V. Needs Analysis

This chapter presents an overview of current bicycling demand and barriers in San Diego and estimates potential future demand and benefits that could be realized through implementation of this Plan. Elements of this chapter were used to develop the Plan recommendations. They include:

- **Bicycle Demand Modeling** – raster-based spatial modeling highlights segments of the roadway network with the greatest propensity for bicycle activity compared to other locations in San Diego.
- **Public Input** summarizes public comment collected throughout the planning process to understand current bicyclists' issues and desires.
- **Bicycle Safety and Accident Analysis** presents a summary and analysis of bicycle related collisions and bicycling safety issues.
- **Commute Patterns** summarizes current commute mode split statistics according to the US Census as an indication of current system usage and to establish a baseline with which to measure progress.
- **Trip Reduction and Potential Air Quality Benefits** were estimated to gauge the potential environmental benefits associated with increasing the bicycle mode split through plan implementation.

Assessing needs and potential benefits is instrumental to planning a system that serves the needs of all user groups; and is useful when pursuing competitive funding and attempting to quantify future usage and benefits to justify future expenditures.

Bicycle Demand Modeling

Modeling bicycle demand provides an objective assessment of potential bicycle travel across the city by analyzing population characteristics and elements of the built environment that are strongly correlated with bicycling. This Plan includes demand modeling on two geographic scales of travel, intra-community travel or "within-community" travel and inter-community or "between-community" travel. The former consists of shorter trips that are taken within a neighborhood or community area; the later refers to longer trips that are taken between communities or neighborhoods. Demand was modeled at these two scales because there is variation in the strength of factors believed to attract or generate bicycle trips for shorter verses longer trips. This demand analysis, along with existing plans and public input, was used to assist in identifying locations in San Diego where investments in bicycle facilities would be most beneficial in terms of the current propensity for bicycle activity. The following sections summarize the demand modeling process and results.

Within-Community Bicycling Demands (Intra-Community)

The within-community bicycle demand model integrates two sub-models, the bicycle trip attractor and bicycle trip generator models, which are designed to identify areas with greater

propensity for bicycling due to the intensity of land uses likely to attract or generate a relatively shorter bicycle trip. The variables employed in these sub-models and their corresponding point systems were presented to and discussed extensively with the Plan's Project Working Group. National and local bicycle travel behavior surveys were also consulted to inform the selection of input variables and their associated points. The City uses similar raster-based spatial modeling approaches in multiple other planning efforts including their 2008 General Plan Update Village Propensity Model and the on-going pedestrian master plan priority modeling.

Bicycle Attractor Model

Table 5.1 presents the bicycle trip attractor model inputs that consist of land uses considered to have a higher potential for attracting bicycle trips, such as schools, beaches, parks and retail centers. The model inputs, their respective points, and the distance-based weights applied to the inputs are also shown in Table 5.1. **Figure 5-1** displays the location of bicycle trip attracting land uses across San Diego. The bicycle trip attracting land uses were buffered by varying distances (as shown in Table 5.1) and then assigned a score.

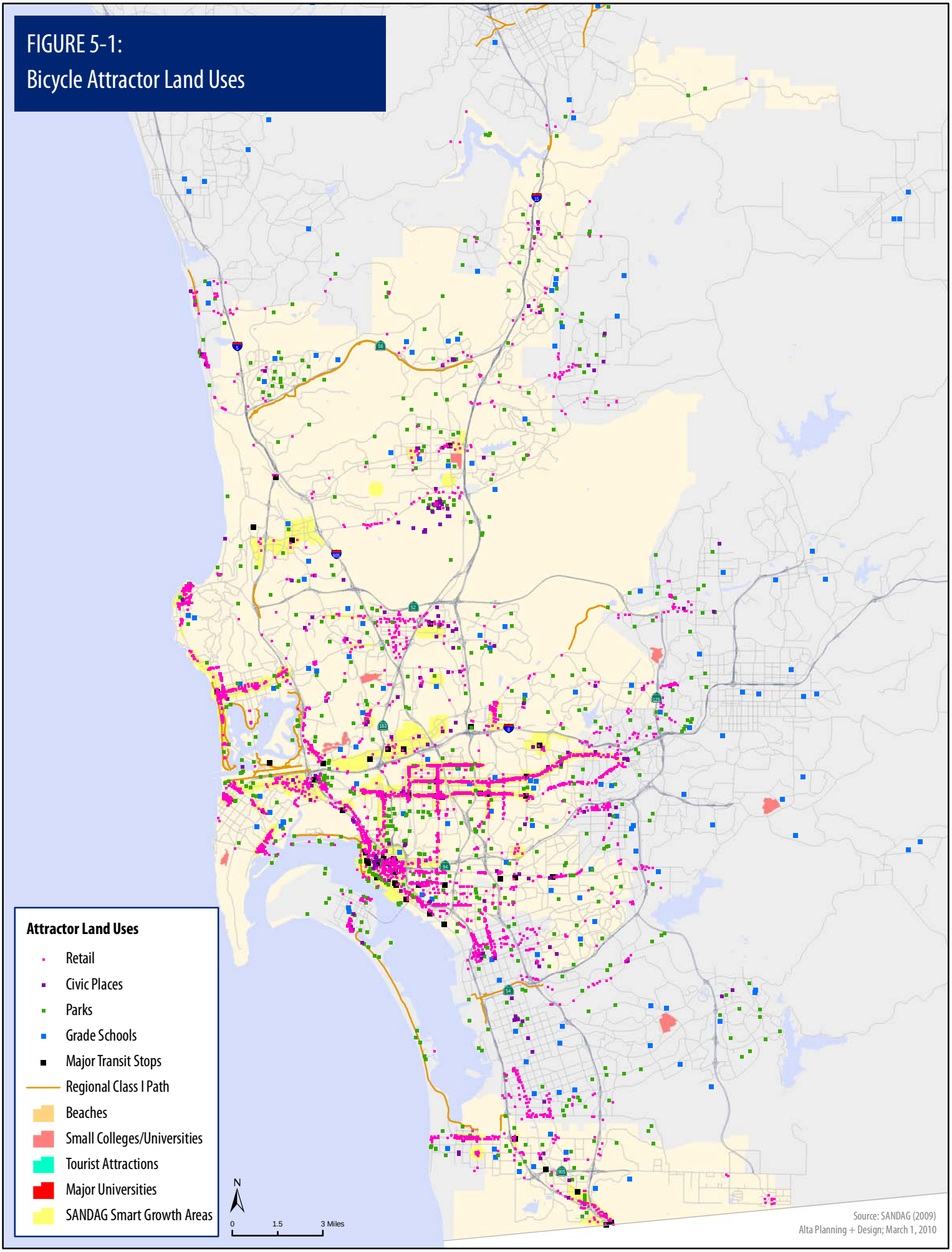
Table 5-1: Bicycle Attractor Input Variables and Scores

Bicycling Attractors	Points	Weights	Score
Major Universities (SDSU and UCSD)	4	1	4
Beaches & Coastal Parks	4		4
Tourist Attractions	4		4
Transit (> 1,000 passengers per day)	4		4
Regional Class I Bikewa	4		4
Non-Coastal Parks & Recreation	3		3
Small Colleges & Universities	3		3
Smart Growth Opportunity Areas	2		2
Retail Facilities*	1		1
High, Middle, & Elementary Schools	1		1
Neighborhood Civic Facilities	1		1
Weighting Values Based on Distance to Attractor			
Within ½ mile	1.50	1	1.50
Between ½ and 1 mile	1.00		1.00
Between 1 and 1 ½ mile	0.75		0.75
Between 1 ½ and 2 miles	0.50		0.50
Between 2 and 3 miles	0.25		0.25

Source: Alta Planning + Design, February 2010

Note:
**Only a single distance-based ranking was applied to Retail Facilities. The area outside of one-quarter mile of retail uses was not included as potential bicycle trip-attracting locations.*

FIGURE 5-1:
Bicycle Attractor Land Uses



Source: SANDAG (2009)
Alta Planning + Design; March 1, 2010

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Land use buffers were generated using ArcView's Network Analyst software resulting in buffers of varying distance around the bicycle trip attracting land uses along the roadway network. Freeways, and other roadways where bicycling is prohibited, were removed from the roads shapefile before generating the street network buffers. **Figure 5-2** displays the raster composite for the attractor model.

Bicycle Generator Model

Table 5.2 displays the bicycle trip generator model inputs including total population and employment densities, and the density of sub-populations believed to have potentially higher rates of bicycling, such as households without a vehicle and bicycle commuters.

Table 5.2: Bicycle Generator Input Variables and Scores

Bicycling Generators	Points	Weights	Score
Population Density (persons per census block)			
> 40	3	2	6
25 - 40	2		4
< 25	1		2
Employment Density (employees per traffic analysis zone)			
> 15	3	2	6
5 - 15	2		4
< 5	1		2
Zero-Vehicle Households (percent of households by census block group)			
≥ 25	3	2	6
15 – 24.99	2		4
5 – 14.99	1		2
Bicycling Commuters (percent of commuters by census block group)			
≥ 4	3	2	6
2 - 3.99	2		4
1 – 1.99	1		2
Walk and Transit Commuters(percent of commuters by census block group)			
≥ 25	3	2	6
15 – 24.99	2		4
5 – 14.99	1		2

Source: Alta Planning + Design, February 2010

Figures 5-3 through **5-7** display the five bicycle trip generator model inputs across the city of San Diego. **Figure 5-8** displays the bicycle generator composite model, which integrates each of the five input variables in a composite raster grid using the point system presented in Table 5.2.

