violent crime. Examining these figures, along with the maps, show a clearly discernible regional-scale pattern of physical disorder and crime. Even expressed as a rate (per 1,000 people), urban areas appear to attract a disproportionate amount of vandalism and malicious mischief. The same pattern is evident for violent crime, which is also disproportionately borne by urban areas. While this result is consistent with intuition, these maps may overstate the effect. Downtown areas have large daytime populations that are not reflected in residential Census numbers. Therefore, crime rates calculated using Census population figures will be inflated in large commercial areas and job centers.

In contrast to physical disorder and crime, vacant parcels are slightly more distributed across the region, although this is to some extent due to the inclusion of undeveloped rural parcels in the analysis. The majority of the region has very low vacancy rates, with the lowest vacancy areas tending to concentrate along the highway network. In some instances, there is dramatic variation between even adjacent block groups. For example, in the downtown San Diego inset, some of the lowest vacancy rates are found immediately adjacent to block groups with high vacancy rates. In a fully developed urban setting such as the downtown, this likely reflects strong location preferences. In outlying areas, the same spatial phenomena may be caused by new development patterns. Nearly thirty percent of block groups have no vacant parcels at all.

Figures 3.10, 3.11, and 3.12 also show the distribution of block groups containing one or more Communities of Concern. In this series of maps, the distribution of Communities of Concern block groups generally mirrors the over-all regional distribution.

Although the maps show only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region.

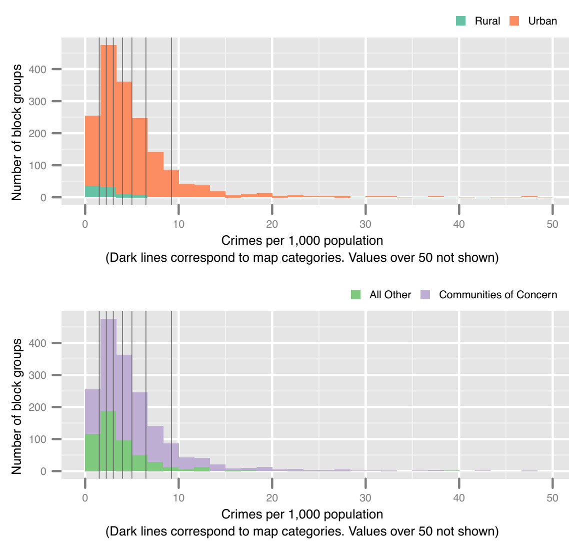


Figure 3.10: Block groups by rates of physical disorder

[21] Anne Ellaway, Sally Macintyre, and Xavier Bonnefoy, "Graffiti, Greenery, and Obesity in Adults: Secondary Analysis of European Cross Sectional Survey," *BMJ (Clinical research ed.)* 331, no. 7517 (September 2005): 611–612; Thomas A. Glass, Meghan D. Rasmussen, and Brian S. Schwartz, "Neighborhoods and obesity in older adults: the Baltimore Memory Study.," *American journal of preventive medicine* 31, no. 6 (December 2006): 455–63; T. K. Boehmer et al., "Perceived and Observed Neighborhood Indicators of Obesity Among Urban Adults.," *International Journal of Obesity* 31, no. 6 (June 2007): 968–77; Wouter Poortinga, "Perceptions of the Environment, Physical Activity, and Obesity," *Social Science & Medicine* 63, no. 11 (December 2006): 2835–46.

[22] Lee R. Mobley et al., "Environment, Obesity, and Cardiovascular Disease Risk in Low-Income Women," *American journal of preventive medicine* 30, no. 4 (April 2006): 327–332; Amy A. Eyler et al., "Quantitative Study of Correlates of Physical Activity in Women From Diverse Racial/Ethnic Groups: The Women's Cardiovascular Health Network Project Summary and Conclusions," *American Journal of Preventive Medicine* 25, no. 3 (October 2003): 93–103.

[23] Julie C. Lumeng et al., "Neighborhood Safety and Overweight Status in Children," *Archives of Pediatrics & Adolescent Medicine* 160, no. 1 (January 2006): 25–31.

[24] Gary W. Evans, "The Built Environment and Mental Health" [in English], *Journal of urban health: bulletin of the New York Academy of Medicine* 80, no. 4 (2003): 536–55.

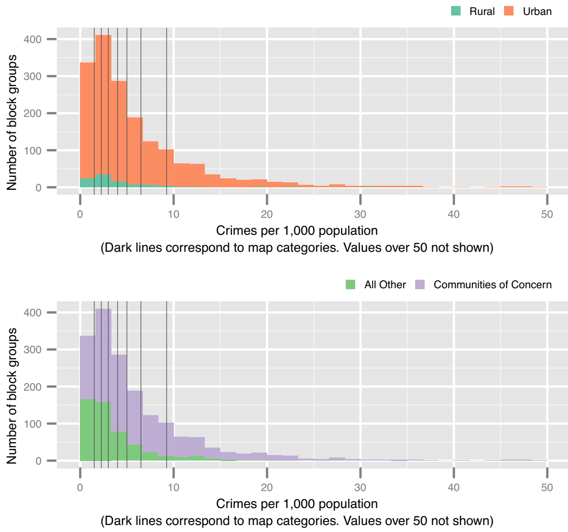


Figure 3.11: Block groups by rates of violent crime

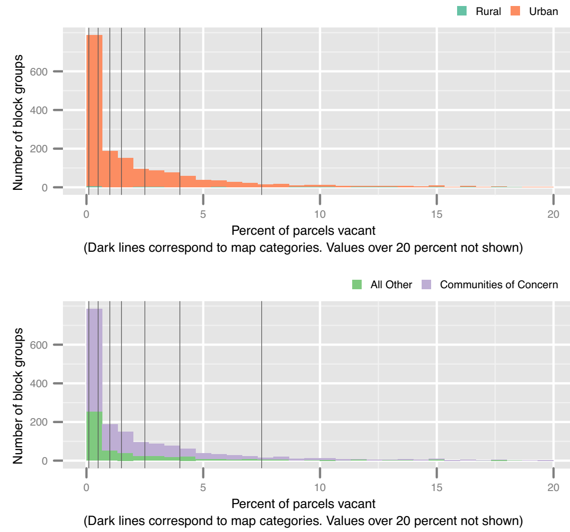
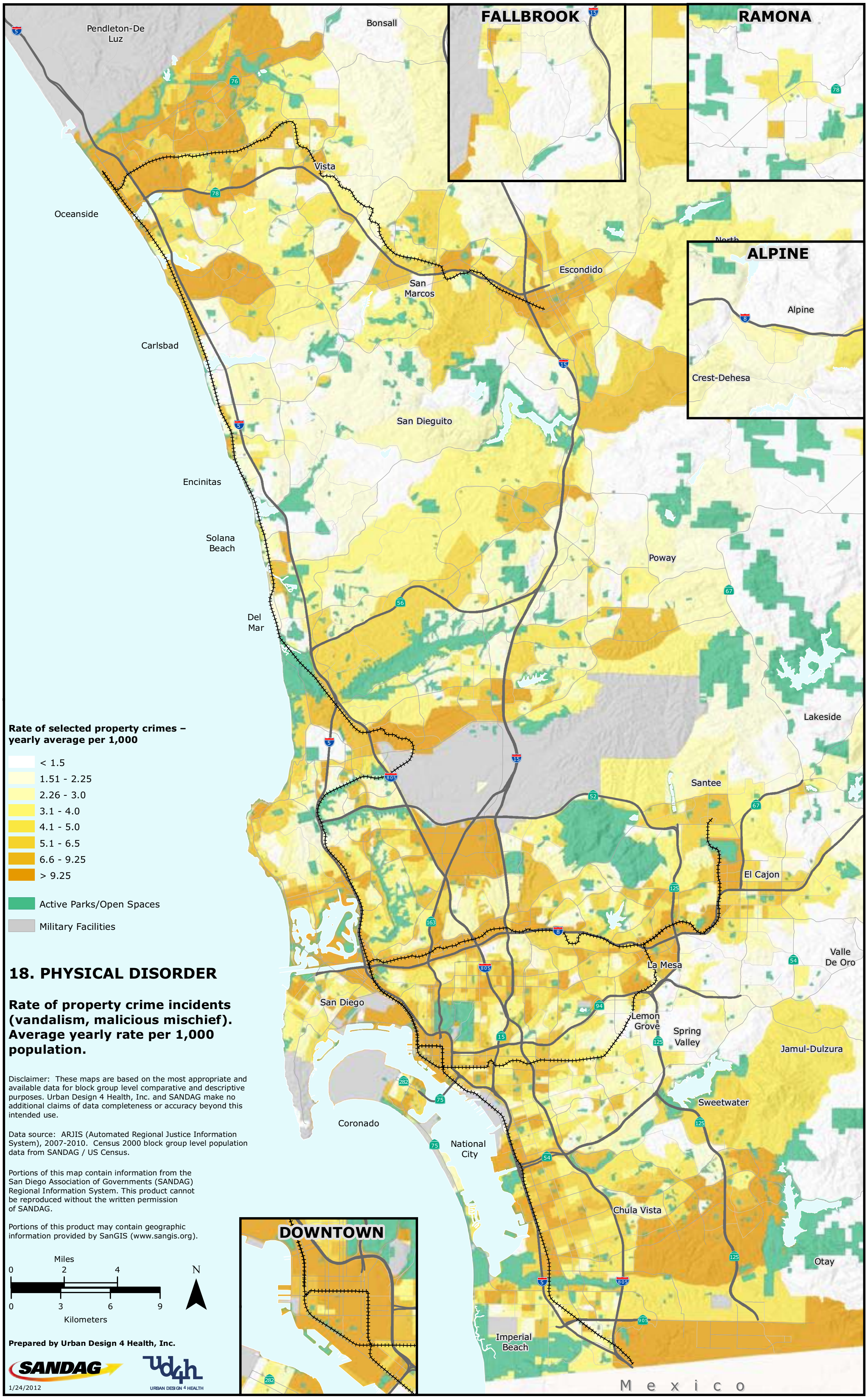


Figure 3.12: Block groups by percentage of vacant parcels



18. PHYSICAL DISORDER

Rate of property crime incidents (vandalism, malicious mischief). Average yearly rate per 1,000 population.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: ARJIS (Automated Regional Justice Information System), 2007-2010. Census 2000 block group level population data from SANDAG / US Census.

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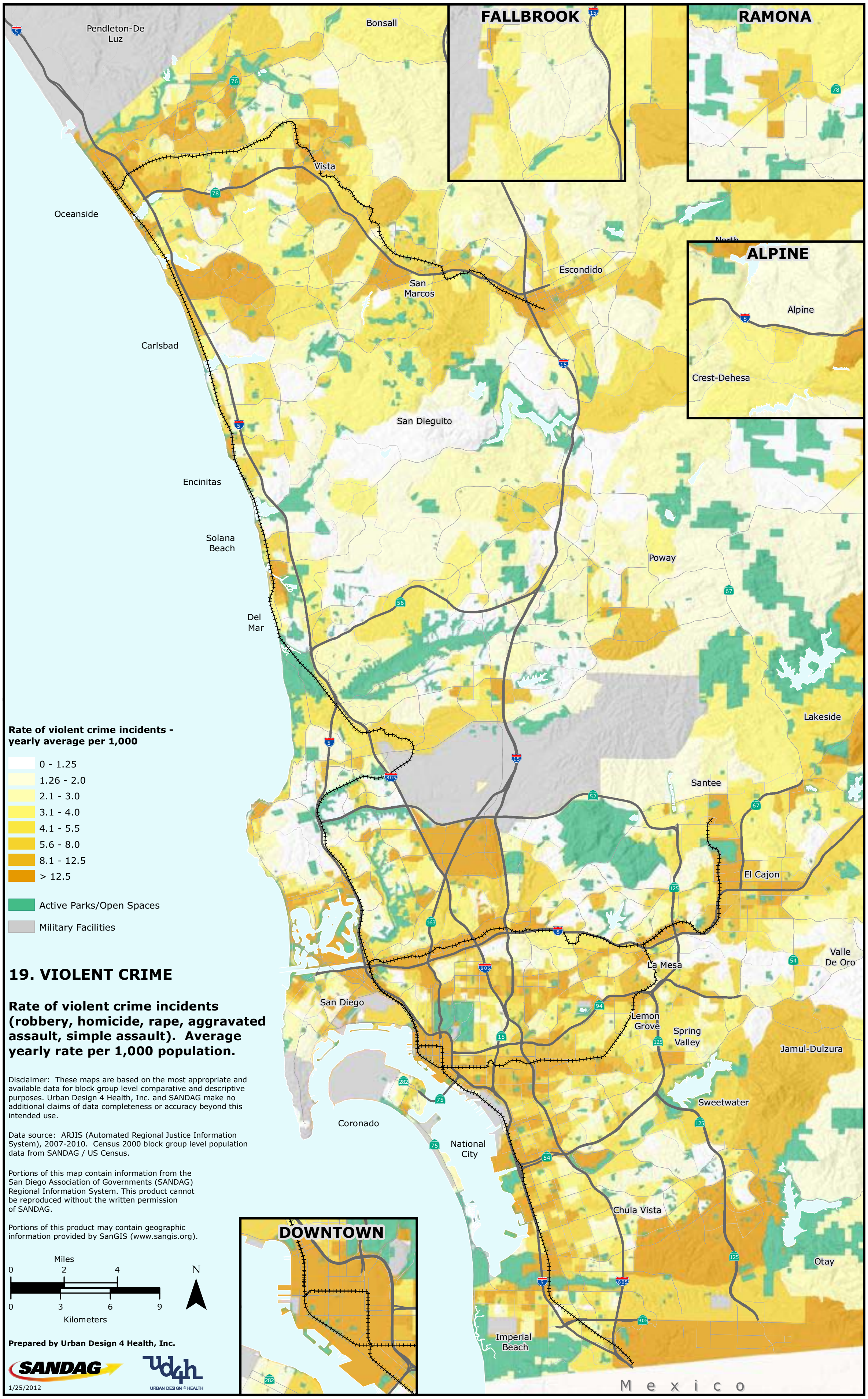

19. VIOLENT CRIME

Rate of violent crime incidents (robbery, homicide, rape, aggravated assault, simple assault). Average yearly rate per 1,000 population.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: ARJIS (Automated Regional Justice Information System), 2007-2010. Census 2000 block group level population data from SANDAG / US Census.