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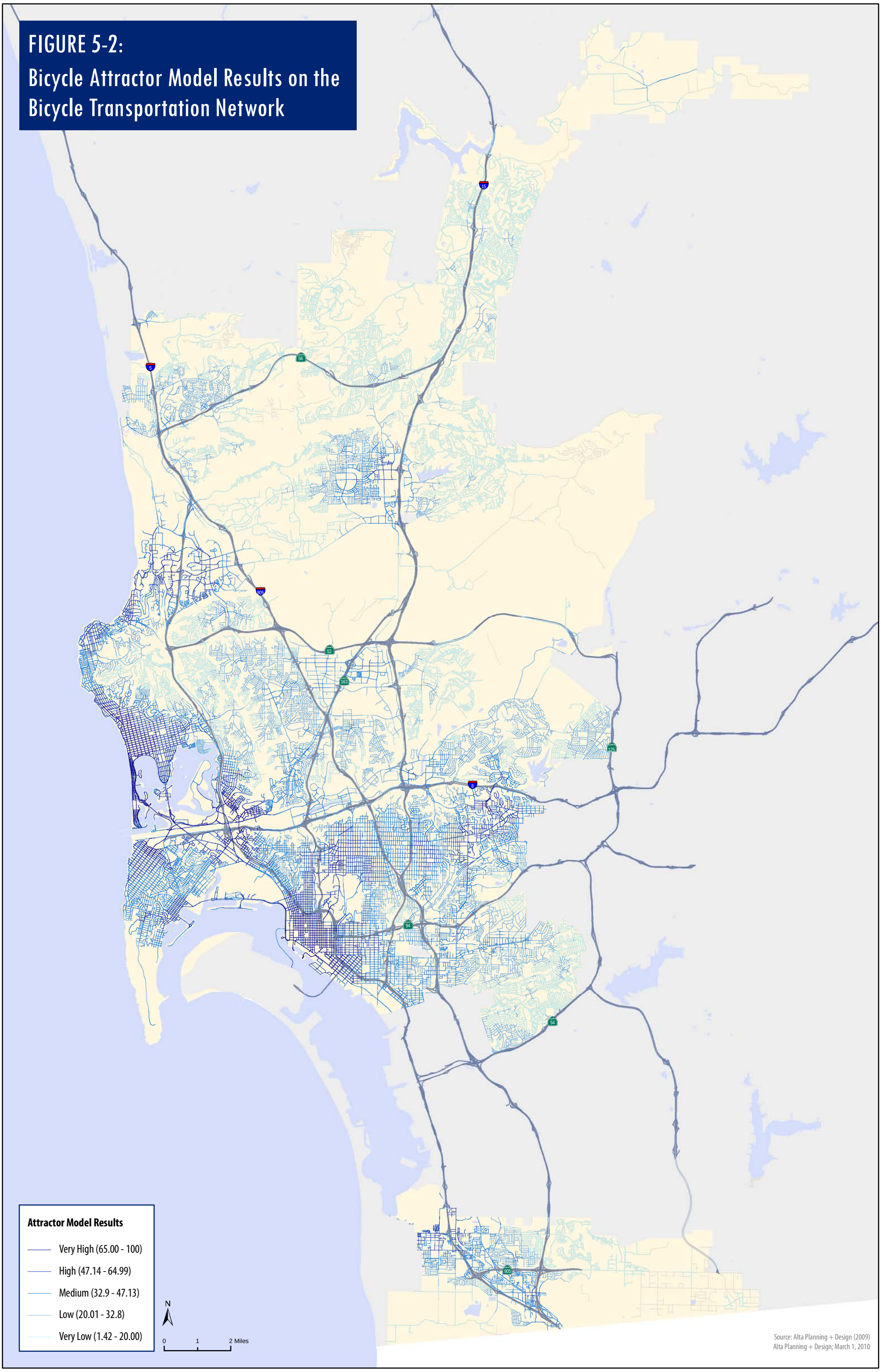
FIGURE 5-2:
Bicycle Attractor Model Results on the Bicycle Transportation Network



Source: Alta Planning + Design (2009)
Alta Planning + Design; March 1, 2010

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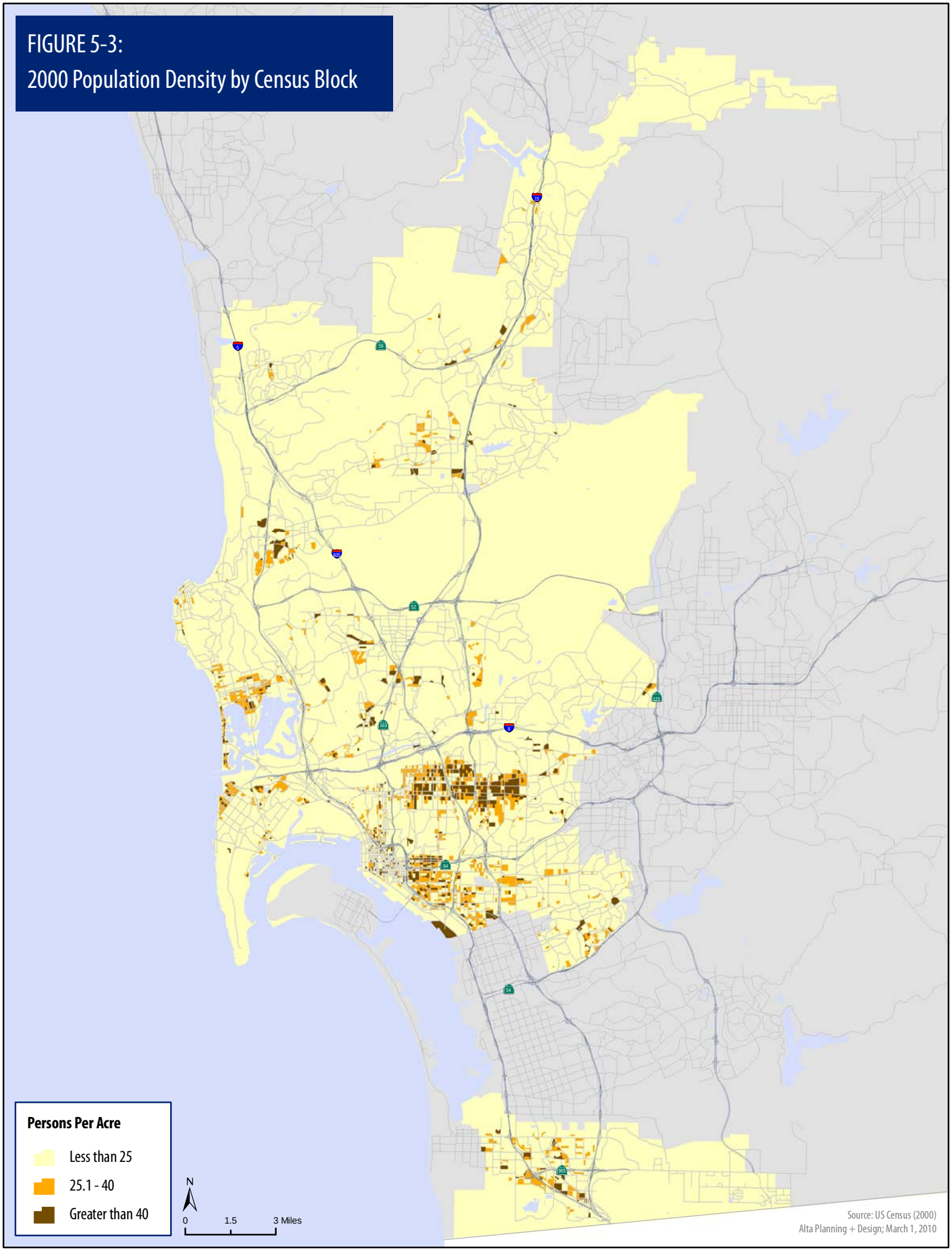
FIGURE 5-3:
2000 Population Density by Census Block
Persons Per Acre
Less than 25
25.1 - 40
Greater than 40
N
0
1.5
3 Miles
Source: US Census (2000)
Alta Planning + Design; March 1, 2010

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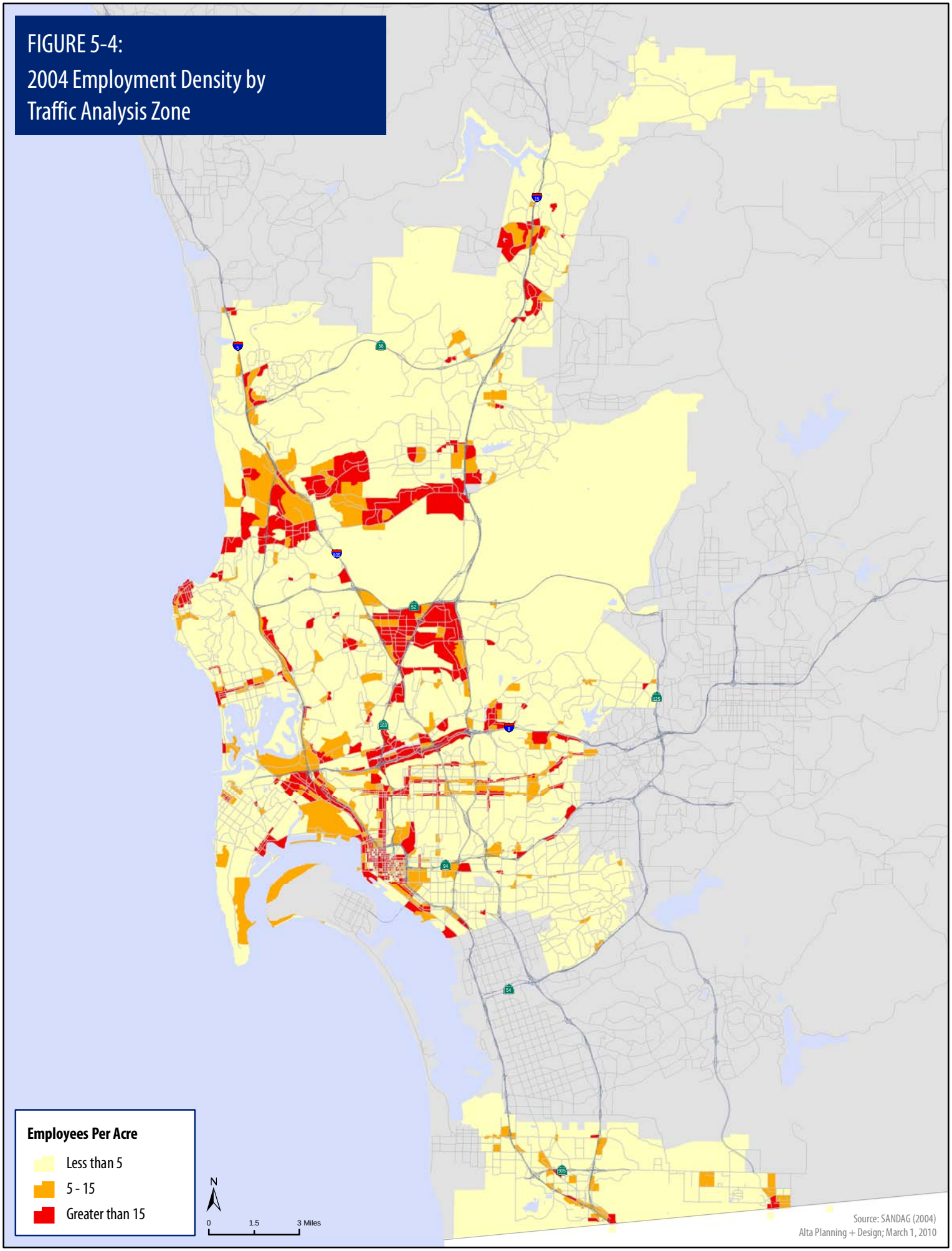
FIGURE 5-4:
2004 Employment Density by
Traffic Analysis Zone
Employees Per Acre
Less than 5
5 - 15
Greater than 15
N
0
1.5
3 Miles
Source: SANDAG (2004)
Alta Planning + Design; March 1, 2010

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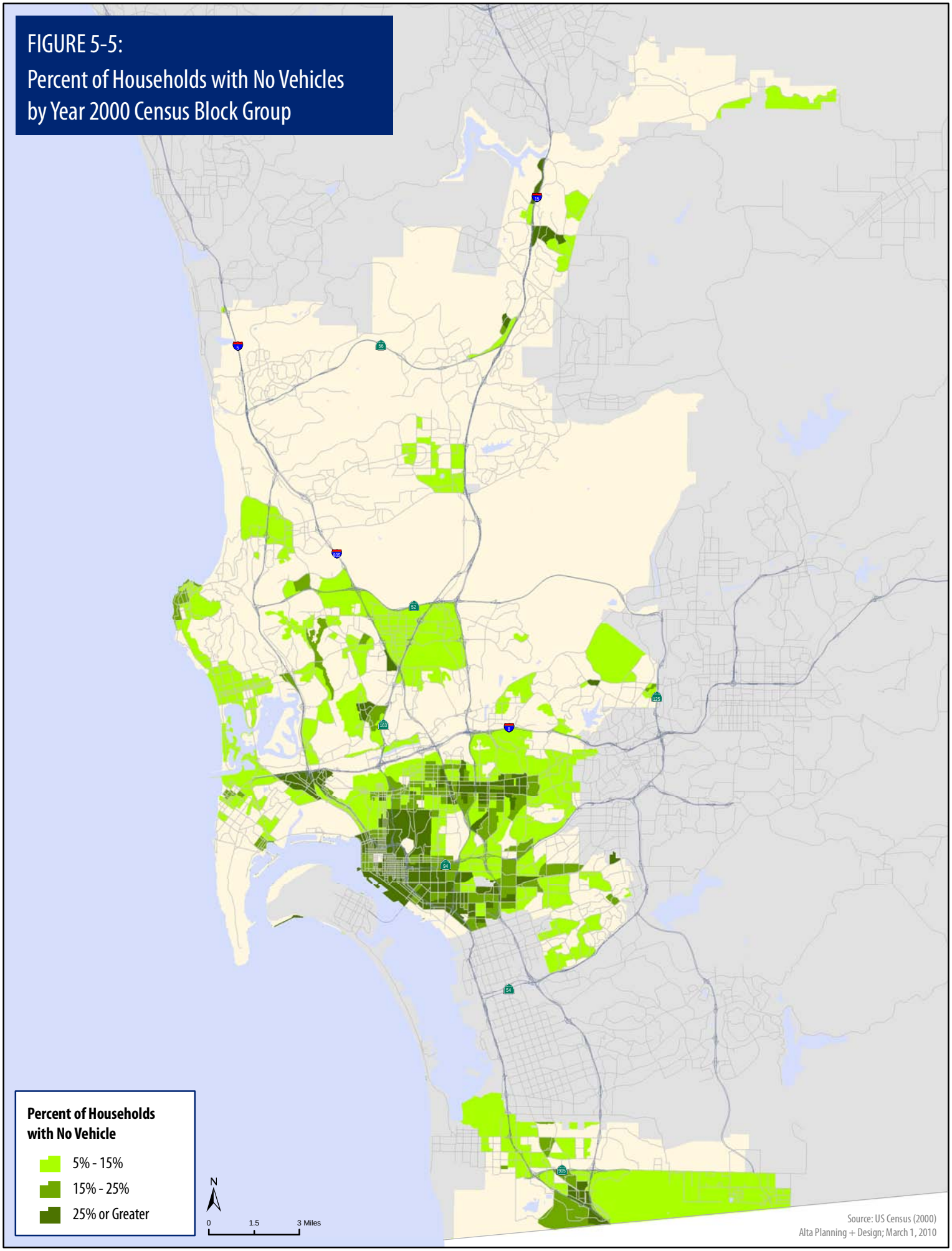
FIGURE 5-5:
Percent of Households with No Vehicles
by Year 2000 Census Block Group
Percent of Households
with No Vehicle
5% - 15%
15% - 25%
25% or Greater
N
0
1.5
3 Miles
Source: US Census (2000)
Alta Planning + Design; March 1, 2010

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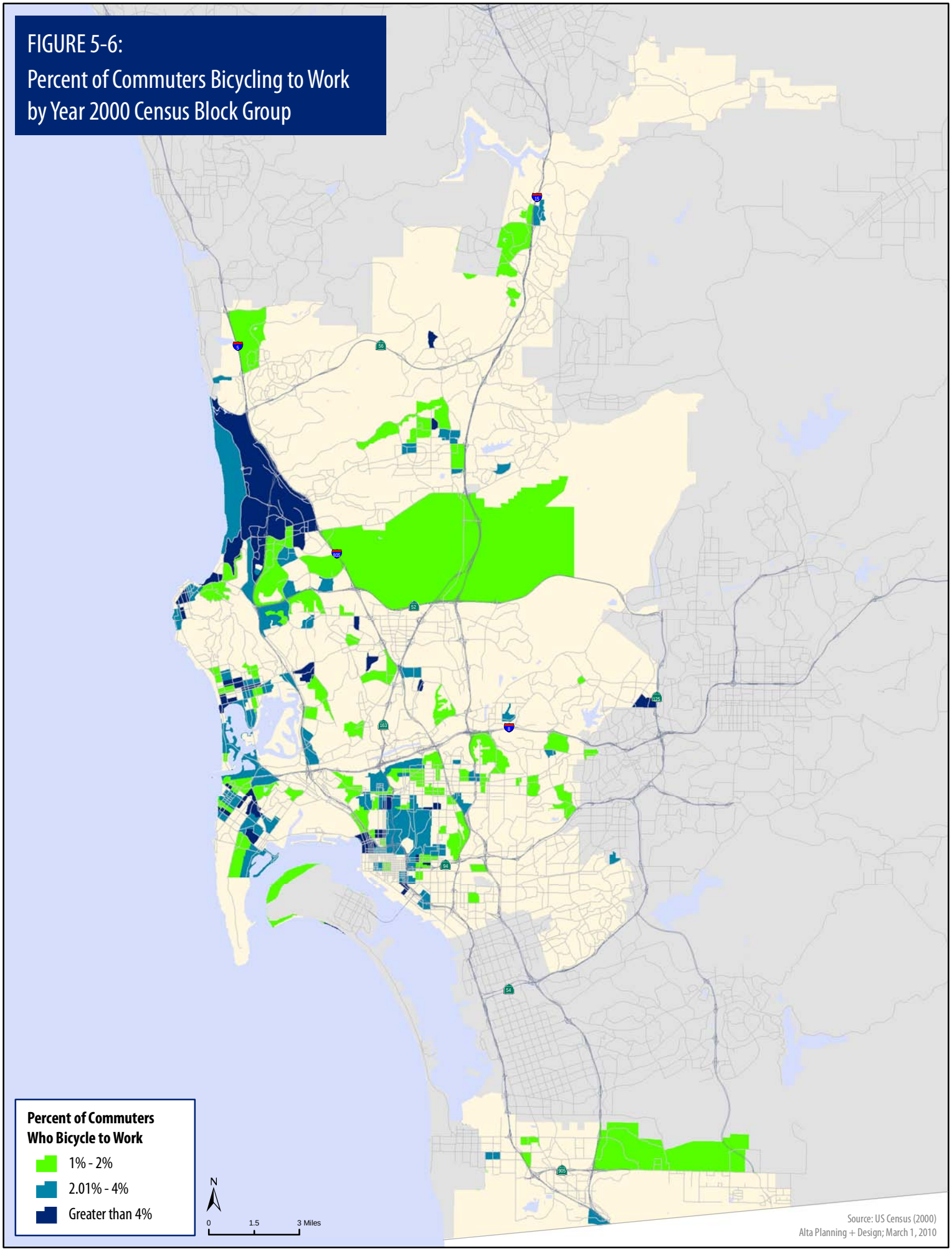
FIGURE 5-6:
Percent of Commuters Bicycling to Work by Year 2000 Census Block Group
Percent of Commuters Who Bicycle to Work
1% - 2%
2.01% - 4%
Greater than 4%
N
0
1.5
3 Miles
Source: US Census (2000)
Alta Planning + Design; March 1, 2010