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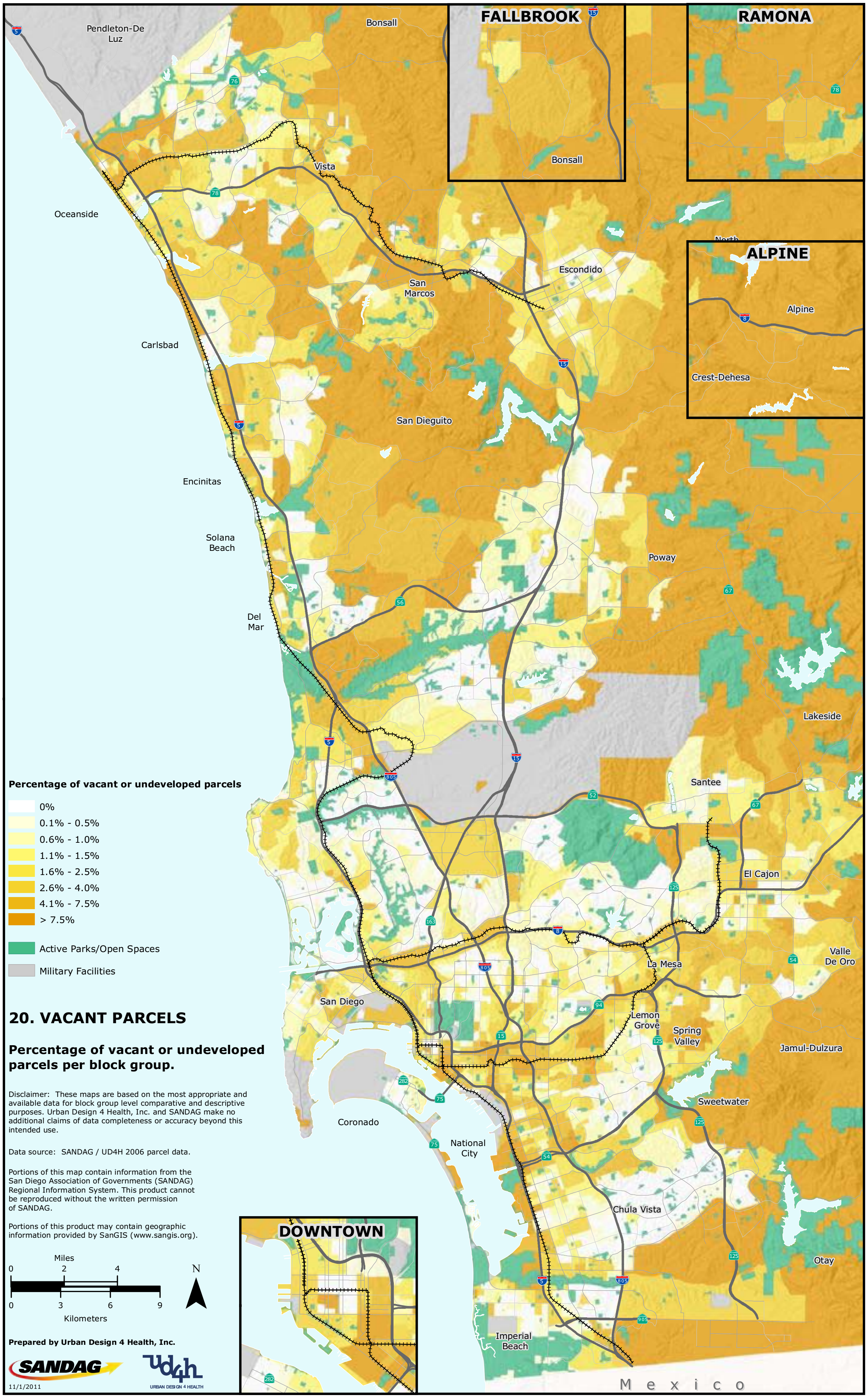

20. VACANT PARCELS

Percentage of vacant or undeveloped parcels per block group.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: SANDAG / UD4H 2006 parcel data.

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Road Design

Heavy traffic and road designs that emphasize vehicle throughput at the expense of other travel modes can compromise safety for cyclists and pedestrians, thereby discouraging walking and bicycling. Although many factors influence whether a road is safe—or is perceived to be safe—for pedestrians and cyclists, several key variables have been identified in the research. Traffic volumes are consistently associated with collision frequency, because an increase in the number of cars moving through an area increases the number of potential conflicts that occur.[25] Road width and road type are also associated with higher pedestrian crash rates. Wide arterial roads encourage higher motor vehicle speeds and increase crossing distances, and have been correlated to increased crashes.[26] Such roads are also often *perceived* to be unsafe or unpleasant by pedestrians and cyclists, and studies have shown that these perceptions translate into behavior, discouraging active transportation.[27]

About the Maps

This set of maps presents two road design measures: Arterial Density (Map 21) and Traffic Volume Density (Map 22). Both measures are divided by the block group area in order to normalize what would otherwise be a large difference between large (rural) and small (urban) block groups.

The Traffic Volume Density map was created using 2008 traffic volume data generated by the SANDAG regional travel model. To calculate the traffic volume density, first an estimate of each block group's total average daily vehicle miles traveled (VMT) was created by multiplying the block group's average roadway link volume by the length of roadway in that block group. Then, the estimate of vehicle miles traveled (VMT) for each block group was divided by the block group's area, resulting in the final traffic volume density. This formula is as follows:

$$Density_v = \frac{avg.\ daily\ link\ volume * centerline\ road\ miles}{block\ group\ area}$$

The Arterial Density map uses 2006 road data from SANDAG to identify all roads classified as arterials. To calculate arterial density, the total length of arterials in each block group is divided by the area of the block group. This formula is as follows:

$$Density_a = \frac{total\ arterial\ centerline\ miles}{block\ group\ area}$$

These maps present the road design measures according to eight groupings with roughly equal numbers of block groups in each grouping (quantiles). For clarity in presentation, the quantile cut points have been rounded, which causes a small shift in the number of block groups per class.

Findings

Both maps reveal a similar pattern, with concentrations of arterials and traffic volumes along the region's major roadway network. In some cases, there are highly visible high arterial / traffic volume corridors that emerge: from the City of Escondido to the City of San Marcos to the City of Carlsbad, and from the City of San Marcos to the City of Vista. Block groups with lower levels of arterial and traffic volume density are found in urban (parts of Mid-City), suburban (La Mesa, Spring Valley, Lemon Grove), and rural areas (Alpine), as well as along much of the shoreline.

Figures 3.13 and 3.14 show the distribution of Census block groups according to traffic volume density and arterial density. Figures 3.13 and 3.14 also show the distribution of block groups containing one or more Communities of Concern. Although there is a large degree of overlap between the Communities of Concern block groups and the rest of the region, the number of block groups designated Communities of Concern generally increases along with arterial and traffic volume density. This phenomenon may warrant closer investigation to determine whether particular populations are being burdened by traffic impacts.

Note that the map shows only the western third of the region, however the analysis was based on all 1,762 block groups in the San Diego region.

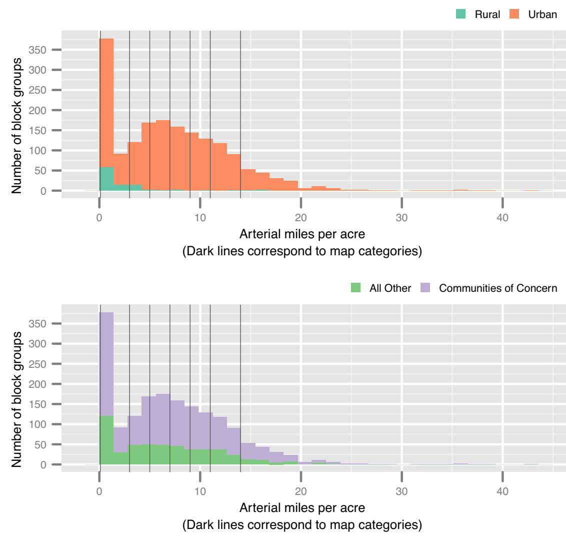


Figure 3.13: Block groups by arterial density

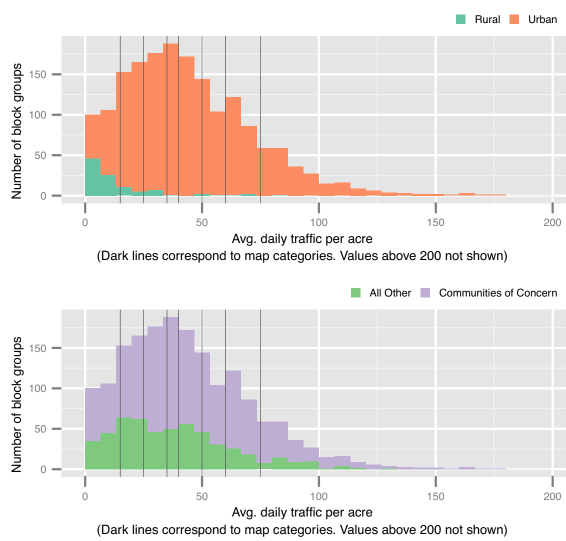
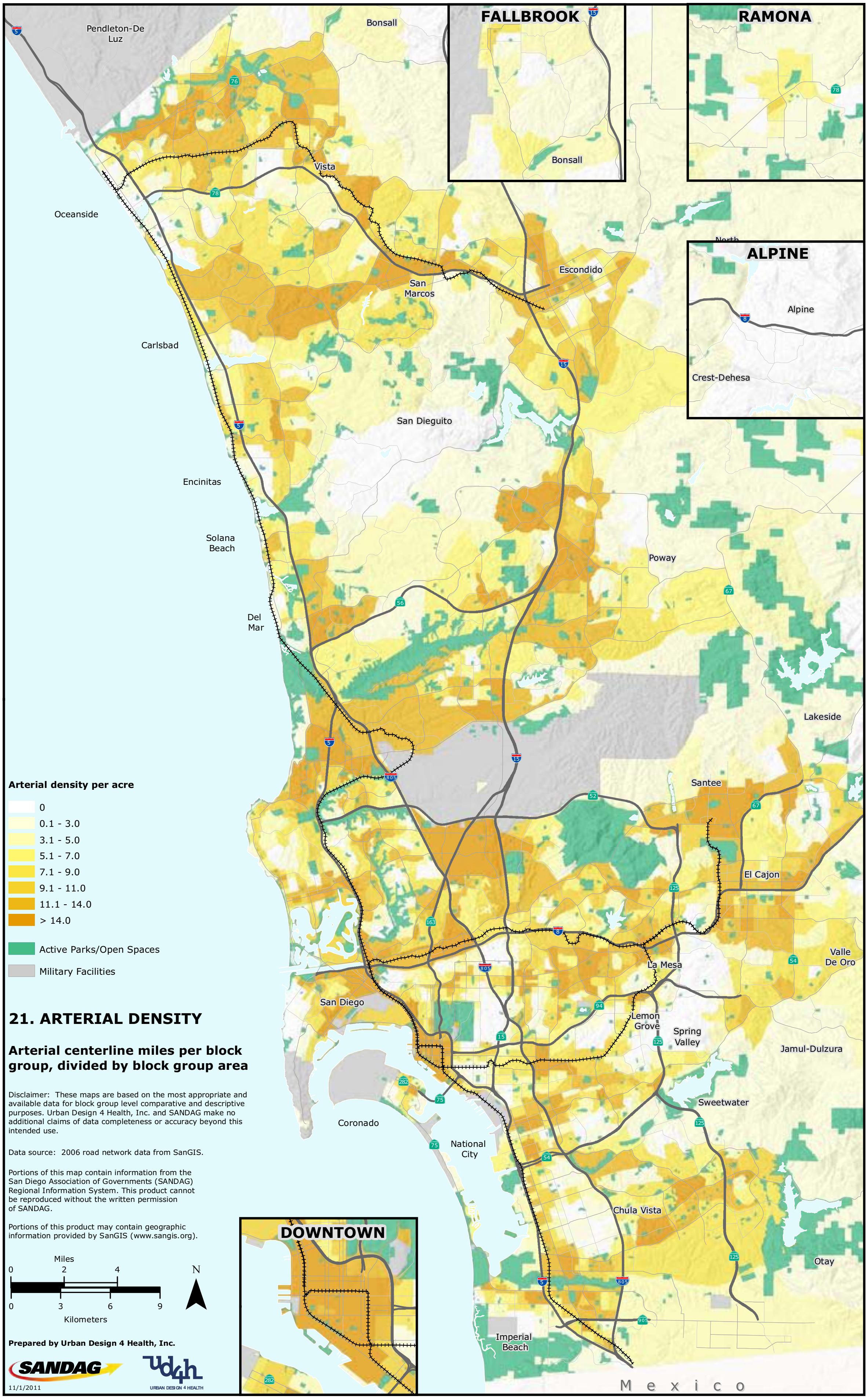


Figure 3.14: Block groups by traffic volume density

[25] Elizabeth A. LaScala, Daniel Gerber, and Paul J. Gruenewald, "Demographic and Environmental Correlates of Pedestrian Injury Collisions: A Spatial Analysis," *Accident Analysis & Prevention* 32, no. 5 (September 2000): 651–8; I. Roberts et al., "Effect of Environmental Factors on Risk of Injury of Child Pedestrians by Motor Vehicles: A Case-Control Study," *BMJ* 310, no. 6972 (1995): 91–94.

[26] Peter Swift, *Residential Street Typology and Injury Accident Frequency* (Swift / Associates, 1998); Per E. Gå rder, "The Impact of Speed and Other Variables on Pedestrian Safety in Maine," *Accident Analysis & Prevention* 36, no. 4 (July 2004): 533–42; Megan Wier et al., "An Area-Level Model of Vehicle-Pedestrian Injury Collisions with Implications for Land Use and Transportation Planning," *Accident Analysis & Prevention* 41, no. 1 (January 2009): 137–45.

[27] Boehmer et al., "Perceived and Observed Neighborhood Indicators of Obesity Among Urban Adults."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San Diego
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National City
Sweetwater
Chula Vista
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Imperial Beach
Alpine
Crest-Dehesa
Mexico
Arterial density per acre
0
0.1 - 3.0
3.1 - 5.0
5.1 - 7.0
7.1 - 9.0
9.1 - 11.0
11.1 - 14.0
> 14.0
Active Parks/Open Spaces
Military Facilities
21. ARTERIAL DENSITY
Arterial centerline miles per block group, divided by block group area
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: 2006 road network data from SanGIS.
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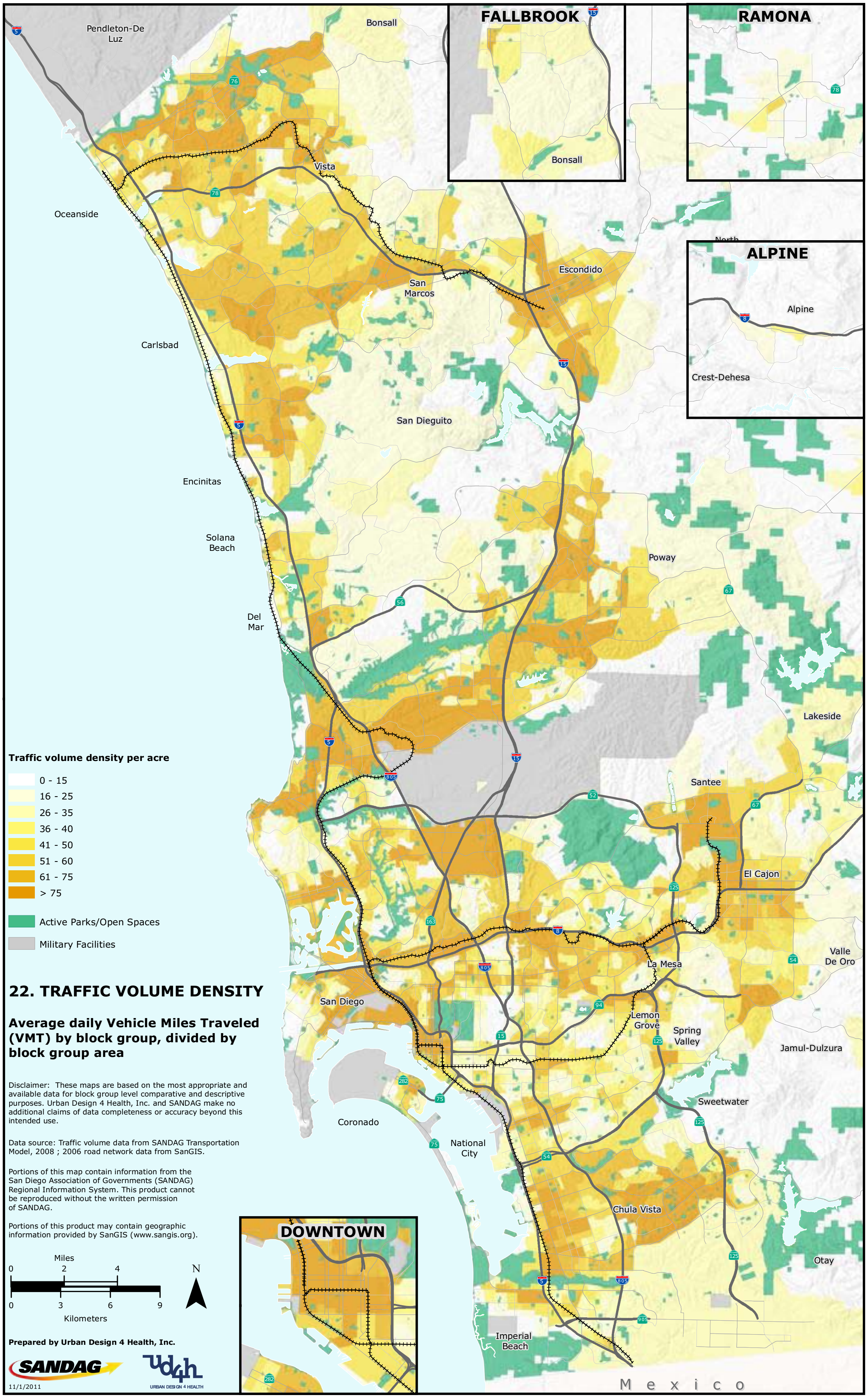
22. TRAFFIC VOLUME DENSITY
Average daily Vehicle Miles Traveled (VMT) by block group, divided by block group area
Traffic volume density per acre
0 - 15
16 - 25
26 - 35
36 - 40
41 - 50
51 - 60
61 - 75
> 75
Active Parks/Open Spaces
Military Facilities
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: Traffic volume data from SANDAG Transportation Model, 2008 ; 2006 road network data from SanGIS.
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Mexico

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Physical Activity Inhibitors

Crime, traffic danger, and the perception thereof have been found to be deterrents to outdoor physical activity and walking.[28] This composite map combines information from the following base maps to examine the region for the presence of physical activity inhibitors: Physical Disorder (Map 18), Violent Crime (Map 19), Arterial Density (Map 21), Traffic Volume Density (Map 22), and Vacant Parcels (Map 20).

To calculate the composite score, each of the base map measures was first given a standardized value (z-score). The final composite score is the average of the base map z-scores. To create the five categories, the Census block groups were separated into five roughly equal groups (quantiles) based on their composite score. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

Findings

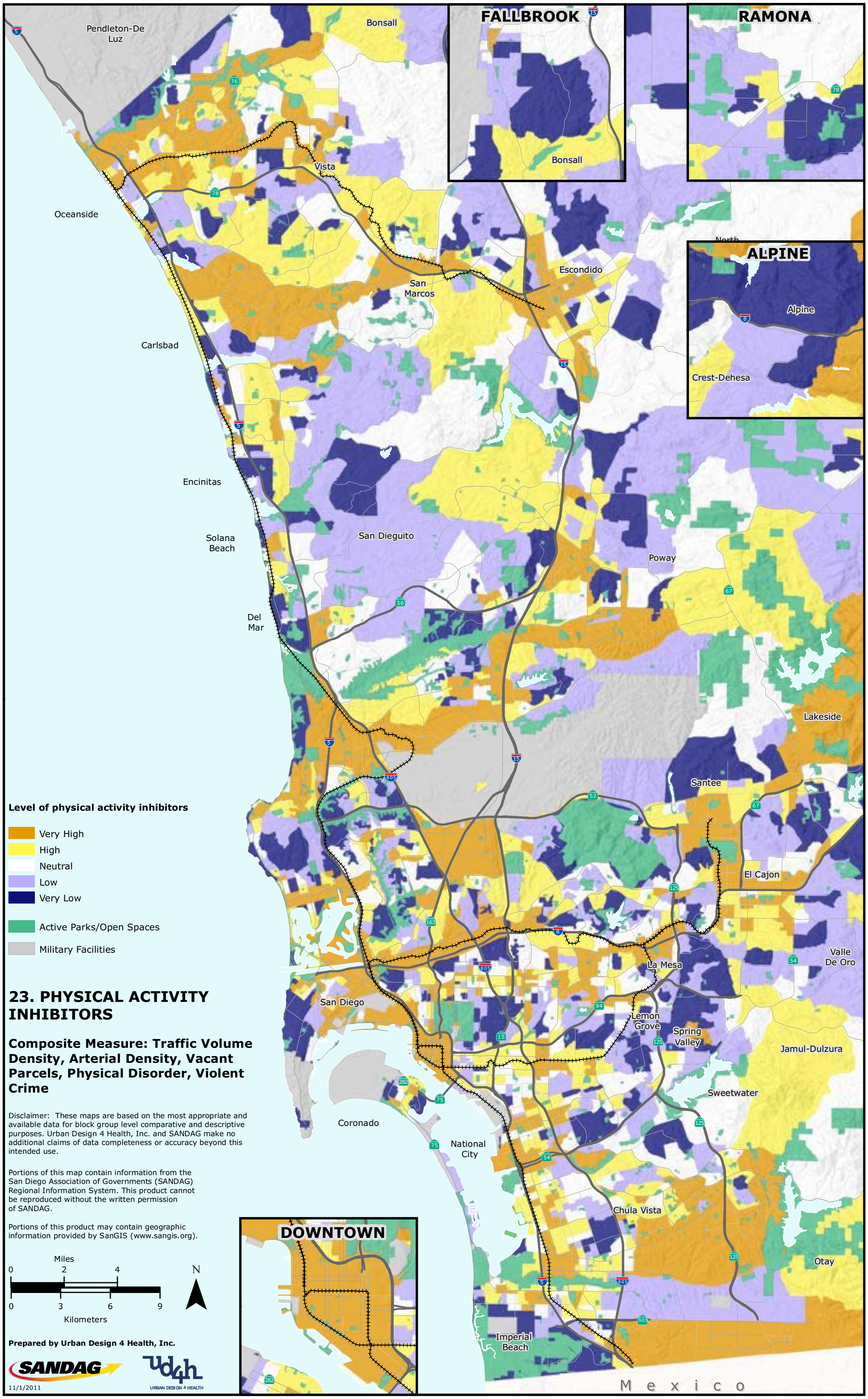
Although some areas of concentration exist, physical activity inhibitors are distributed rather evenly, with block groups characterized as "high" and "low" found in all parts of the region. Concentrations of inhibitors are most clearly seen in and along major transportation corridors. This is partially due to the large amount of spatial convergence between two of the component base maps—Arterial Density and Traffic Volume Density. The Physical Disorder and Violent Crime base maps also concentrate to a lesser degree along the region's transportation corridors.

Table 3.9 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. More Communities of Concern overlap with the "low" and "very low" map categories, and in higher proportions. This indicates that barriers to physical activity may actually be less of a problem for some Communities of Concern; however, these dynamics (and areas where physical activity barriers are present) should be examined in more detail before drawing conclusions.

Table 3.9: Block groups by level of physical activity inhibitors

Level of Physical Activity Inhibitors	All Block Groups	Communities of Concern Block Groups
Very High	353 (20%)	215 (12%)
High	352 (20%)	221 (13%)
Neutral	352 (20%)	248 (14%)
Low	352 (20%)	265 (15%)
Very Low	353 (20%)	284 (16%)
All categories	1,762 (100%)	1,233 (70%)

[28]Susan Duncan et al., "Neighborhood Physical Activity Opportunity: A Multilevel Contextual Model," *Research Quarterly for Exercise & Sport* 73, no. 4 (2002); Saelens et al., "Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation"; James F. Sallis et al., "Assessing Perceived Physical Environmental Variables That May Influence Physical Activity," *Research quarterly for exercise and sport* 68, no. 4 (1997); Catherine E. Ross and John Mirowsky, "Neighborhood Disadvantage, Disorder, and Health," *Journal of Health and Social Behavior* 42, no. 3 (2001): 258–276.



23. PHYSICAL ACTIVITY INHIBITORS

Composite Measure: Traffic Volume Density, Arterial Density, Vacant Parcels, Physical Disorder, Violent Crime

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Chapter 4

Injury Prevention

The built environment influences traffic safety in a number of ways. Wide roads that are designed to move vehicles as efficiently as possible can result in more frequent and more severe collisions between motor vehicles and non-motorized users. Large scale, visually homogenous street surroundings such as bare building walls and parking lots further decrease safety by encouraging speed and driver inattentiveness. The rarity of bicyclists and pedestrians on these streets increases the risk for the remainder who do choose to walk or bicycle, as auto-oriented street designs send a message that some streets are only for cars. This section seeks to identify areas of the region with high concentrations of pedestrian / cyclist injuries from traffic, areas where there may be a high risk for these users, and the places that may need investment or enforcement.

Topics discussed in this section include:

- Traffic Safety: pedestrian and cyclist crash locations and crash rate
- Pedestrian Traffic Safety
- Cyclist Traffic Safety
- Traffic Safety for Youth

Traffic Crashes

Vehicle collisions with pedestrians and cyclists are a serious health threat, as they often result in injury or death. Traffic crashes also carry additional health risks beyond physical injury, as even the perception of danger from traffic can deter walking, cycling, and other physical activity,[1] especially for young children[2] and the elderly.

About the Maps

The four maps in this section report crashes for the following:

- Pedestrian-Involved Motor Vehicle Crashes (1998–2007)
- Cyclist-Involved Motor Vehicle Crashes (1998–2007)
- Pedestrian Crash Rate (average yearly rate, 1998–2007)
- Cyclist Crash Rate (average yearly rate, 1998–2007)

These maps were developed using data from the Statewide Traffic Reporting System (SWTRS) for the period 1998–2007. Only collisions involving cyclists or pedestrians were included in the maps.

The maps illustrate two ways to examine traffic safety risk in the region. The crash location maps show the location and number of crashes between vehicles and pedestrians, and between vehicles and bicycles, as a density plot in which each crash is represented as a point. This simple visualization shows where clusters of accidents have occurred during the ten-year period. These crash location plots are useful for identifying "hot spots," however, they hide some of the factors that may lead to more crashes in a given area—an area might have more total crashes just because there is more pedestrian or cyclist activity there. The crash rate maps adjust for these factors by normalizing the total number of crashes by population. The total number of crashes per Census block group was divided by ten (the number of years of available data) in order to derive an annual average. Dividing the annual average by population yields a per-capita yearly rate, which is then multiplied by 1,000.

In some areas of the region (particularly in downtown San Diego), the residential population is much smaller than the daytime population, which would result in an overstatement of the crash rate in these areas. To help correct for this, the crash rates were calculated using SANDAG's daytime population estimates rather than Census residential population counts. Daytime populations account for employment, schools, hospitals, and other centers of daytime activity, when the majority of pedestrian activity occurs.

The crash rate maps present rates divided into eight groupings, with a roughly equal number of block groups in each grouping (quantiles). For clarity in presentation, quantile cut points have been rounded, which causes a small shift in the number of block groups per quantile.

Findings

Over the last ten years the San Diego region has seen an average of over 1,000 pedestrian crashes and 800 cyclist crashes per year (see Table 4.1).

Table 4.1: Yearly average crashes involving pedestrians and bicyclists, 1998-2007

	Pedestrian	Cyclist	Total
Yearly Average Crashes	1,079	831	1910
Yearly Average Fatalities	64	8	72

Figures 4.1 and 4.2 below summarize the distribution of block groups according to pedestrian- and bicycle-involved crash rates. High crash rates were observed throughout the region, with some concentration in downtown San Diego. This result is intuitive, as there is both more pedestrian traffic and more motor vehicle traffic in downtown San Diego. High crash rates were also found in the centers of other cities throughout the region, and along highway corridors. Cyclist crash rates were only slightly lower than pedestrian crash rates, with high rates occurring in roughly the same areas.

While these maps show where crashes have historically occurred, and where potential exposures are high, historical crash numbers are not necessarily predictive of future crash patterns. Relying solely on crash clusters to make judgments about investment, enforcement, or policy may ignore other places where dangerous conditions have not previously resulted in crashes. Furthermore, solely targeting hot spots may be less effective than systemic or area-wide strategies for crash reduction.

Figures 4.1 and 4.2 also show the distribution of block groups containing one or more Communities of Concern. The distribution of Communities of Concern largely mirrors that of the region as a whole, however there is noticeable overlap with the Communities of Concern in areas where crash rates are highest. Although the map shows only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region.