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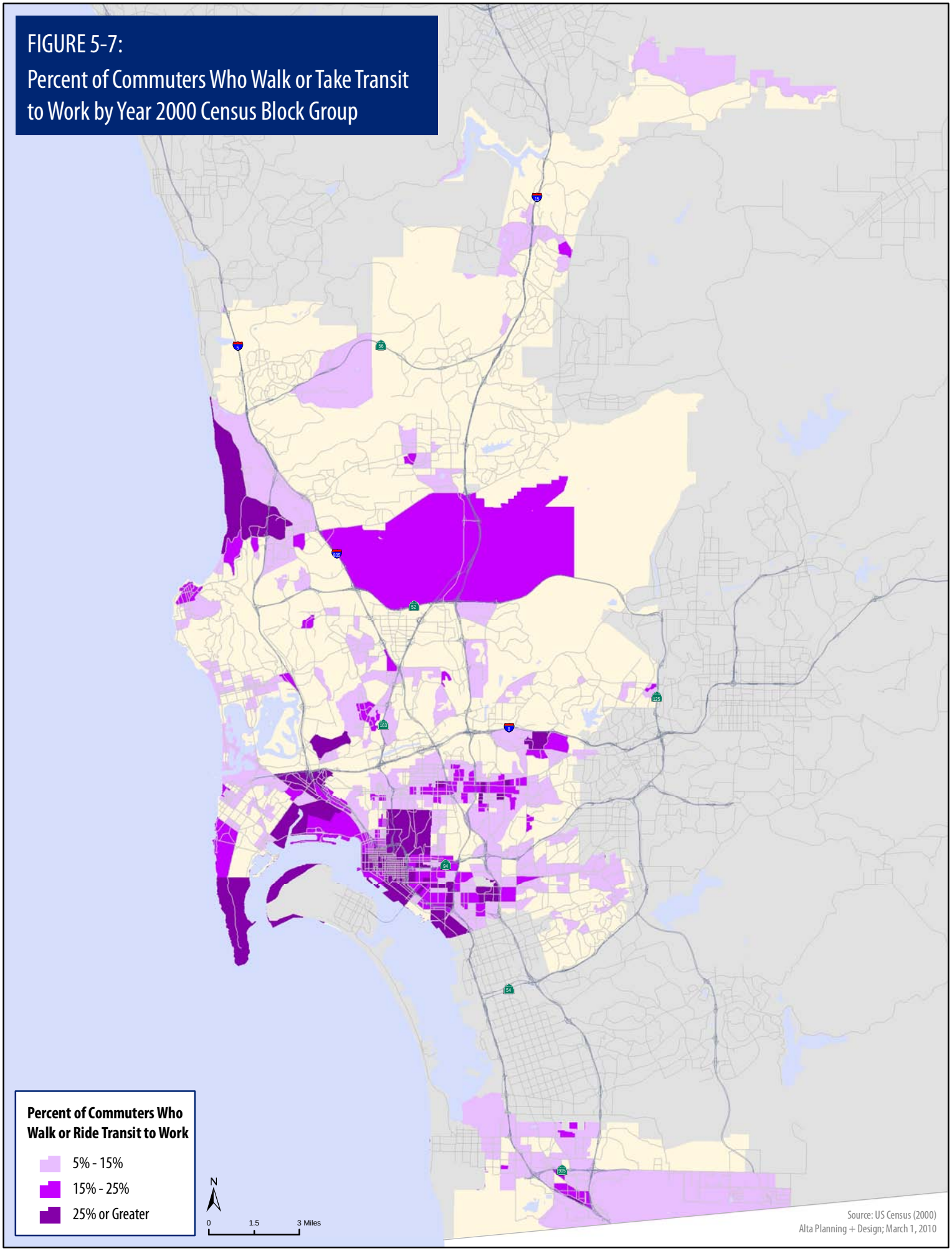
FIGURE 5-7:
Percent of Commuters Who Walk or Take Transit to Work by Year 2000 Census Block Group
Percent of Commuters Who Walk or Ride Transit to Work
5% - 15%
15% - 25%
25% or Greater
N
0
1.5
3 Miles
Source: US Census (2000)
Alta Planning + Design; March 1, 2010

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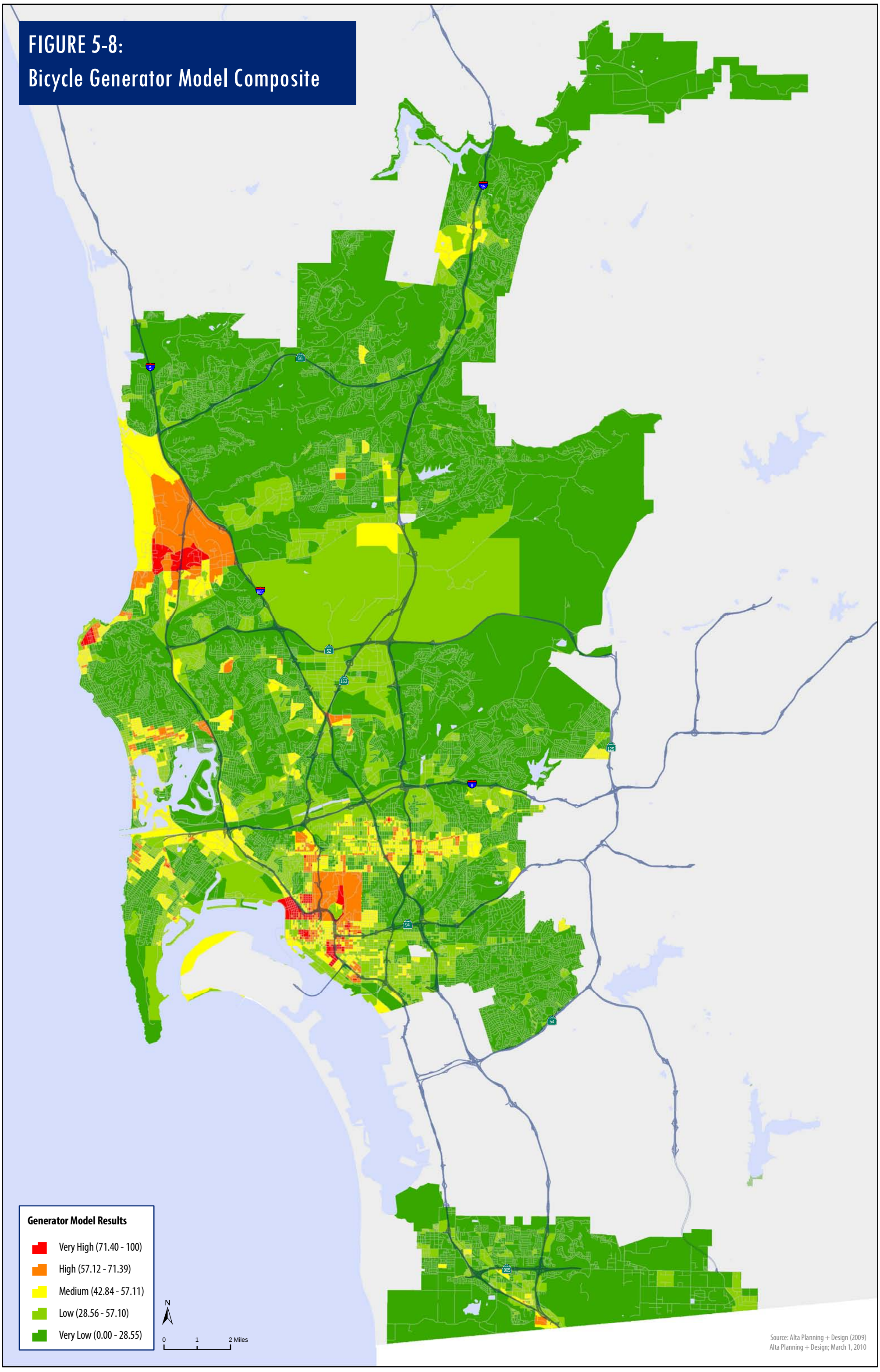
FIGURE 5-8:
Bicycle Generator Model Composite



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Identifying High Within-Community Bicycle Demands (Intra-Community)

Intra-community bicycle demands were then estimated by summing the bicycle attractor and generator scores associated with each segment of the bicycle transportation network and selecting the highest 50% scoring segments. The top 50% of the bicycle transportation segments were assembled into high bicycle demand zones.

Figure 5-9 displays the results of the combined attractor and generator models on the bicycle transportation network, along with the top 50% scoring segments used to form the high demand intra-community bicycle zones. Key intra-community bicycle demand zones include the University Town Center and UCSD areas, La Jolla, Pacific Beach, Mission Bay, Downtown, Mid-City and San Diego State areas.

In order to focus these results on high intra-community bicycle demand corridors, only Circulation Element roadways within the high intra-community demand zones were maintained as final scored output from the intra-community demand modeling effort. By focusing on the Circulation Element roadways, this assessment is ensured of capturing important local bicycling destinations. **Figure 5-10** displays Circulation Element roadway segments within high intra-community demand zones, along with their final intra-community demand scores.

Between-Community Bicycling Demands (Inter-Community)

This section presents the methodology and results of a network-based bicycle demand assessment intended to capture the demand for longer bicycling trips across the city of San Diego. A gravity model framework was employed to estimate network-based bicycle demands, incorporating consideration of both the intensity of activity centers and the distances between them.

The gravity model, as applied in the field of long-range transportation planning, posits that activity centers with higher intensity land uses will generate higher demand for travel between them than activity centers with lower intensity land uses. It also posits that activity centers in closer proximity will generate higher demand for travel between them than activity centers farther apart. In sum, intensity of land uses encourages interactions, while distance discourages interactions. This simple theory of human behavior within an urban region has been widely applied to understand and predict travel behavior and the demand for interactions across a metropolitan region.