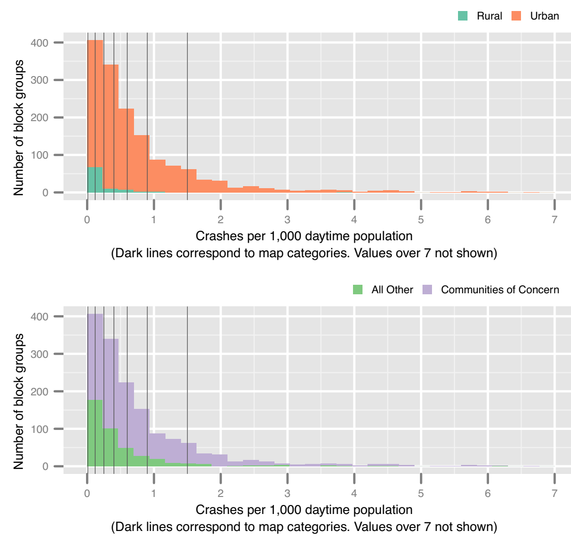


Figure 4.1: Block groups by pedestrian-involved crash rate

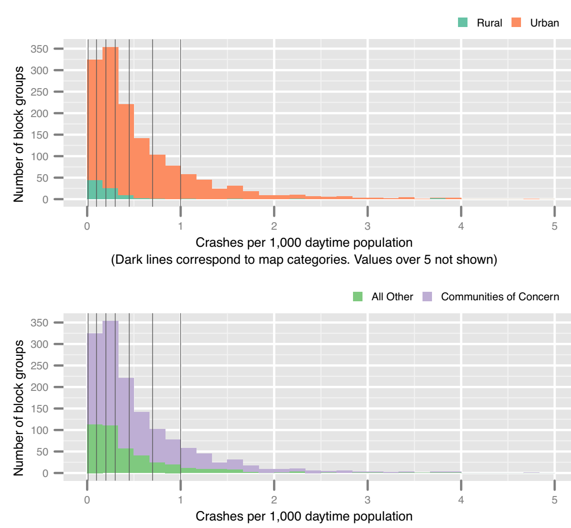
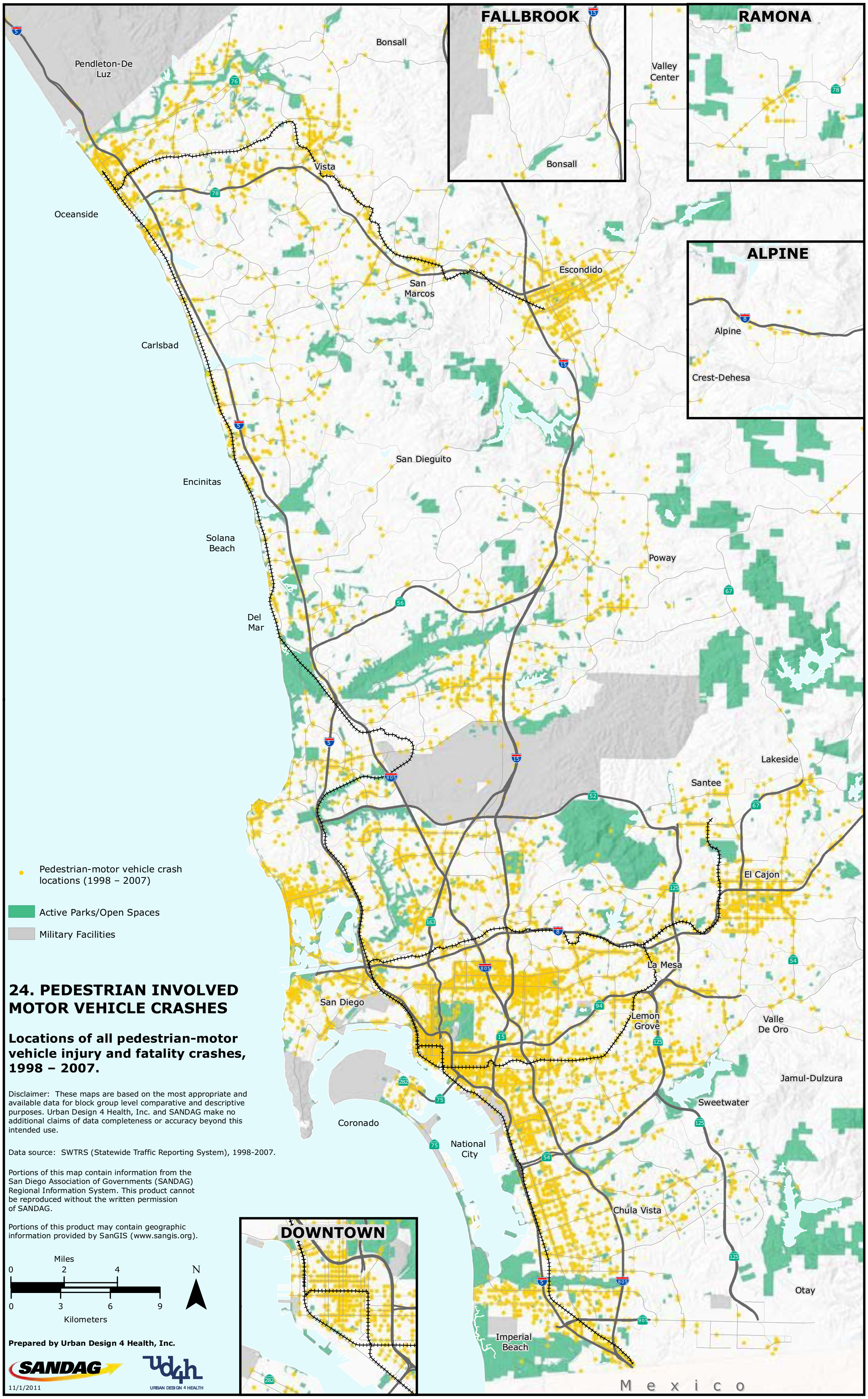


Figure 4.2: Block groups by bicycle-involved crash rate

[1]Mitch J. Duncan, John C. Spence, and W. Kerry Mummery, "Perceived Environment and Physical Activity: A Meta-Analysis of Selected Environmental Characteristics," *The International Journal of Behavioral Nutrition and Physical Activity* 2 (September 2005): 11.

[2]Anna Timperio et al., "Perceptions of Local Neighbourhood Environments and Their Relationship to Childhood Overweight and Obesity," *International Journal of Obesity* 29, no. 2 (February 2005): 170–5; World Health Organization, *Transport, Environment, and Health*, ed. Carlos Dora and Margaret Phillips (Copenhagen: WHO Regional Office Europe, 2000); Noreen C. McDonald, "Exploratory Analysis of Children's Travel Patterns," *Transportation Research Record: Journal of the Transportation Research Board* 1977 (January 2006): 1–7.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Mexico
Pedestrian-motor vehicle crash locations (1998 – 2007)
Active Parks/Open Spaces
Military Facilities
24. PEDESTRIAN INVOLVED MOTOR VEHICLE CRASHES
Locations of all pedestrian-motor vehicle injury and fatality crashes, 1998 – 2007.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SWTRS (Statewide Traffic Reporting System), 1998-2007.
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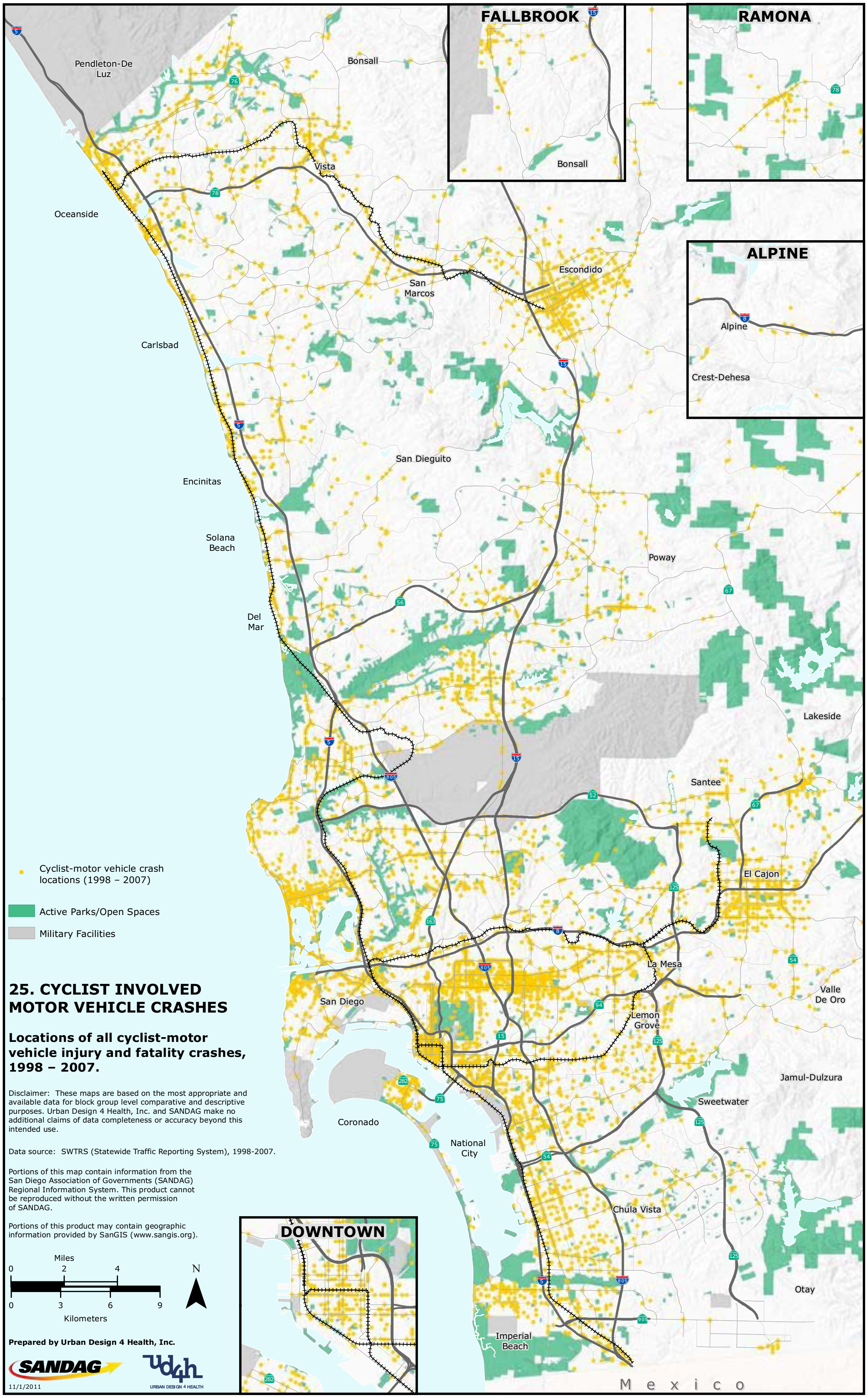
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Cyclist-motor vehicle crash locations (1998 – 2007)
Active Parks/Open Spaces
Military Facilities
25. CYCLIST INVOLVED MOTOR VEHICLE CRASHES
Locations of all cyclist-motor vehicle injury and fatality crashes, 1998 – 2007.
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: SWTRS (Statewide Traffic Reporting System), 1998-2007.
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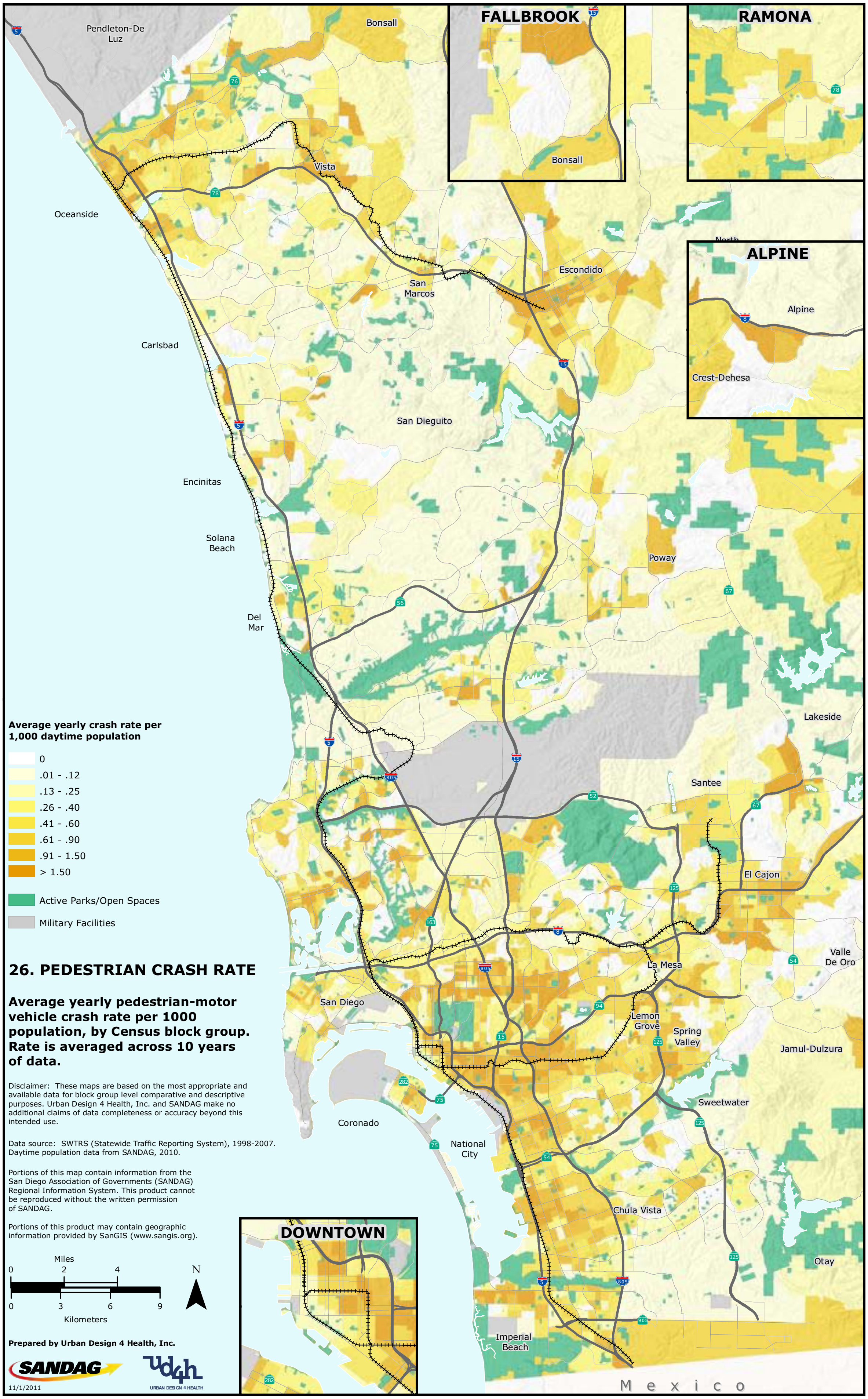

26. PEDESTRIAN CRASH RATE

Average yearly pedestrian-motor vehicle crash rate per 1000 population, by Census block group. Rate is averaged across 10 years of data.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: SWTRS (Statewide Traffic Reporting System), 1998-2007. Daytime population data from SANDAG, 2010.

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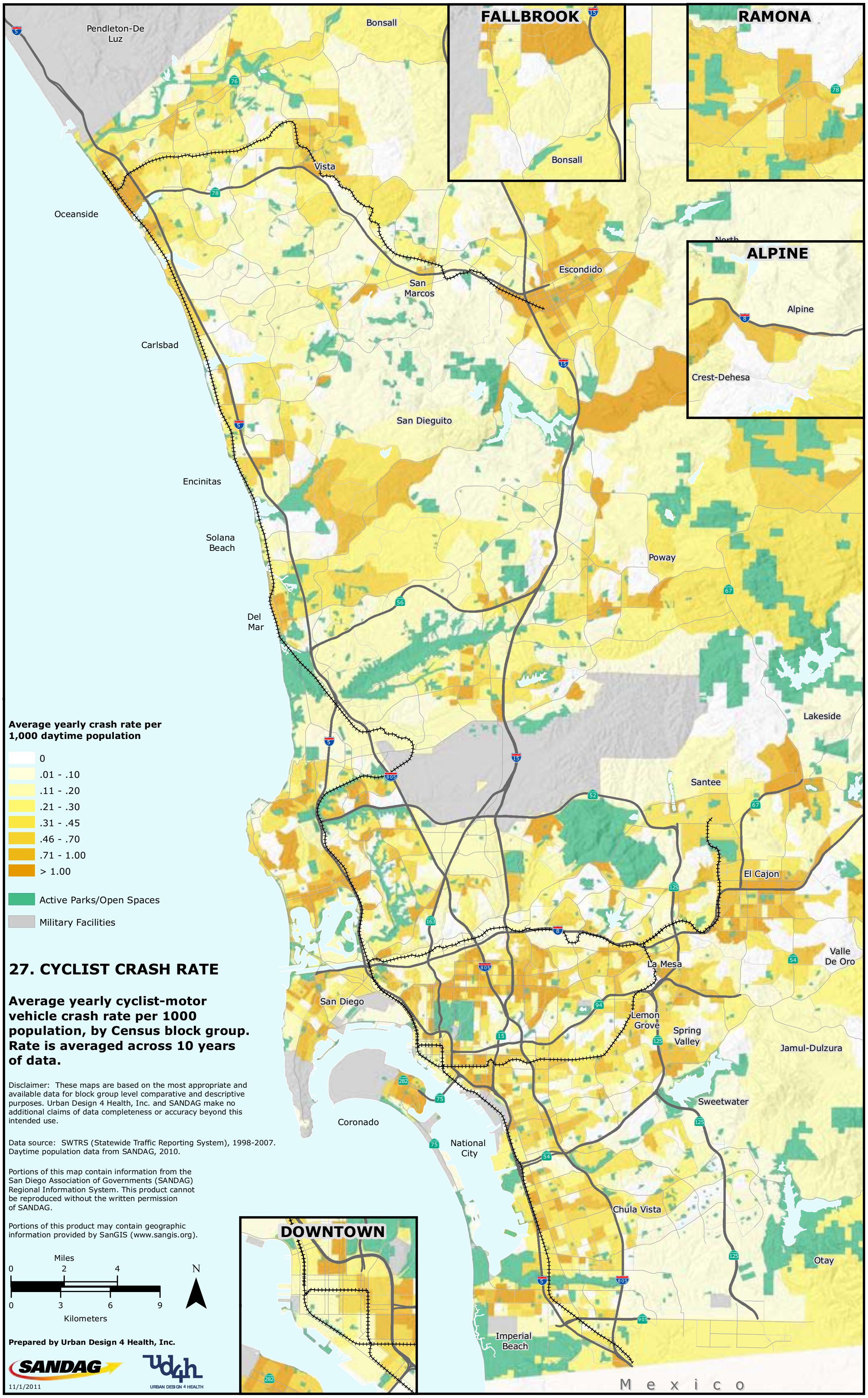

27. CYCLIST CRASH RATE

Average yearly cyclist-motor vehicle crash rate per 1000 population, by Census block group. Rate is averaged across 10 years of data.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: SWTRS (Statewide Traffic Reporting System), 1998-2007. Daytime population data from SANDAG, 2010.

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Pedestrian Traffic Safety

This composite map combines factors from several measures in order to identify block groups with high potential risk for pedestrian injury. The base maps incorporated into this composite map include: Sidewalk Completeness, (Map 7), Arterial Density (Map 21), Traffic Volume Density (Map 22) and Pedestrian Crash Rate (Map 26).

To calculate the composite score, each of the base map measures was first given a standardized value (z-score). The final composite score is the average of the base map z-scores. To create the five categories, the Census block groups were separated into five roughly equal groups (quantiles) based on their composite score. In these maps, better sidewalk coverage contributes positively to pedestrian safety. Conversely, high pedestrian crash rates, traffic volumes, and arterial densities decrease the pedestrian safety score. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

Findings

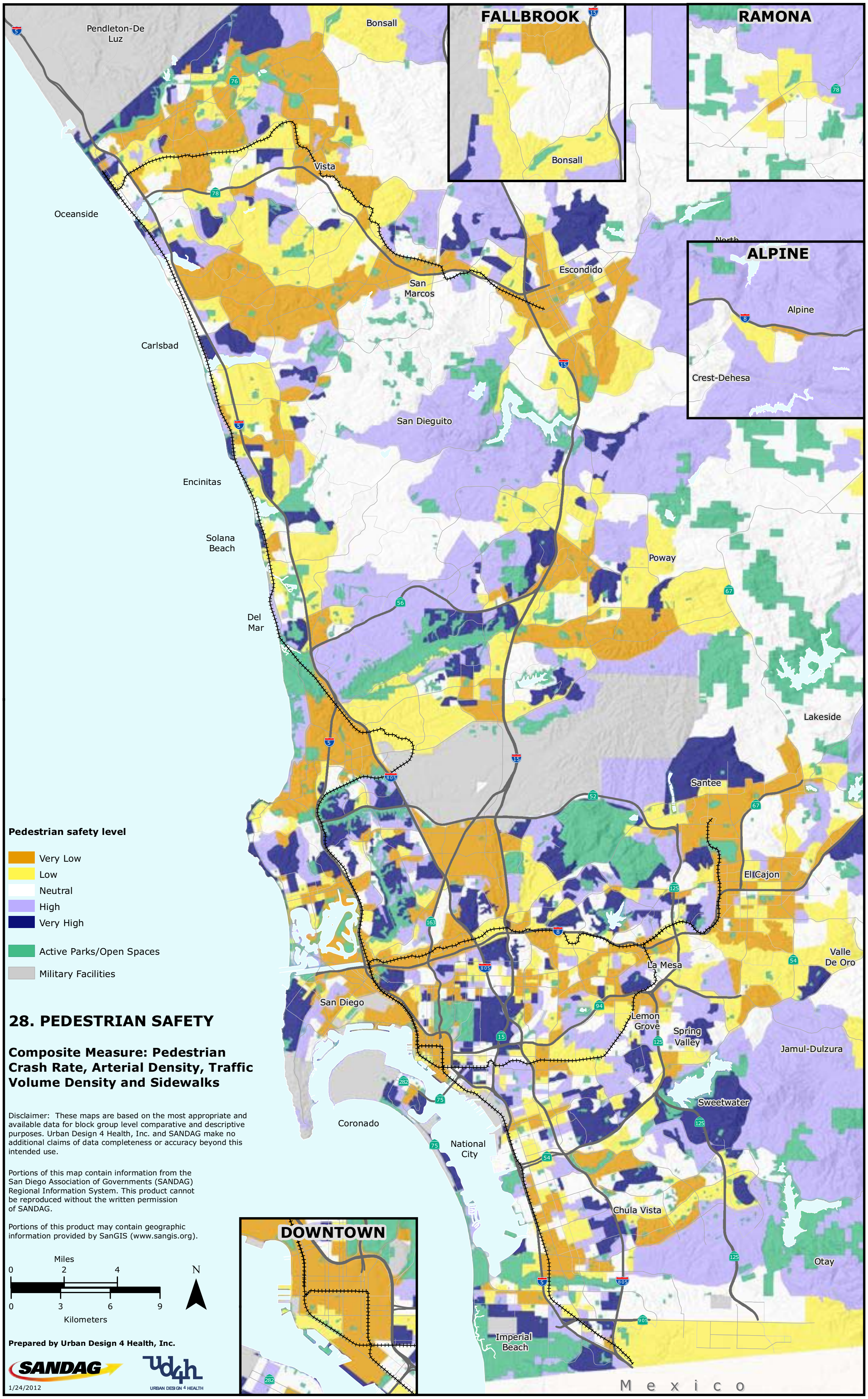
The areas anticipated to hold higher risk for pedestrians are frequently found along the region's major roadway corridors and near commercial and employment centers. This result is partially explained by the similarity between several of the component base maps. The Traffic Volume Density and Arterial Density base maps both show the highest traffic and arterial densities in block groups adjacent to large roadways (freeways and arterials) and / or containing concentrations of commercial activity or employment. A similar distribution is also present in the Pedestrian Crash Rate base map. The Sidewalks base map, on the other hand, largely reflects the region's historical development patterns and serves as a mitigating factor, particularly in the southern part of the urban area that has a robust sidewalk network.

The Pedestrian Traffic Safety map does not account for pedestrian volumes. Areas that have more pedestrians will also have more potential conflict points (and presumably, more crashes). Without pedestrian-count data, it is difficult to separate areas with higher pedestrian traffic from areas that truly carry disproportionate risk. Currently, there is no systematic, region-wide data available on pedestrian volumes, which would enhance the utility of this map. However, the map is still able to call attention to potentially higher-risk areas—where more investigation and focus may be needed to create a safer, more welcoming walking environment.

Table 4.2 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. A greater number of Communities of Concern block groups is found in the "very low" category than the other categories, with fewest in the "high" and "very high" categories. This distribution is an indication that vulnerable communities in the region may be facing traffic and safety barriers to walking; addressing these barriers could produce additional health benefits to these communities.

Table 4.2: Block groups by level of pedestrian safety

Level of Safety	All Block Groups	Communities of Concern Block Groups
Very High	353 (20%)	231 (13%)
High	352 (20%)	235 (13%)
Neutral	352 (20%)	250 (14%)
Low	352 (20%)	242 (14%)
Very Low	353 (20%)	275 (16%)
All categories	1,762 (100%)	1,233 (70%)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Chula Vista
Otay
Imperial Beach
M e x i c o
Pedestrian safety level
Very Low
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Neutral
High
Very High
Active Parks/Open Spaces
Military Facilities
28. PEDESTRIAN SAFETY
Composite Measure: Pedestrian Crash Rate, Arterial Density, Traffic Volume Density and Sidewalks
Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
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Miles
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Cyclist Safety

This composite map combines several measures in order to identify block groups with potentially high risk for cyclist injury. The base maps incorporated into this composite map include: Non-motorized Trails Access (Map 10), Arterial Density (Map 21), Traffic Volume Density (Map 22), and Cyclist Crash Rate (Map 27).

To calculate the composite score, each of the base map measures was first given a standardized value (z-score). The final composite score is the average of the base map z-scores. To create the five categories, the Census block groups were separated into five roughly equal groups (quantiles) based on their composite score. In these maps, better non-motorized trails access contributes positively to cyclist safety. Conversely, high cyclist crash rates, traffic volumes, and arterial densities decrease the cyclist safety score. Although only the western third of the region is shown in the map, the analysis was based on all 1,762 block groups in the San Diego region.

Findings

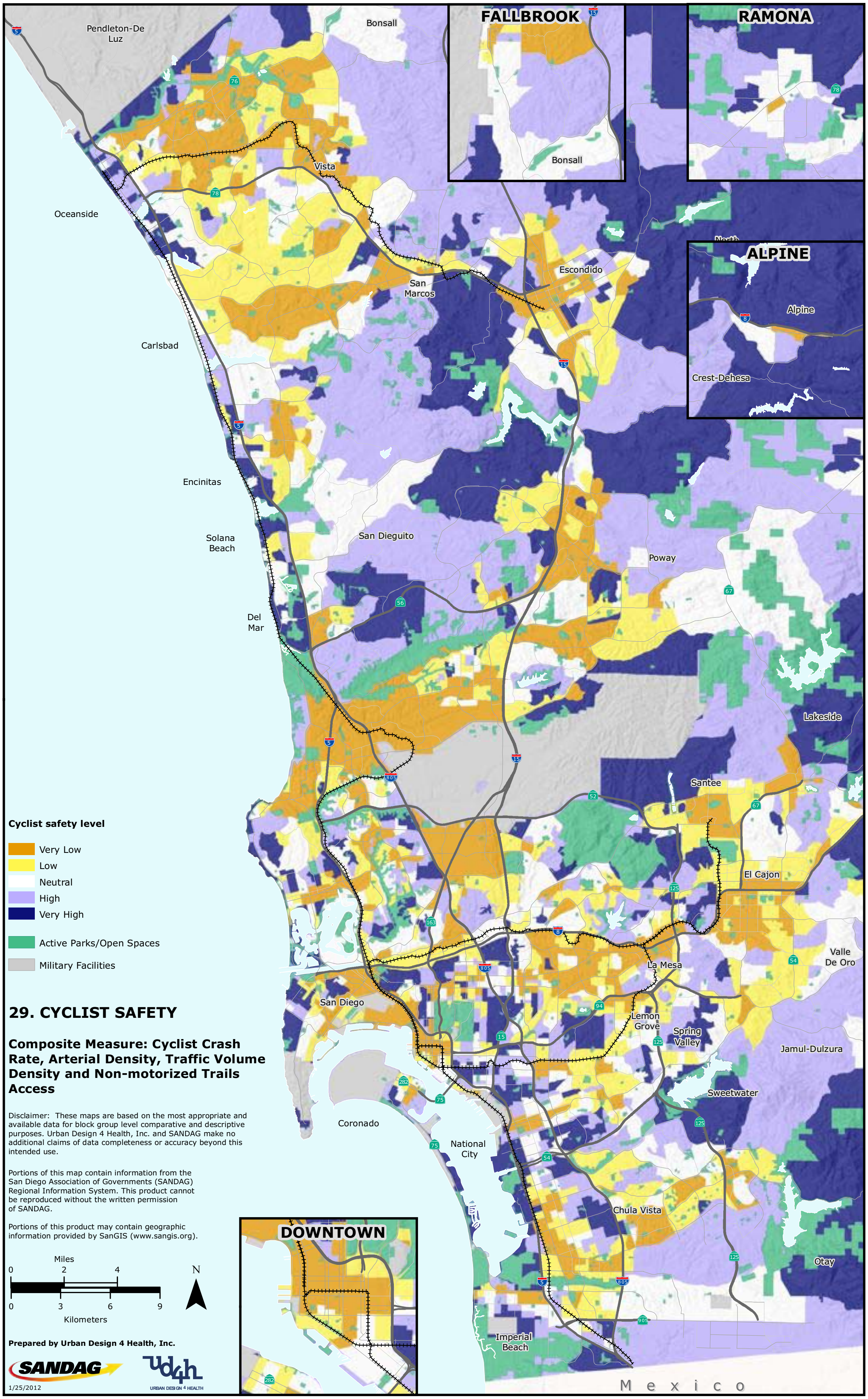
The spatial distribution of risk seen in this map is similar to that of the Pedestrian Safety map (Map 28), with the areas of highest risk for cyclists generally concentrated along major roadway corridors and near commercial and employment centers. Shoreline areas, which are well served by trails and have fewer large roads, appear to carry less risk for cyclists. As with the Pedestrian Safety map, these results are partially explained by the similarity between some of the component base maps, especially the Traffic Volume Density and Arterial Density base maps. Both maps show high traffic and arterial densities in block groups with large roadways and / or major commercial or employment centers. The Non-Motorized Trails Access map also shows similar spatial patterns as the Traffic Volume and Arterial Density maps (albeit to a lesser degree), creating a mitigating effect on the final composite map.

One important caveat is that this map largely shows the major attractors of cyclist activity (both routes and destinations). Areas with more cyclists will also have more potential conflict points (and presumably, more crashes). Because systematic, region-wide counts or other detailed estimates of cyclist trip patterns do not currently exist, it is difficult to separate areas with higher cyclist traffic from areas that truly carry disproportionate risk. Collecting and incorporating this data would improve the accuracy of the map. It would be counterproductive to conclude that decreasing cyclist activity is an acceptable way to decrease risk in these areas—the focus should instead be on the investments, policies, and enforcement necessary to create a safer bicycle network.