Application of the gravity model requires the development of activity center and network systems. The activity centers should describe the amount and intensity land uses, while the network system should characterize distances and travel paths between the activity centers. For the purposes of this project, SANDAG's Smart Growth Opportunity Areas (SGOAs) and the City of San Diego's high Village Propensity areas were used as the basis for the activity center system between which travel demand would be estimated. In terms of the network system, ArcView's Network Analyst was employed to develop two shortest path networks between all SGOAs – one along the bicycle transportation network and the other along the network of existing and proposed (2002) bicycle facilities. The purpose for conducting two separate shortest path assessments is to capture the varying preferences of

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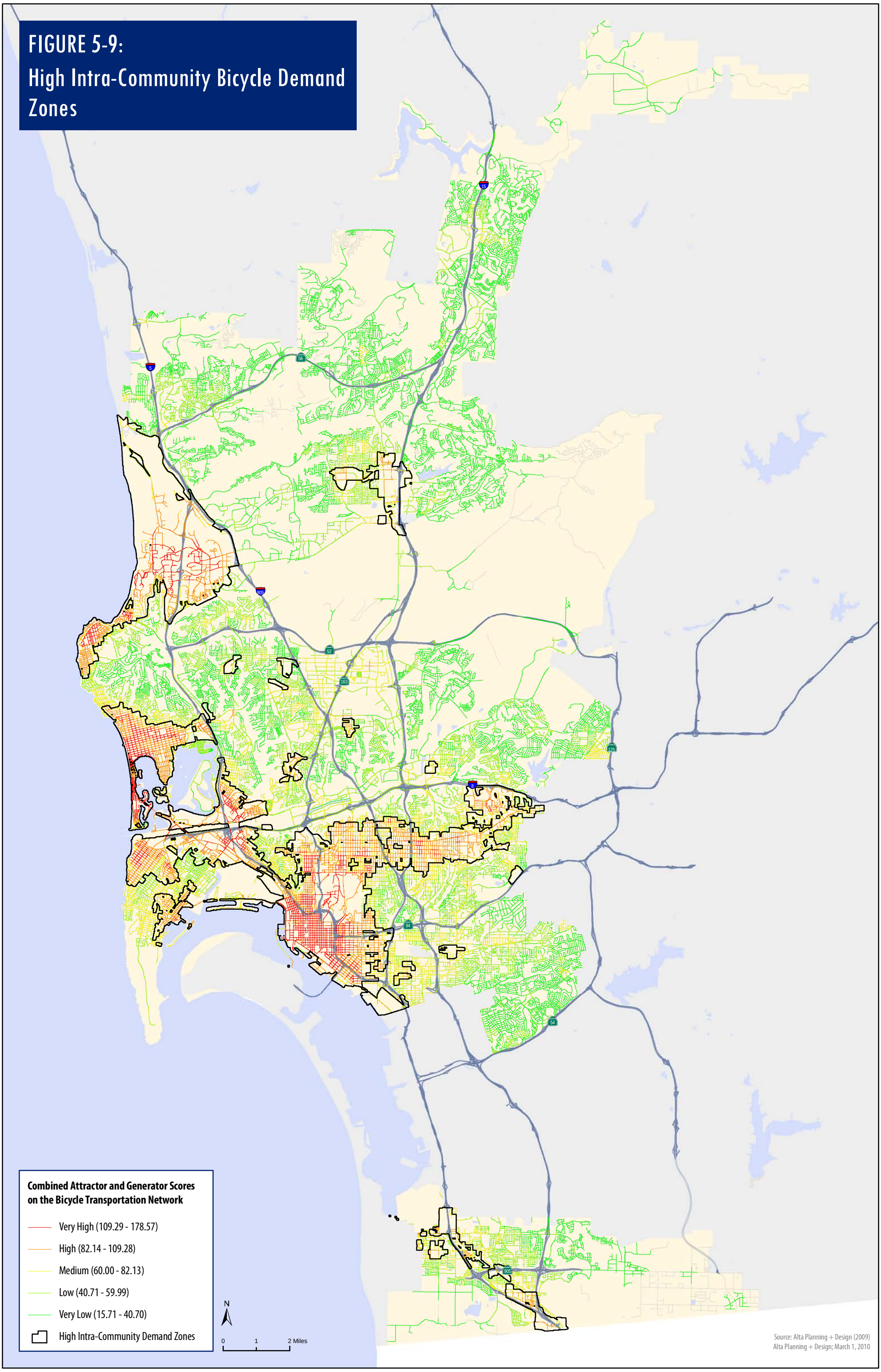
FIGURE 5-9:
High Intra-Community Bicycle Demand Zones



Source: Alta Planning + Design (2009)
Alta Planning + Design; March 1, 2010

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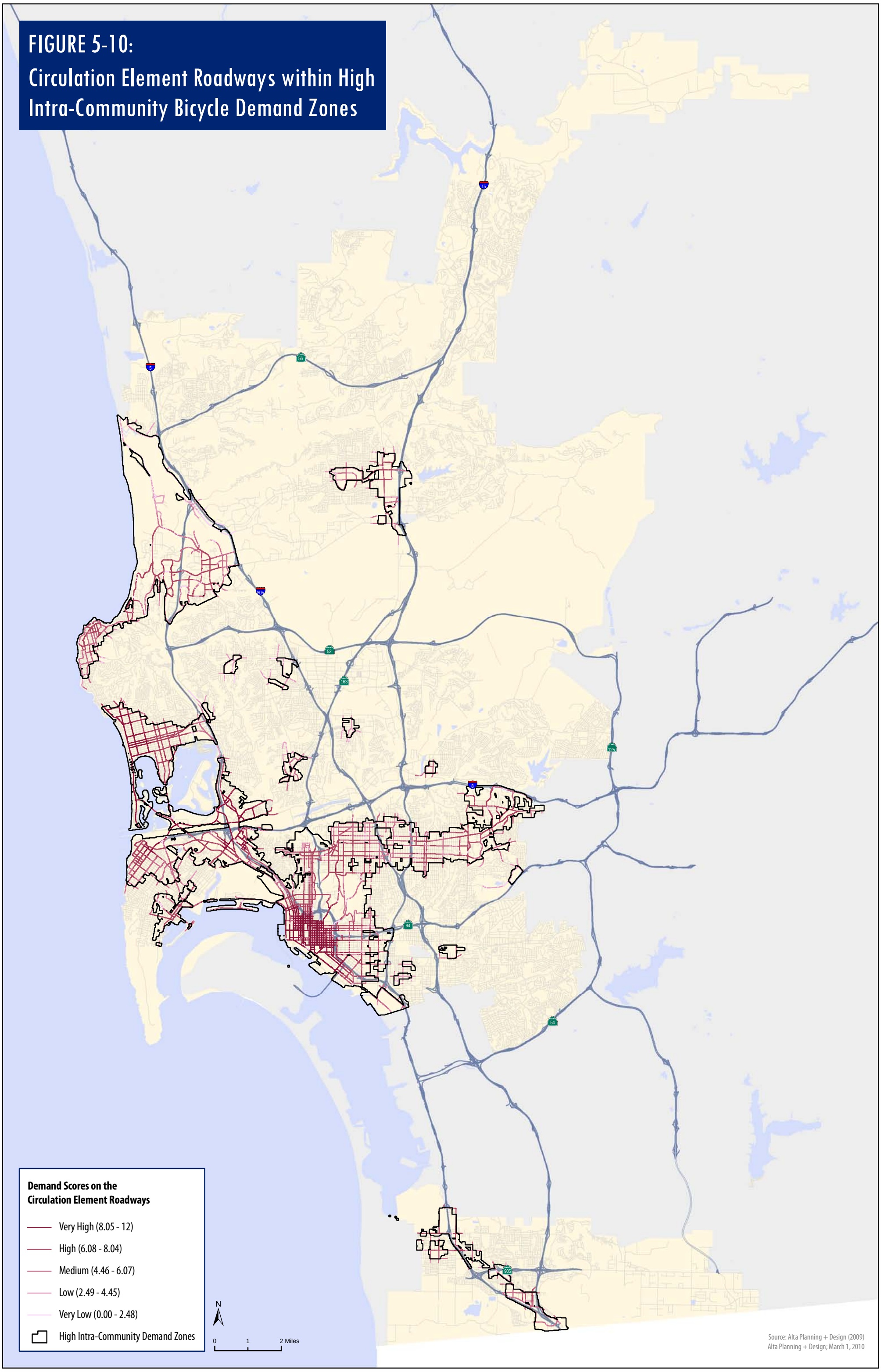
FIGURE 5-10:
Circulation Element Roadways within High Intra-Community Bicycle Demand Zones



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bicyclists, including those who prefer taking the most direct route between origins and destinations, and those who prefer routes with bicycle facility.

Table 5.3 describes the hierarchy and key characteristics of SANDAG's SGOAs, which were used as the basis for activity centers systems in the inter-community demand analysis. **Figure 5-11** displays the activity centers system, along with the two shortest path network systems developed for the inter-community demand analysis.

Table 5.3: SANDAG's Smart Growth Opportunity Area (SGOA) Typologies

Smart Growth Place Type	Minimum Residential Target	Minimum Employment Target	Minimum Transit Service Characteristics
Metropolitan Center	75 du/ac	80 emp/ac	Regional Services
Urban Center	40 du/ac	50 emp/ac	Light Rail/Rapid Bus
Town Center	20 du/ac	30 emp/ac	Light Rail/Rapid Bus
Community Center	20 du/ac	N/A	High Frequency Local Bus within Transit Priority Areas based on the Urban Service Boundary in the 2007-2011 Coordinated Plan
Rural Village	10.9 du/ac	N/A	N/A
Special Use Center	Optional	45 emp/ac	Light Rail/Rapid Bus
Mixed-Use Transit Corridor	25 du/ac	N/A	High Frequency Local Bus

Source: Smart Growth Concept Site Descriptions June 6, 2008 (SANDAG)

High Village Propensity areas are not explicitly included in Table 5.3, since in almost all cases, they overlap with an SGOA. In addition, using SGOAs was advantageous since they provide a justifiable activity centers system outside the boundary of the city of San Diego.

Interaction Levels between Activity Centers

Table 5.4 shows the points system developed for ranking interactions between various origin-destination pairs by activity center type. As shown, the activity centers interaction score ranges from 0 to 6. Interactions between a Metro and Urban Center for example would score 6 points, while interaction between a Town Center and a Community Center would score 1 point.