Table 4.3 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. Although the distribution of Communities of Concern is fairly even across the five map categories, the "very low" category contains the most block groups with Communities of Concern present. More detailed investigation of the overlap between the different Communities of Concern and areas with potentially high risk for cyclists could help to identify possible barriers to physical activity in these areas. Improvements and mitigation in these areas would provide extra benefits for low-income and low-mobility populations in particular.

Table 4.3: Block groups by level of cyclist safety

Level of Safety	All Block Groups	Communities of Concern Block Groups
Very High	353 (20%)	240 (14%)
High	352 (20%)	252 (14%)
Neutral	352 (20%)	235 (13%)
Low	352 (20%)	240 (14%)
Very Low	353 (20%)	266 (15%)
All categories	1,762 (100%)	1,233 (70%)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DOWNTOWN
Pendleton-De Luz
Bonsall
Vista
Oceanside
San Marcos
Escondido
Alpine
Crest-Dehesa
Carlsbad
Encinitas
Solana Beach
San Dieguito
Poway
Del Mar
Lakeside
Santee
El Cajon
La Mesa
Valle De Oro
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
M e x i c o
Cyclist safety level
Very Low
Low
Neutral
High
Very High
Active Parks/Open Spaces
Military Facilities
29. CYCLIST SAFETY
Composite Measure: Cyclist Crash Rate, Arterial Density, Traffic Volume Density and Non-motorized Trails Access
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Traffic Safety for Youth

This composite map combines several measures in order to identify Census block groups with potentially high risk for youth injury from traffic crashes. A two-step process was used to develop the map. First, only those block groups in which more than 50 percent of households had access to an elementary school, park, or daycare center were included in the analysis. These block groups (551 total) were selected based on their likelihood to attract young pedestrians or cyclists. Only the selected block groups were given a composite score. Scores were based on the combination of the following base maps: Sidewalk Completeness (Map 7), Arterial Density (Map 21), Traffic Volume Density (Map 22), Cyclist Crash Rate (Map 27), and Pedestrian Crash Rate (Map 26).

The analysis divides the 551 selected block groups into five categories (very high, high, neutral, low, and very low) according to their composite score. To calculate the composite score, each of the base map measures was first given a standardized value (z-score) for each block group. The final composite score per block group is the average of the base map z-scores. To create the five categories, the Census block groups were separated into five roughly equal groups (quantiles) based on their composite score. In these maps, better sidewalk coverage contributes positively to youth traffic safety. Conversely, high pedestrian and cyclist crash rates, traffic volumes, and arterial densities decrease the youth traffic safety score. Although only the western third of the region is shown in the map, the analysis was based on the entire San Diego region.

Findings

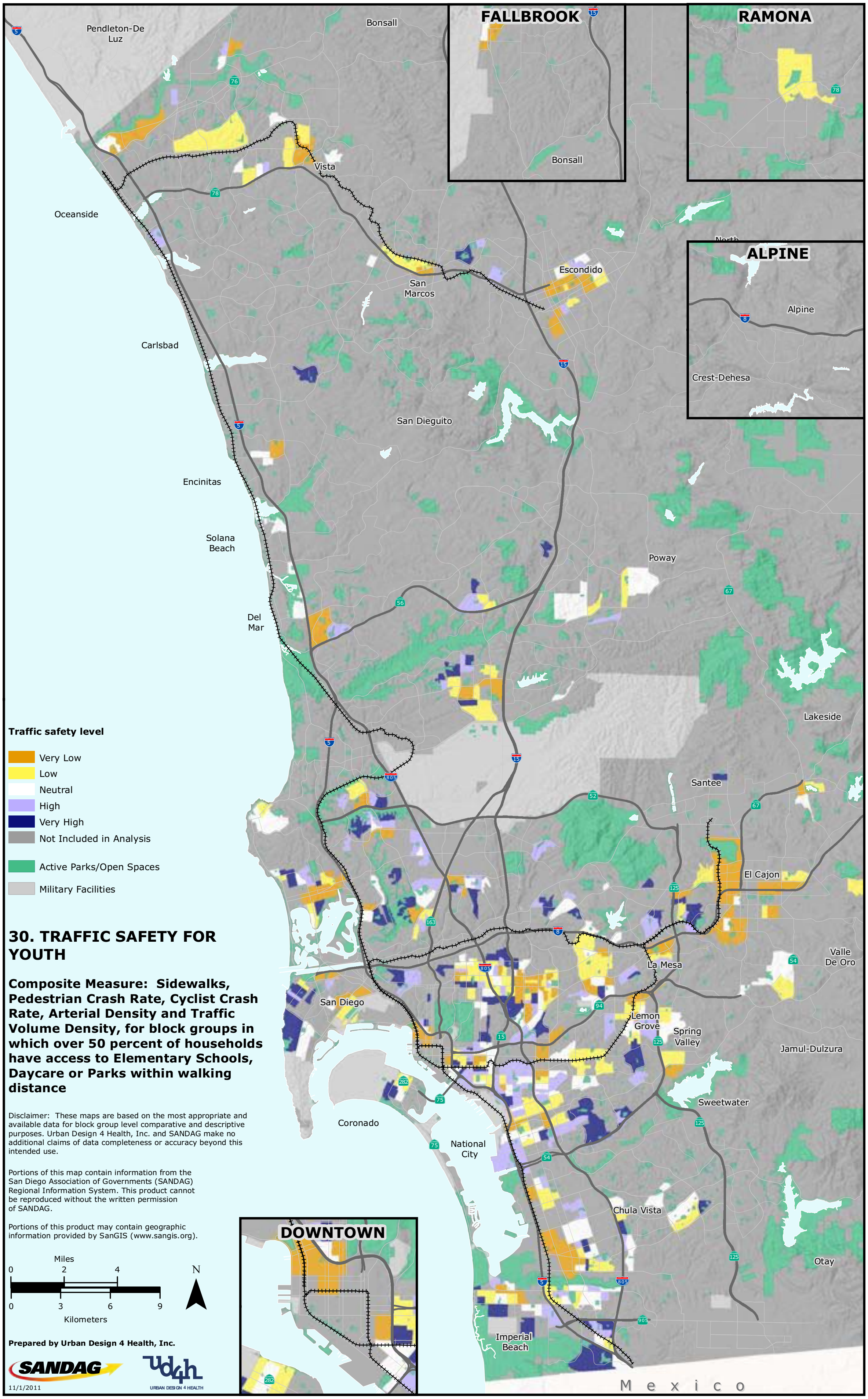
Less than one-third of the 1,762 block groups in the County were included in the analysis as being likely locations for youth trips. The bulk of the selected block groups are found in the southern half of the urban area, as most of the relevant destinations—particularly elementary schools—are found in this part of the region. Of the block groups included, a few larger areas of high-risk are found around El Cajon and southwest Chula Vista. However, few discernable patterns exist and in some cases very high risk block groups are directly adjacent to very low-risk block groups.

The map does not account for actual youth walking and cycling trip volumes. Areas with more youth activity will also have more potential conflict points and, without systematic counts, it is impossible to separate areas with higher youth pedestrian / cyclist traffic from areas that truly carry disproportionate risk. Region-wide data on cyclist and pedestrian volumes (either for youth or for the broader population), which would contribute to a more accurate assessment of risk, is not currently available. However, the map is still able to call attention to potentially higher-risk areas—where programs and investment may be appropriate to reduce traffic safety risks for youth.

Table 4.4 shows the number of block groups in each of the map categories, together with the number of block groups containing one or more Communities of Concern. Nearly 85 percent of the block groups included in the analysis are also Communities of Concern, with the largest number falling into the "low" and "very low" categories.

Table 4.4: Block groups by level of youth traffic safety

Level of Safety	All Block Groups	Communities of Concern Block Groups
Very High	110 (20%)	87 (16%)
High	110 (20%)	88 (16%)
Neutral	110 (20%)	87 (16%)
Low	110 (20%)	95 (17%)
Very Low	111 (20%)	106 (19%)
All categories	551 (100%)	463 (84%)



FALLBROOK
RAMONA
ALPINE
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Pendleton-De Luz
Bonsall
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San Marcos
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San Dieguito
Encinitas
Solana Beach
Del Mar
Poway
Lakeside
Santee
El Cajon
La Mesa
Valle De Oro
San Diego
Lemon Grove
Spring Valley
Jamul-Dulzura
Sweetwater
Coronado
National City
Chula Vista
Otay
Imperial Beach
Alpine
Crest-Dehesa
North
Mexico
Traffic safety level
Very Low
Low
Neutral
High
Very High
Not Included in Analysis
Active Parks/Open Spaces
Military Facilities
30. TRAFFIC SAFETY FOR YOUTH
Composite Measure: Sidewalks, Pedestrian Crash Rate, Cyclist Crash Rate, Arterial Density and Traffic Volume Density, for block groups in which over 50 percent of households have access to Elementary Schools, Daycare or Parks within walking distance
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Chapter 5

Nutrition

Healthy body weight or alternatively, overweight / obesity status is a function of genetics, calories consumed (diet), and calories expended (activity levels). This section focuses on dietary patterns and how the relative access to healthy or unhealthy food may influence body weight. Recent declines in physical activity have been accompanied by an increasing prevalence of high-fat, high-calorie, low-quality foods. Evidence suggests that the environment we live in can also promote a good or poor diet. Unfortunately, many areas have poor access to healthy food choices; these are often referred to as "food deserts." Food deserts also tend to be in areas with lower-income residents, or where many inhabitants are mobility-compromised either by disability or from limited transportation options. Individuals with limited mobility (low-income, elderly, youth, and others who don't drive) are more dependent on locally available food outlets. For these populations, having healthy food options available nearby is especially important. This section examines which areas of the region have walking access to healthy and unhealthy food options.

Topics discussed in this chapter include:

- Healthy Food Access
- Fast Food Density

Healthy Foods Access

The built environment can contribute to a healthy diet through convenient access to healthy food. The declining rate of physical activity in the US has accompanied an increased prevalence of high-fat, high-calorie foods. A local food environment that includes supermarkets has been positively associated with meeting dietary guidelines for fruits and vegetables.[1]

About the Map

The Healthy Food Access map measures the percentage of households in each block group within walking distance (0.6 mile or 1 km) of a grocery store or farmers' market. The map uses existing grocery store location data from the Neighborhood Quality of Life Study (NQLS).[2] The food-outlet data were subject to detailed field verification in 2010. The category "Grocery Store" includes all outlets classified as *Grocery Store*, *Market / Produce*, or *Specialty Markets*, and therefore includes more than just large supermarkets.

Locations of the region's 49 farmers' markets were identified from 2011 San Diego County Department of Environmental Health permit data. The number of households within walking distance of farmers' markets was calculated using the same method as for grocery stores. Because there are so few farmers' markets, fewer households were within walking access of these food outlets. In addition, most farmers' markets are only open 1-2 times a week, further limiting access. However, farmers' markets do make an important contribution to healthy, local food access and enhance the walkability of the neighborhoods in which they are located, and so were included as part of this analysis.

Census block groups were separated into eight roughly equal groups (quantiles). Although the map shows only the western third of the region, the analysis was based on all 1,762 block groups in the San Diego region. For clarity, the quantile divisions have been rounded, causing a small shift in the number of block groups per quantile.

The analysis estimates the proportion of households that have walking access to healthy food outlets. It does not explicitly account for households that drive, bicycle, or take public transit to shop for food. However, the distance decay principle[3]—the concept that people are more likely to make trips to destinations that are nearby—is a cornerstone of transportation planning, and also explains travel patterns to food. People are more likely to choose nearby destinations regardless of chosen travel mode, even though access to a bike, car, or good public transit service will expand the range of healthy food options.

Findings

Healthy food access is relatively high, particularly in the urban core and the central cities across the region. Pockets of high access also emerge along some of the major roadway corridors. Figure 5.1 summarizes the distribution of block groups according to household access to healthy foods. The largest number of urban block groups had 100 percent of households with access to healthy foods within walking distance. A much smaller, but significant number of urban block groups had little to no access. Although rural block groups are more likely to be food producers, they generally had low access to healthy foods for purchase.

Figure 5.1 also shows the distribution of block groups containing one or more Communities of Concern. Generally, the patterns of access among Communities of Concern mirror those found in the region as a whole

As compared to other destination types analyzed in the Atlas, healthy food is the most accessible destination type overall, with 1,270 grocery stores and 49 farmers' markets distributed throughout the region. Just over 80 percent of multi-family households—and nearly 60 percent of all households in the region—have access to a grocery store or farmers' market within walking distance, as shown in Table 5.1.