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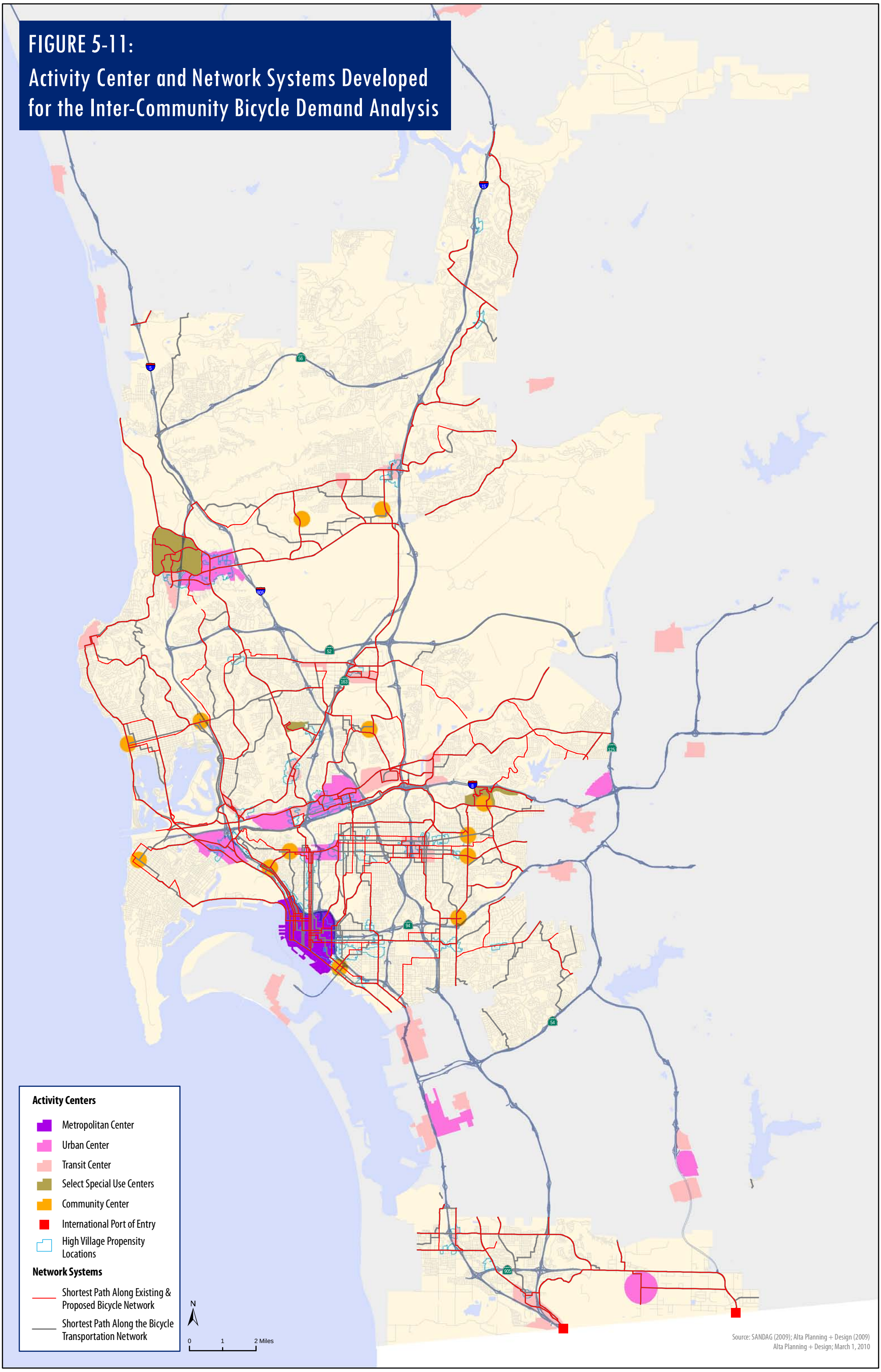
FIGURE 5-11:
Activity Center and Network Systems Developed for the Inter-Community Bicycle Demand Analysis
Activity Centers
Metropolitan Center
Urban Center
Transit Center
Select Special Use Centers
Community Center
International Port of Entry
High Village Propensity Locations
Network Systems
Shortest Path Along Existing & Proposed Bicycle Network
Shortest Path Along the Bicycle Transportation Network
N
0
1
2 Miles
Source: SANDAG (2009); Alta Planning + Design (2009)
Alta Planning + Design; March 1, 2010

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Table 5.4: Activity Centers Interaction Scores (TO / FROM Matrix)

	Metro Centers[1]	Urban Centers[2]	Town Centers[3]	Large Employment Centers[4]	Community Centers[5]
Metro Center	6	6	5	4	3
Urban Centers	6	5	4	3	2
Town Centers	5	4	3	2	1
Large Employment Centers	4	3	2	1	1
Community Centers	3	2	1	1	1

Source: Alta Planning + Design, February 2010

Notes:

1. *The San Ysidro Port of Entry is given the same demand score as a Metro Center.*
2. *SDSU and UCSD are given the same demand scores as Urban Centers.*
3. *The Otay Mesa Port of Entry and Mesa College were given the same demand scores as Town Centers.*
4. *Large Employment Centers not currently included as SGOAs were included in this analysis.*
5. *Only existing Community Centers were included in this analysis. No proposed Community Centers were included, as were for the other activity center types.*

Distance Decay Factor

A distance decay factor was developed to account for the fact that activity centers in closer proximity should generate more interaction; and likewise, those farther apart would experience less interaction. **Table 5.5** displays the equations that were used to calculate distance decay factors for every shortest path connection between all activity centers.

Table 5.5: Distance Decay Factor Equations

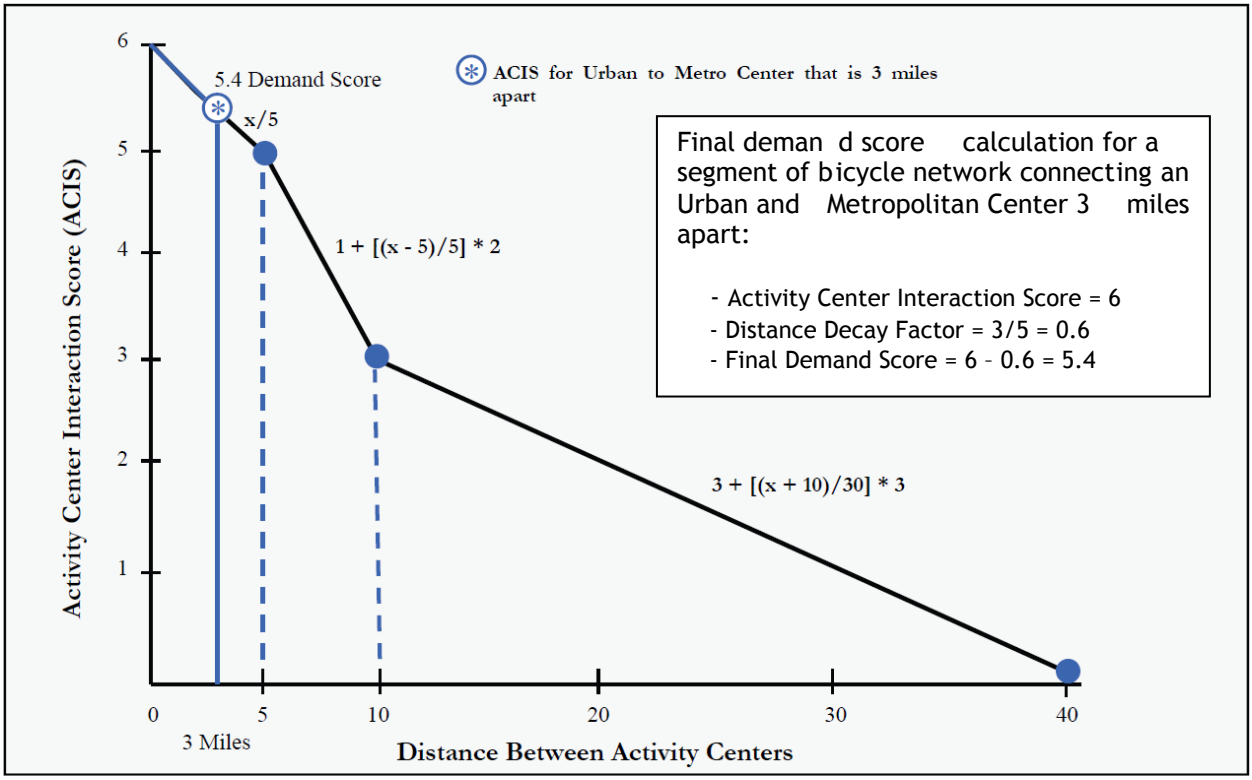
Length of Shortest Path (x)	Distance Decay Equation
x is between 0 and 5 Miles	x / 5
x is between 5 and 10 Miles	1 + [(x – 5) / 5] * 2
x is between 10 and 40 Miles	3 + [(x – 10) / 30] * 3

Source: Alta Planning + Design, February 2010

The distance decay factors range from 0 to 6 and were developed to reflect higher demands for shorter trips and lower demands for longer trips. The final demand ranking along the bicycle network is calculated by subtracting the distance decay factor from the activity center interaction score, as displayed in Table 5.4.

Figure 5-12 illustrates the application of the distance decay equations, as well as a final demand score calculation for a segment of bicycle network connecting between Uptown and Downtown San Diego.

Figure 5-12: Distance Decay Factors and Sample Calculation



Source: Alta Planning + Design, February 2010

The activity center interaction score between Uptown (an Urban Center) and Downtown (a Metro Center) would be 6 based upon the matrix presented in Table 5.4. Assuming Uptown and Downtown are approximately 3 miles apart, the distance decay factor would be 0.6 (i.e. 3 ÷ 5 = 0.6). Subtracting the distance decay factor from the activity centers interaction scores gives a final demand score of 5.4.

Identifying High Between-Community Bicycle Demand (Inter-Community)

An initial inter-community bicycle demand score was calculated for the shortest path between every activity center, incorporating consideration of both the type of activity center at the origin-destination and the distance between the respective activity centers. **Figure 5-13** displays the results of this analysis.

In addition to assigning a demand score for the shortest path, consideration was also given to the frequency with which each segment of each shortest path served as a connection between any given activity center origin and destination pair. The frequency-related demand score is shown in **Figure 5-14.**

The initial inter-community demand score and the frequency-related inter-community demand score were summed to calculate a final inter-community demand score. The results of the final inter-community demand analysis are presented in **Figure 5-15**. The range of final inter-community demand scores is from 0 to 12.