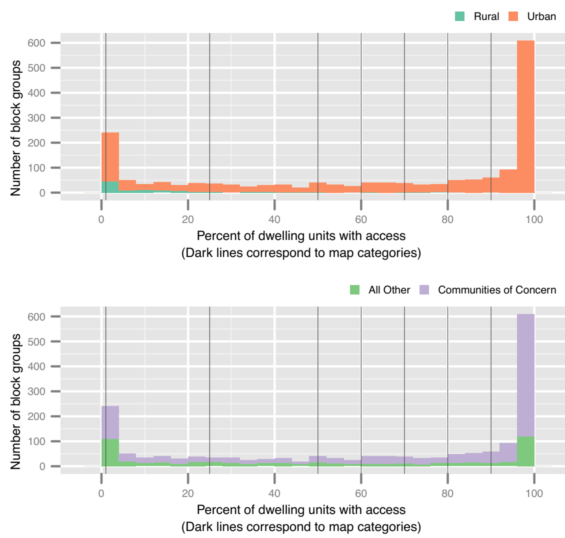


Figure 5.1: Block groups by access to healthy foods

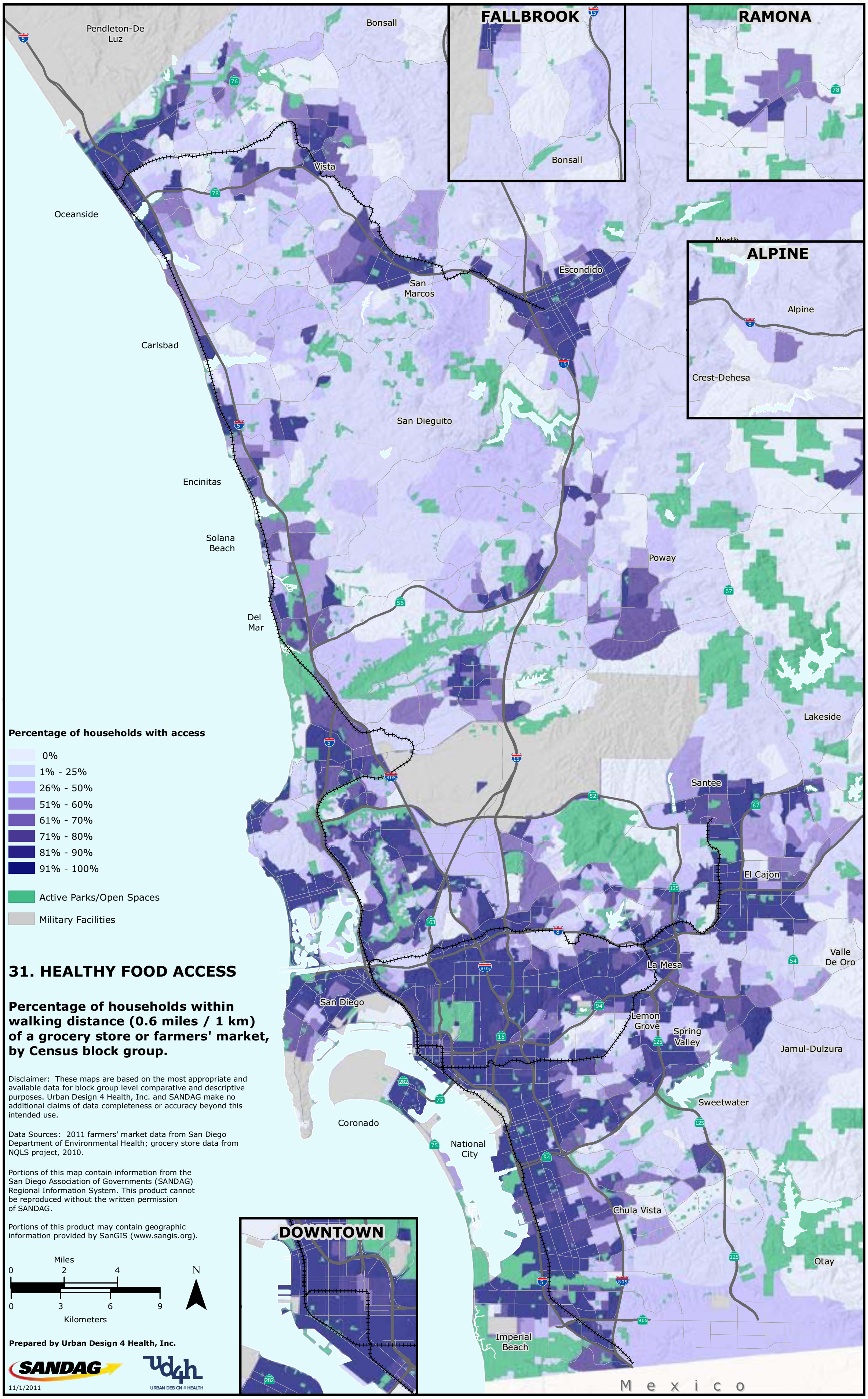
Table 5.1: Access to healthy foods

Household Type	Households with Access
Multi-family	362,008 (80.59%)
Single-family	320,065 (46.08%)
All Residential	682,073 (59.34%)

[1] Kimberly Morland, Steve Wing, and Ana Diez Roux, "The Contextual Effect of the Local Food Environment on Residents' Diets: The Atherosclerosis Risk in Communities Study," *American Journal of Public Health* 92, no. 11 (November 2002): 1761–7.

[2] The Neighborhood Quality of Life Study (NQLS) is a research project developed by James Sallis and other researchers at San Diego State University in collaboration with the consultant team, Urban Design 4 Health, Inc. http://www.nqls.org

[3] George Kingsley Zipf, "The P1 P2/D Hypothesis: On the Intercity Movement of Persons," *American Sociological Review* 11, no. 6 (1946): 677–686.



31. HEALTHY FOOD ACCESS

Percentage of households within walking distance (0.6 miles / 1 km) of a grocery store or farmers' market, by Census block group.

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Data Sources: 2011 farmers' market data from San Diego Department of Environmental Health; grocery store data from NQLS project, 2010.

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Fast Food Density

In the US, the percentage of meals and snacks consumed at fast food restaurants doubled between 1972 and 1995, with broad implications for nutrition.[4] Frequency of fast food restaurant use is associated with higher energy and fat intake, both due to an increase in the consumption of higher-fat, lower-nutrition food and from displaced consumption of healthy foods.[5]

About the Map

The map measures the density of fast food restaurants by Census block group. The map uses existing fast food-outlet data from the Neighborhood Quality of Life Study (NQLS).[6] Food-outlet data were subject to detailed field verification in 2010. The study identified 3,108 fast food restaurants. Densities are reported as fast food outlets per 100 acres. The map divides Census block groups into eight roughly equal groups (quantiles). For clarity, divisions between quantiles have been rounded, which causes a small shift in the number of block groups per quantile.

Findings

Block groups with a higher density of fast food outlets can be found along the region's major highway and arterial corridors and near interchanges. "Corridors" of high fast food-density were most visible along SR 78 and I-8, south of downtown between I-5 and I-805, and along University Avenue to La Mesa. A few smaller pockets of high fast food density areas emerge along the shoreline.

However, over 50 percent of block groups had a fast food-restaurant density of zero as shown in Figure 5.2.

Figure 5.2 also shows the distribution of block groups containing one or more Communities of Concern. No relationship between fast food density and Communities of Concern was immediately apparent—generally, the distribution mirrors that of the region as a whole. Further inferential statistical testing would be necessary to reveal any pattern that may exist.

The map shows only the western third of the region, however the analysis was based on all 1,762 block groups in the San Diego region.

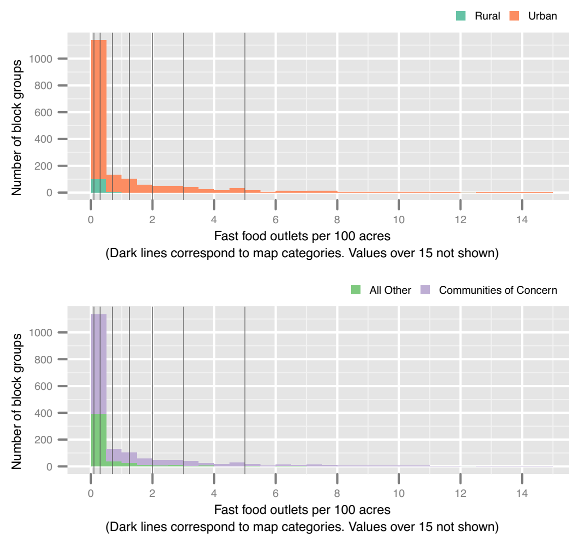
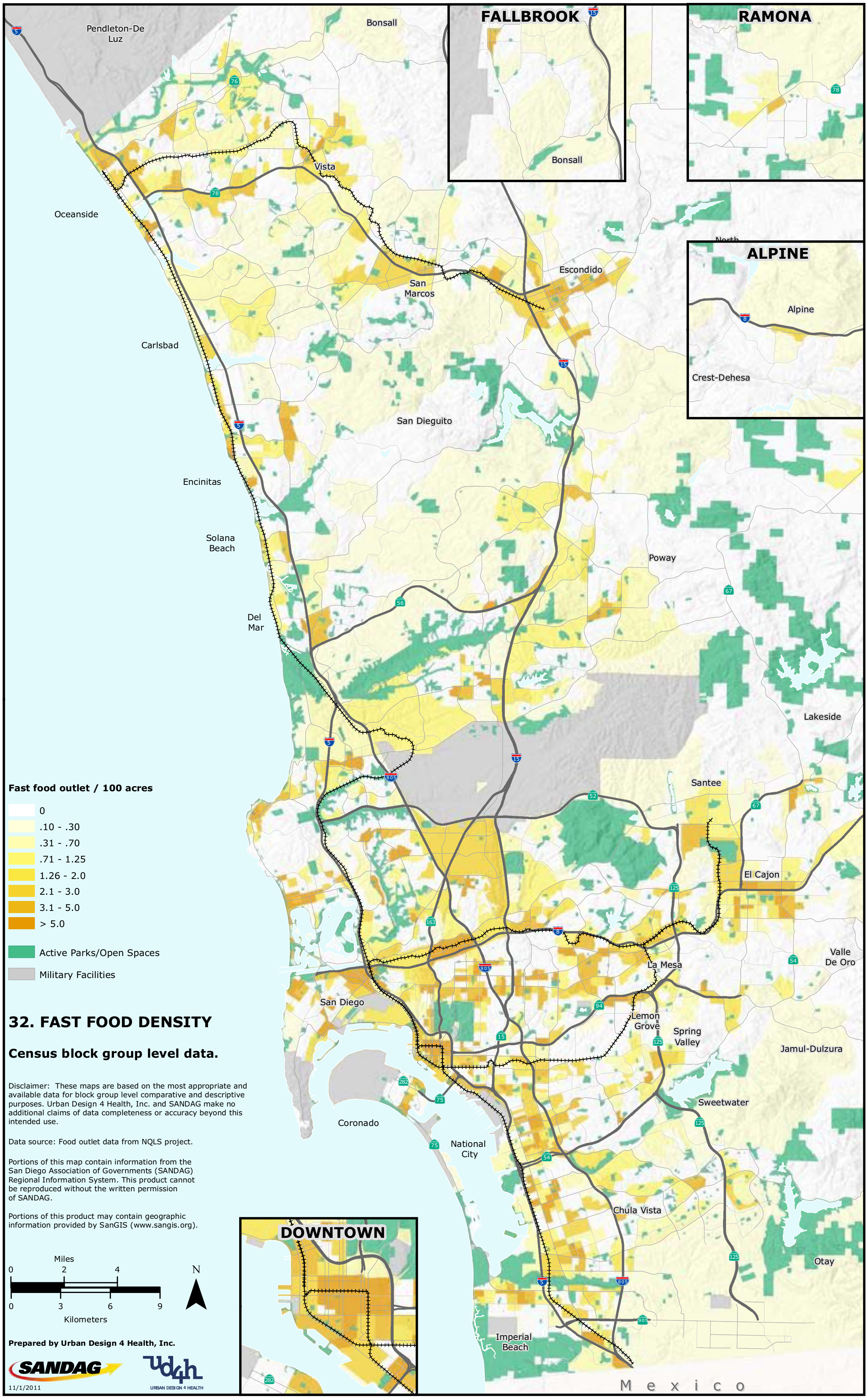


Figure 5.2: Block groups by fast food restaurant density

[4]Simon A. French, Mary Story, and Robert W. Jeffery, "Environmental Influences on Eating and Physical Activity," *Annual Review of Public Health* 22, no. 1 (2001): 309–335.

[5]Simon A. French et al., "Fast Food Restaurant Use Among Adolescents: Associations With Nutrient Intake, Food Choices and Behavioral and Psychosocial Variables," *International Journal of Obesity* 25, no. 12 (December 2001): 1823–33.

[6]The Neighborhood Quality of Life Study (NQLS) is a research project developed by James Sallis and other researchers at San Diego State University in collaboration with the consultant team, Urban Design 4 Health, Inc.


32. FAST FOOD DENSITY
Census block group level data.
Fast food outlet / 100 acres
0
.10 - .30
.31 - .70
.71 - 1.25
1.26 - 2.0
2.1 - 3.0
3.1 - 5.0
> 5.0
Active Parks/Open Spaces
Military Facilities
FALLBROOK
RAMONA
ALPINE
DOWNTOWN
Pendleton-De Luz
Bonsall
Vista
Oceanside
San Marcos
Escondido
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Lakeside
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El Cajon
Valle De Oro
La Mesa
San Diego
Lemon Grove
Spring Valley
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Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.
Data source: Food outlet data from NQLS project.
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Chapter 6

Air Quality

Measuring air pollution and its health risks is a complex endeavor. Air pollution can come from a number of different sources, which in urban areas are primarily mobile (cars, trucks, buses) and stationary industrial (factories, power plants, heavy rail yards) sources. These sources emit numerous pollutant types, each with its own patterns of dispersion and health impacts. Dispersion and concentration of pollutants are also affected by regional wind and weather patterns.

The built environment relates to air pollution in two primary ways: through the total amount of pollutants emitted, and the proximity of those pollutants to humans. For example, although higher density and more walkable areas are typically linked to lower levels of vehicle emissions *per capita*, residents of these areas may be exposed to higher exposures to vehicle pollution because of higher overall traffic levels and congestion. They also may be in closer proximity to industrial and other point pollution sources. Suburban and exurban areas may be more likely to be impacted by agricultural pollution (pesticides and dust), as well as ground-level ozone, which is formed through the combination of oxides of nitrogen (NOx) and volatile organic compounds (VOCs) in the presence of sunlight and will often concentrate miles downwind of its source.

About the Map

This analysis focused on fine particulate matter (PM 2.5), coarse particulate matter (PM 10), and diesel particulate matter (DPM) as those are the pollutants for which proximity and adjacent location are the greatest concern. DPM is also classified as an air toxic by the US EPA and has a clear link to respiratory illness and cancer. Other criteria pollutants, such as NOx, VOCs and carbon monoxide (CO) contribute to air pollution, and although they can cause serious health impacts, they present fewer issues for adjacent neighborhoods.

High traffic volumes, high truck traffic, and congested roadways generally can be associated with increased exposure to high CO and particulate concentrations. However, there are many local and site-specific factors (e.g., wind speed and direction, terrain, and building design) that determine specific exposure levels for specific sensitive receptors; these specific exposure levels are determined through project-specific analyses and health risk assessments (HRAs).

The map identifies areas at risk of exposure to air pollution based on the percentage of homes in each block group that are within a zone of impact to three types of known transportation-related pollution sources: freeways and high-traffic roads, rail yards, and ports. The zones of impact were established based on California Air Resources Board (CARB) guidelines, published in CARB's 2005 Air Quality and Land Use Handbook as follows:

Freeways and high-traffic roads impact zone: 500 feet, based directly on CARB guideline to avoid siting homes and other sensitive land uses within 500 feet of freeways, urban roads carrying 100,000 vehicles per day, or rural roads with 50,000 vehicles per day. All roads meeting CARB criteria for traffic volumes were buffered 500 feet from the roadway edge to calculate how many homes were within the zone of impact.

Rail yards impact zone: 0.25 miles, based on findings contained in the Health Risk Assessment conducted for the San Diego BNSF rail yard by CARB in 2008, and supported by the CARB guideline to avoid siting new sensitive land uses within 1,000 feet of a major service and maintenance rail yard.

Ports impact zone: 0.25 miles. Because there were no set CARB guidelines for San Diego's three ports, Port of San Diego air pollution inventories were used in combination with CARB guidelines to determine the zone of impact. The findings from the CARB BNSF rail terminal analysis were applied as a result, since the ports are in the same general location as the rail yard and generate the same pollutants (PM, DPM) of concern.

This analysis is necessarily limited to a small set of pollution sources and pollutants for which clear guidance was available on the spatial extent of the health impacts. Although many studies have been done on air pollution exposure, the application of those findings to particular situations is an extremely technical endeavor, and beyond the scope of this analysis. Although this map can provide some general guidance, readers should not draw conclusions about health impacts without further, more detailed analysis.

Findings

The concentrations of air pollution closely follow the region's major highway corridors; this is expected as they were a major focus of the analysis. The impact of the ports and the rail yards is not visible on the maps because these areas are also adjacent to a number of highway corridors.

Figure 6.1 shows the distribution of block groups according to household proximity to pollution sources. The majority of block groups in the region did not have a substantial number of dwelling units within the impact zones. However, 108 block groups had 50 percent or more of their housing units within the zone of impact.