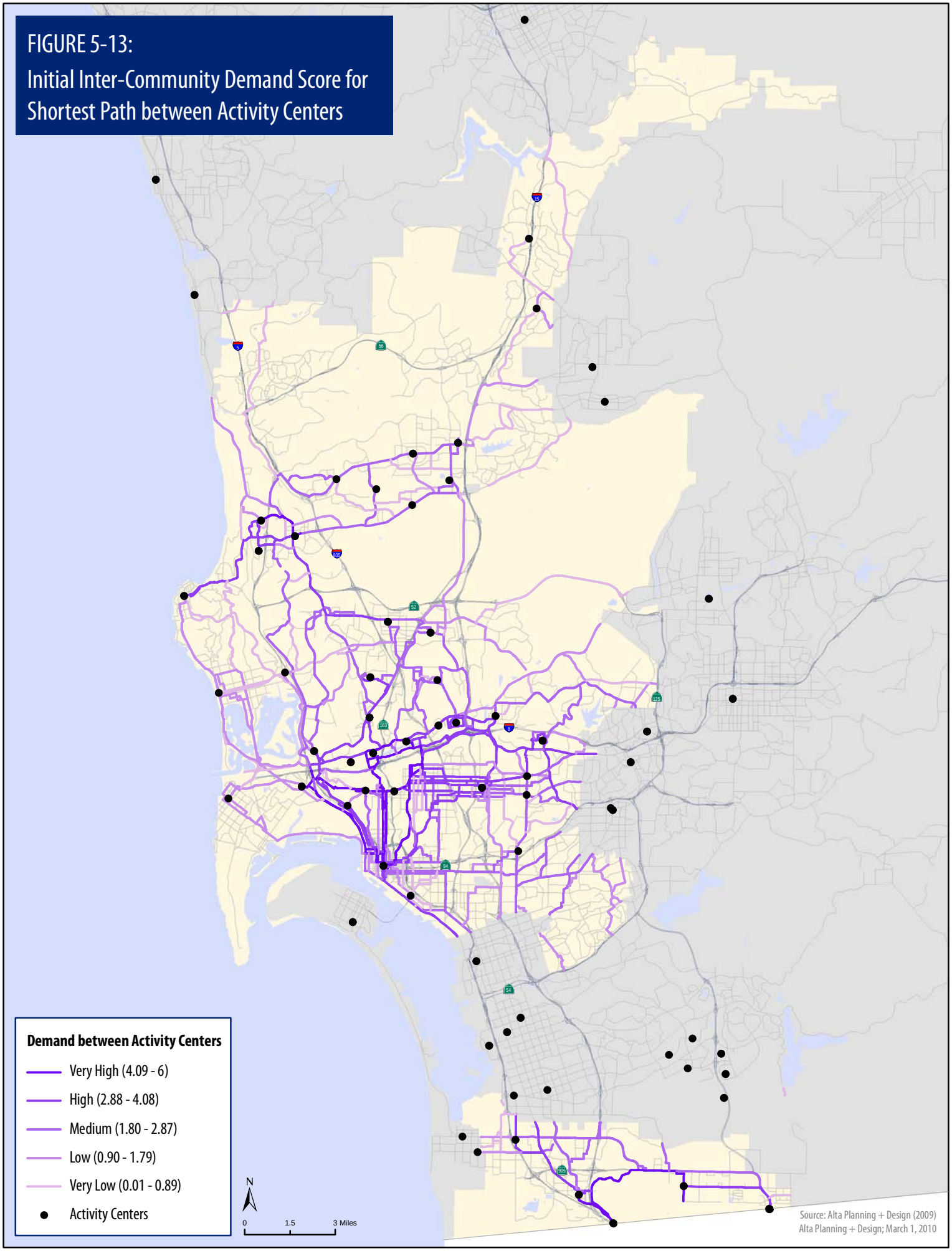


FIGURE 5-13:
Initial Inter-Community Demand Score for Shortest Path between Activity Centers
Demand between Activity Centers
Very High (4.09 - 6)
High (2.88 - 4.08)
Medium (1.80 - 2.87)
Low (0.90 - 1.79)
Very Low (0.01 - 0.89)
Activity Centers
N
0
1.5
3 Miles
Source: Alta Planning + Design (2009)
Alta Planning + Design; March 1, 2010

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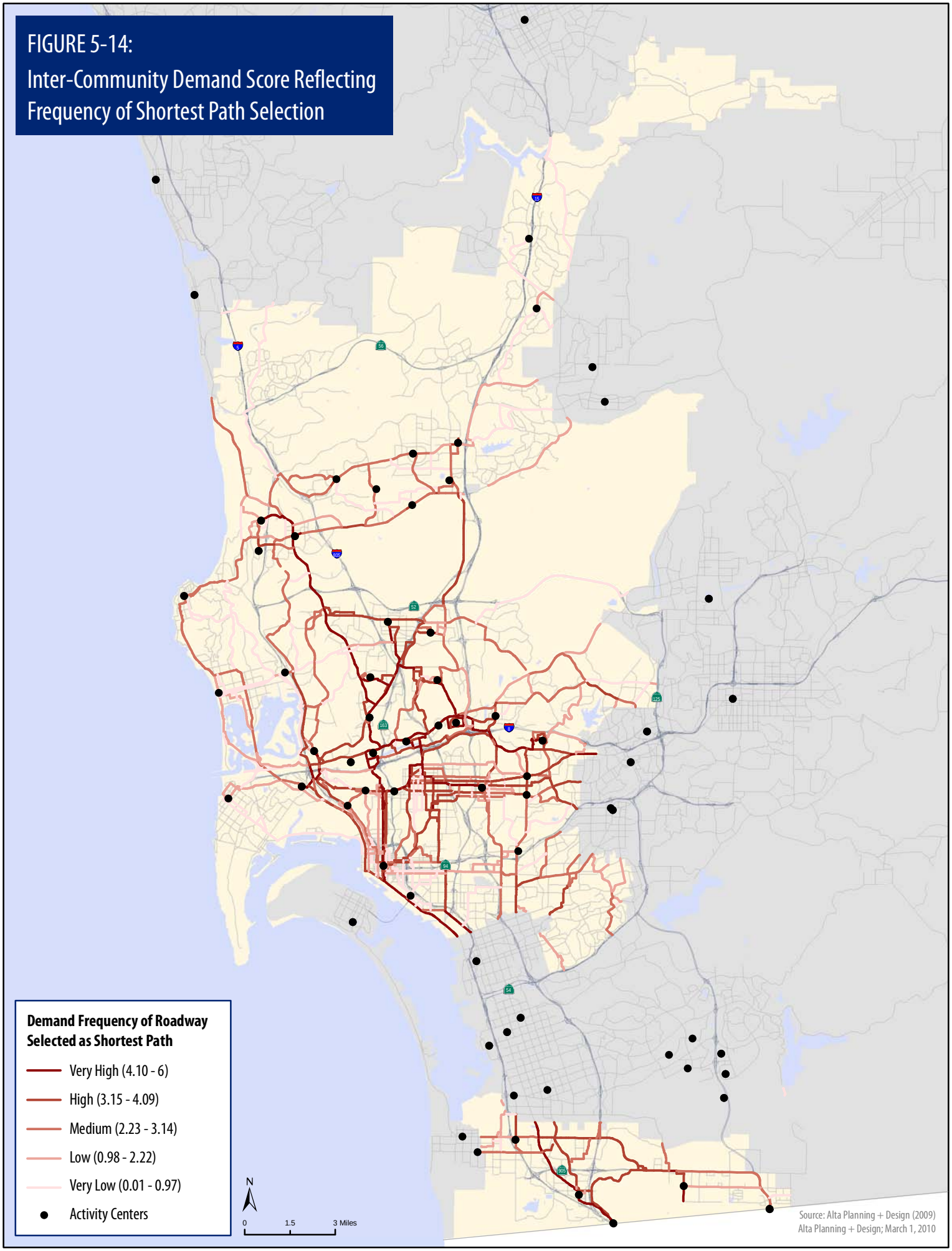
FIGURE 5-14:
Inter-Community Demand Score Reflecting Frequency of Shortest Path Selection
Demand Frequency of Roadway Selected as Shortest Path
Very High (4.10 - 6)
High (3.15 - 4.09)
Medium (2.23 - 3.14)
Low (0.98 - 2.22)
Very Low (0.01 - 0.97)
Activity Centers
N
0
1.5
3 Miles
Source: Alta Planning + Design (2009)
Alta Planning + Design; March 1, 2010

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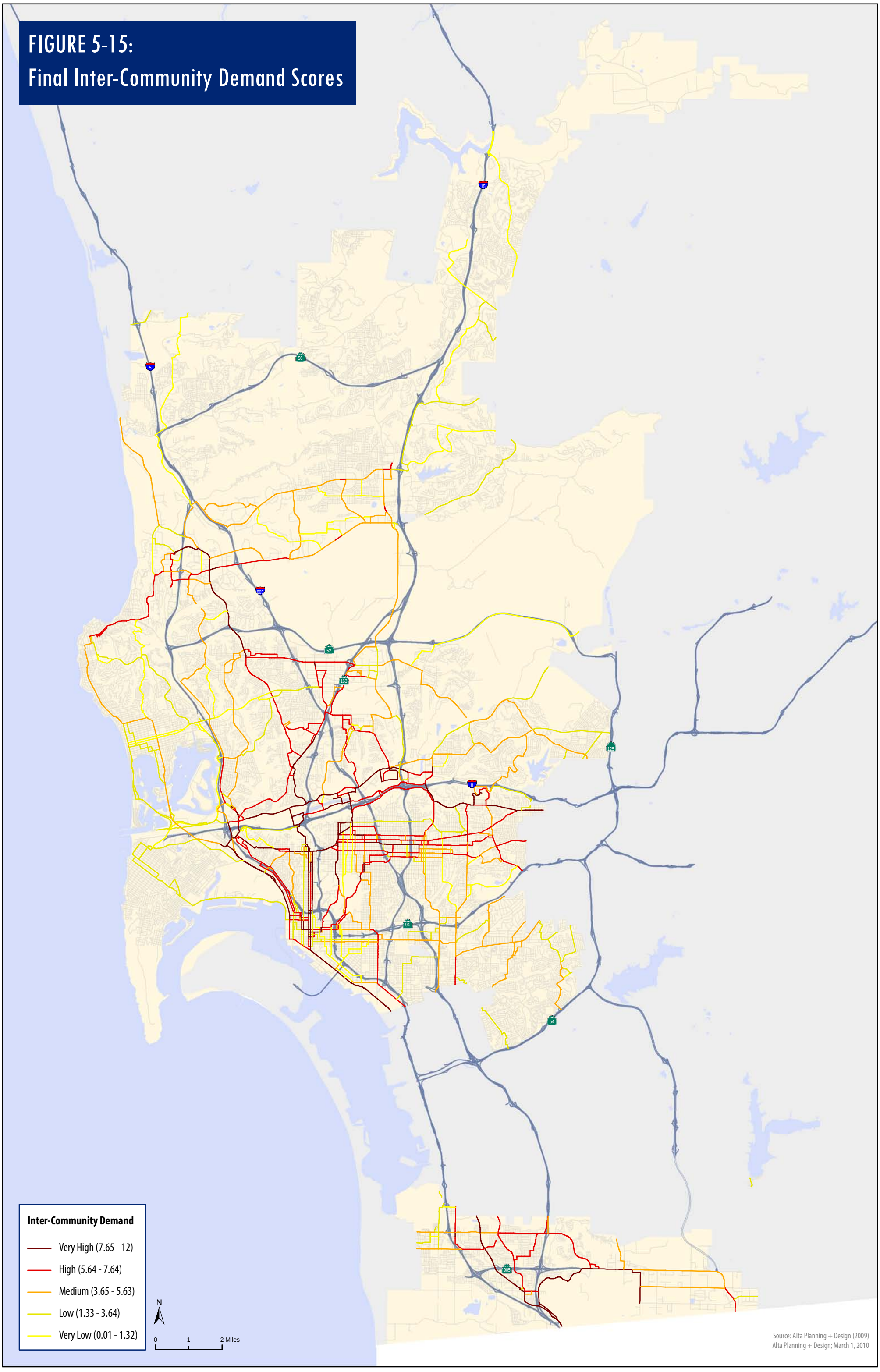
FIGURE 5-15:
Final Inter-Community Demand Scores