Figure 6.1 also shows the distribution of block groups containing one or more Communities of Concern. Although the pattern of impacts generally mirrors that of the region as a whole, inferential testing is needed to confirm that this is the case. A more detailed analysis of specific neighborhoods and other pollutants should be used to identify areas that may be suffering from disparate impacts.

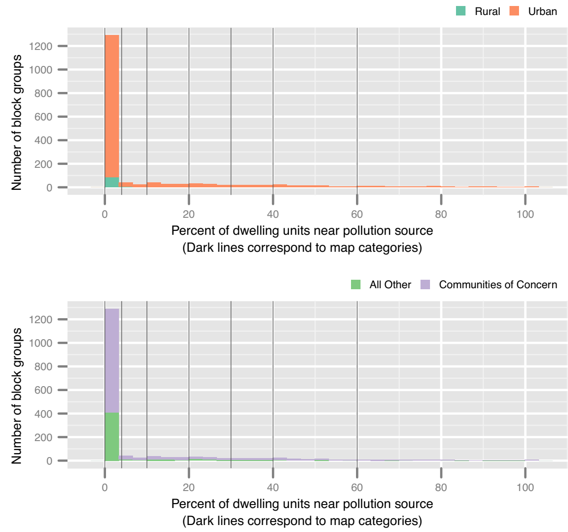
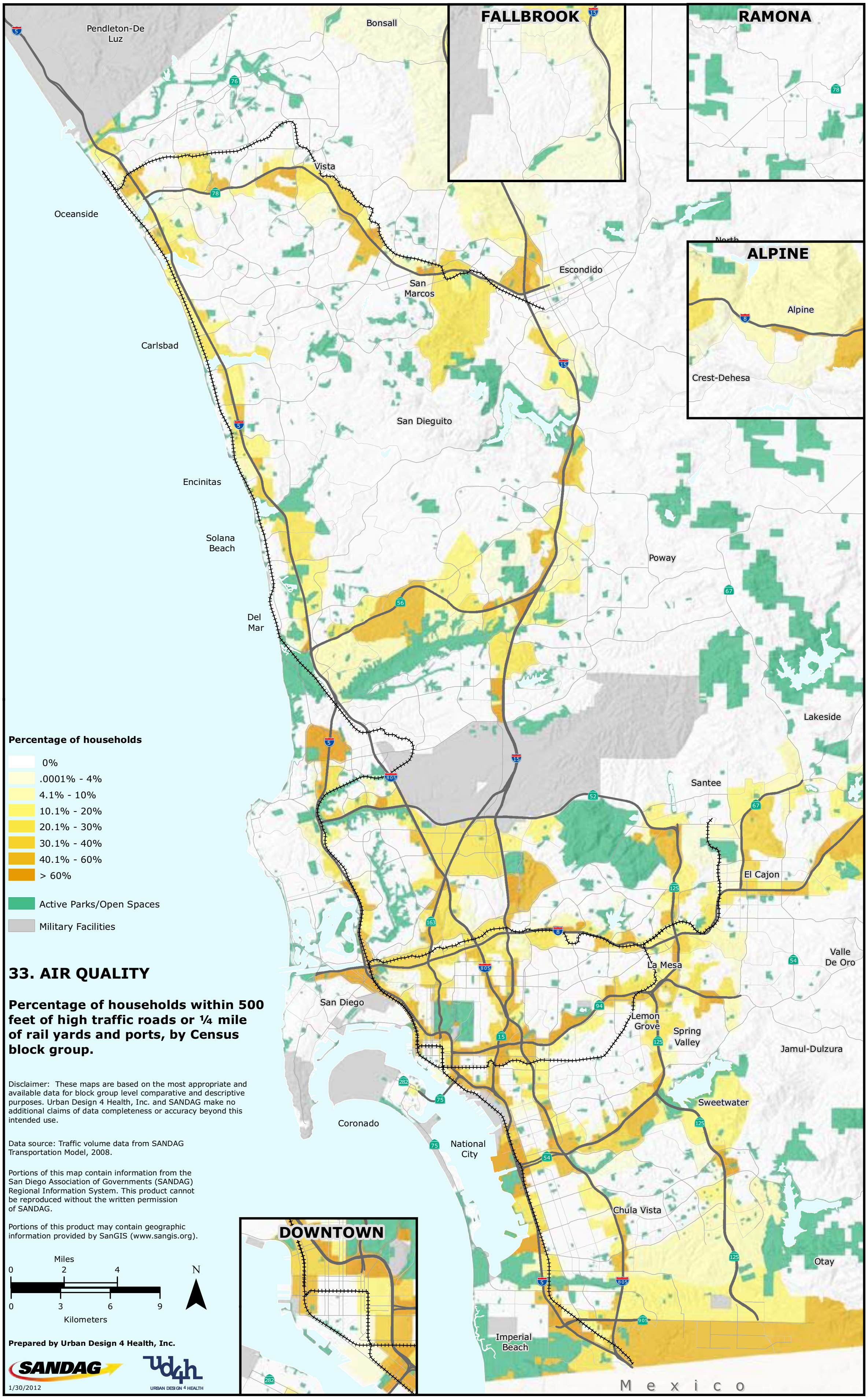


Figure 6.1: Block groups by proximity to selected air pollution sources



33. AIR QUALITY

Percentage of households within 500 feet of high traffic roads or ¼ mile of rail yards and ports, by Census block group.

Disclaimer: These maps are based on the most appropriate and available data for block group level comparative and descriptive purposes. Urban Design 4 Health, Inc. and SANDAG make no additional claims of data completeness or accuracy beyond this intended use.

Data source: Traffic volume data from SANDAG Transportation Model, 2008.

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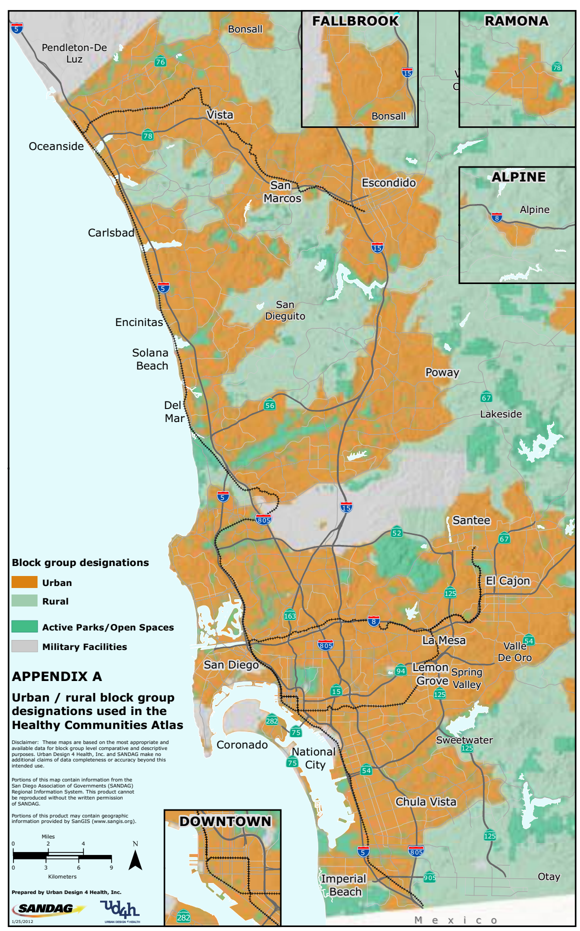
Appendix A: Dividing Urban and Rural Block Groups

To create the histograms summarizing the data across the rural and urban parts of the region, it was necessary to categorize each block group in the region as either urban or rural. Based on discussion with SANDAG, the following process was used to classify the block groups. SANDAG provided a GIS line file showing the urban area boundary for the region. There are a number of non-contiguous, small areas that are officially part of the urban area; for this analysis all of those areas that are smaller than 1000 acres were removed from the set of urban block groups. This file was intersected with the block group centroids (centerpoints); any block group with its centroid within the adjusted urban area boundary were designated ″urban″ block groups. The rest were classified as ″rural.″ The map on the following page shows the final block group level urban / rural designations.



Urban / Rural Block Group Designations Used In The Healthy Communities Atlas

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Appendix B: Amenities Methodology

Creating Accessibility Measures

Several of the maps in the Atlas display measures of accessibility calculated as the percentage of housing units in each block group that are within a one kilometer walking distance (about a 6-10 minute walk)[1] from the destination of interest (e.g. parks, daycare centers). The accessibility measures used 2010 housing unit counts provided by SANDAG.

This process starts by creating a 1 kilometer network "buffer" that approximates a 6-10 minute walk along the street network. This buffer extends from the location of interest in all directions, excluding areas that are not accessible to pedestrians (such as highway on-ramps). Parcels that intersect with these buffers are flagged. Next, the total number of housing units on each parcel is calculated, and aggregated into a per-block group total. This is then divided by the total number of housing units per block group, which gives a result as the percentage of households with access to that particular amenity. The technical details of this process are documented below.

Spatial Join—2006 / 2010 Parcel Files to Block Groups

SANDAG's Land Use/Dwelling Unit (LUDU) GIS polygon datasets for 2006 and 2010 were provided along with the land use coding system for the analysis. These files provide reliable parcel level data on number of dwelling units and land use classifications, updated on an annual basis.

Step 1: Using GIS, identified the location of each parcel centroid.

Step 2: Results from Step 1 were exported as a text file table, then brought back into the ArcGIS project and plotted. Results were then exported as shapefiles with point geometry, and added to the project. Points with road and freeway right of ways were selected out of the point files, and the remaining records were exported as separate shapefiles.

Step 3: The parcel centroid file was then spatially joined to the block group shapefile. A spatial join was conducted through the table, with each point receiving the information of the census block group record "closest to it," along with a distance measure to indicate how far the point (i.e., parcel centroid) is from the nearest polygon/census block group For points that are within a polygon, Distance = 0. There were 22 parcels in the shapefile based on LUDU 2010 and 25 parcels based on LUDU 2006 with distance values greater than zero; further review of those parcels revealed that all were within 125 ft. of the Mexican border, and had no dwelling units on them.

Step 4: The attribute table from the output file generated in Step 3 for LUDU 2010 was exported to Microsoft Access, where reduced tables were created which contained only the IDKey, the land use code description and STFID (the Census Block Group identifier). The reduced table was then added back to the ArcGIS project, and table joined to the relevant LUDU shapefile, using the IDKey field generated in Step 1.

Once the table joins were verified as successful, all the records in the LUDU shapefile were selected and exported to a new separate shapefile, which now contains the census block group identifier for non-roadway parcel polygon.

Network Buffering of Amenities

The ESRI Network Analyst tool was used to create buffers around each of the amenities described below. An existing (2006) walkable road network file for the SANDAG region was used for this task. This file had already been modified to exclude links of the network that were not accessible to pedestrians (highway on/off ramps, etc).

Fast Food Locations

Network Buffers: 1km distance around fast food locations
Total unique values: 3104.

Grocery Store Locations

Network Buffers: 1km distance around grocery store locations
Food type categories used: market produce stores, grocery store, specialty markets

[1]Chanam Lee and Anne Vernez Moudon, "Correlates of walking for transportation or recreation purposes," *Journal of Physical Activity & Health* 3 (2006): 77; Anne Vernez Moudon et al., "Operational Definitions of Walkable Neighborhood: Theoretical and Empirical Insights," *Journal of Physical Activity & Health* 3 (2006): S99–S117; Frank et al., "The Development of a Walkability Index: Application to the Neighborhood Quality of Life Study"; Lawrence D. Frank et al., "Many Pathways From Land Use to Health: Associations Between Neighborhood Walkability and Active Transportation, Body Mass Index, and Air Quality," *Journal of the American Planning Association* 71, no. 1 (2006): 75–87.

Total loaded: 1267/1270; removed 3.
Total unique values: 1267.

High Quality Bus Corridor Locations—Major Bus Stops

Network Buffers: 1km distance around major bus stops
Total unique values: 1403.

Major Rail Stations – all rail stations

Network Buffers: 1km distance around major rail stations
Total unique values: 22.

Park Boundary Access Points—Boundary points were placed at fixed interval of 200 ft.

Park boundary points were removed where no park access exists. The park boundary points loaded into Network Analyst were reviewed. Parks that were identified as not being parks (e.g., park polygons over housing units that were inaccurately added to the park dataset) were removed before the 1km buffers were created. Some park access points have been verified by UD4H as part of the LIFE-PN study. This information was used where available. All park access points within 250 ft from the road network were originally loaded into Network Analyst. Utilizing aerial imagery, park polygons, San Diego road networks, those park boundary points that were clearly not appropriate access points were removed. An example of this was those park access points that were within 250 ft. of a road but were present on the rear side of private property (e.g. homes). Some parks only have one park boundary access point/network buffer while others have many.

Network Buffers: 1km distance around park access points
Network Analyst Options: i.) generalized buffers, ii.) trimming: 25m
Total unique parks: 985.

Day Care Facilities

Network Buffers: 1km distance around State Licensed Day Care Facilities
Total unique values: 846.

Recreational Centers

Network Buffers: 1km distance around recreational centers
Total unique values: 54.

Libraries

Network Buffers: 1km distance around libraries
Total unique values: 80.

Identification and aggregation of dwelling units within 0.6 miles (1km) of Amenities

Step 1: The attribute tables were exported to Microsoft Access, where crosstab queries were performed to calculate the total number of dwelling units for each Census 2000 Block Group, for 2006 and 2010, as well as subtotals for dwelling units on parcels classified as single family, multi-family, or unknown/unusable parcel classification. The table below provides information on the use categories from the SANDAG supplied file called "UpdatedLandUseCodingSept07.xls." Mappings used by UD4H are as follows:

LU Code	Description	UD4H mapping
1000	Spaced Rural Residential	SF
1100	Single Family Residential	SF
1110	Single Family Detached	SF
1120	Single Family Multiple-Units	SF
1190	Single Family Residential Without Units	SF
1200	Multi-Family Residential	MF
1280	Single Room Occupancy Units (SRO's)	MF
1290	Multi-Family Residential Without Units	MF
1300	Mobile Home Park	MF
1400	Group Quarters	MF
1401	Jail/Prison	
1402	Dormitory	MF
1403	Military Barracks	MF
1404	Monastery	MF
1409	Other Group Quarters Facility	MF

Step 2: Using the buffers described in the Network Buffering of Amenities section, subsets of parcels were selected based on their intersection with the various 1km buffers. The results of those "Select by Location" ArcGIS queries were then exported as separate parcel polygon map themes.

Step 3: The attribute tables of the output files generated in Step 2 were exported to a Microsoft Access database where, for each set of buffer intersection results, the residential land use parcels were identified as either single or multi-family.

Step 4: Using the results in Step 3, crosstab queries similar to the ones listed in Step 1 were performed to aggregate the dwelling units (within the 1 km. network buffer for each amenity) to each Census 2000 Block Group. Subtotals were tabulated for dwelling units on parcels classified as single family and multi-family.

Step 5: The results from the queries in Step 4 were then joined to the results from the query in Step 1, to create the final dataset.