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High Combined Bicycling Demand Zones

The last step in the bicycle demand analysis involves combining the intra-community demand scores (Figure 5-9) and the inter-community demand scores (Figure 5-15). The final bicycle demand score, incorporating both intra and inter community travel, ranges from 0 to 24 and is mapped across San Diego in **Figure 5-16**. This analysis identifies roadway segments with the greatest propensity for bicycling activity taking into consideration demands for shorter and longer trips.

Public Input

This section summarizes the public outreach effort undertaken as a part of the planning process, and provides a synopsis of San Diego community members' bicycle riding behaviors, attitudes, issues and recommendations for types of improvements. The input obtained through this extensive outreach effort was integrated into the identification and prioritization of infrastructure and program recommendations presented in Chapters 6 and 7.

The public involvement strategy entailed convening a Project Working Group (PWG), presenting to community and bicycling organizations, facilitating a public workshop, and collecting input on a continual basis via the City's bicycle planning website. The fact that the Plan's development has overlapped with the San Diego Regional Bicycle Plan also enabled the City to utilize the substantial amount of input collected from San Diego residents via the regional planning process. As of October 2008, the San Diego Regional Bicycle Plan survey database contained 985 surveys completed by city of San Diego residents (59 percent of total respondents) according to the residential information provided by survey respondents.

The PWG met five times throughout the planning process to advise the City on the Plan's development. The purpose of the PWG meetings was to present work products to the group and ask PWG members to provide substantive input and direction for future project tasks. In particular, the PWG was instrumental in refining the prioritization process presented in Chapter 6.

Another facet of the public outreach process involved attending a combination of bicycle organization and community planning group meetings focused in areas of the city that showed the weakest representation within the Regional Bicycle Plan public involvement efforts. To encourage participation from San Diego residents who had not participated in the Regional Bicycle Plan effort, the zip codes of San Diego survey respondents were tabulated and the project team pursued attending all community planning area meetings where representation was low. The project team attended the following meetings:

- Kearny Mesa Community Planning Group Meeting
- Southeastern San Diego Planning Committee Meeting
- San Ysidro Community Planning Group Meeting
- Otay Mesa / Nestor Community Planning Committee Meeting

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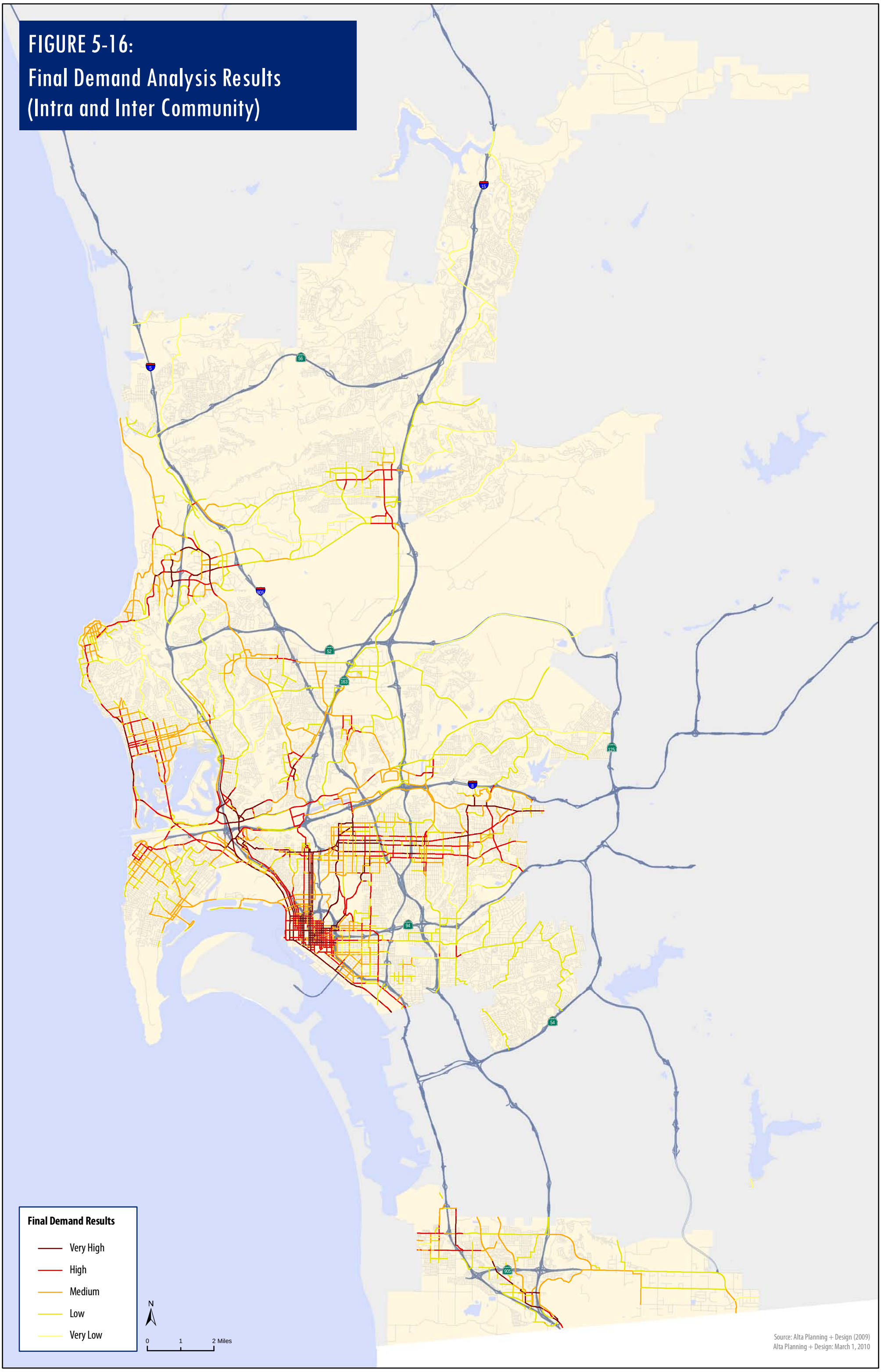
FIGURE 5-16:
Final Demand Analysis Results (Intra and Inter Community)



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- Barrio Logan Community Plan Update Workshop
- San Diego Cyclo-Vets Monthly Meeting
- San Diego County Bicycle Coalition Board Meeting

At these seven meetings, the team presented an overview of the Plan project, and distributed and collected bicycle surveys to record community input. The survey distributed during these events was identical to the online survey accessible via the City's bicycle planning website. This allowed the project team to combine the online survey responses with the responses collected during community meetings. This surveying effort resulted in the collection of a total of 574 surveys as of March 31, 2009, including 513 online surveys and 61 hard copy surveys collected during community meetings. These 574 surveys, along with the 985 surveys collected via the regional planning effort, fed directly into the Plan recommendations. The information obtained via the Regional Bicycle Plan survey is presented in **Appendix B**. The 574 surveys collected through this planning process are summarized in the following section.

Bicycle Survey Results

The bicycle survey consisted of questions about bicyclists' behaviors, preferences, and deficiencies in the bicycling environment.

Table 5-6 shows that, when asked about their motivations for bicycling, 89.8% of survey participants responded that they bicycle for exercise and health reasons, followed by 80.7% responding that they bicycle for enjoyment, and 67.6% bicycle for environmental and/or social reasons.

Table 5-6: Survey Respondents' Motivations for Bicycling

Reason	Percent of Responses
For exercise / health reasons	89.8 %
For enjoyment	80.7 %
For environmental and/or social reasons	67.6 %
To get to work	62.7 %
For shopping / errands	44.0 %
To get to school	29.2 %
To get to transit	20.8 %
Other	5.3 %
I don't bike	2.1 %

Source: Alta Planning + Design, March 2009

Respondents' reasons for bicycling summarized in Table 5-6 are not mutually exclusive. For example, bicyclists may be inclined to bike to work for the health benefits associated with biking and also because they enjoy bicycling. Thus, to better understand what types of bicyclists responded to the survey, respondents were also asked to indicate if the majority of their trips are utilitarian or recreational in nature. **Table 5-7** shows that the majority of trips taken by respondents are utilitarian.

Table 5-7: Respondents' Recreational verses Utilitarian Trips

Trip Type	Percent of Responses
Utilitarian	64.0 %
Recreational	36.0 %
Total	100 %

Source: Alta Planning + Design, March 2009

Table 5-8 shows that respondents' most common average riding distance for a one-way trip is 3 to 5 miles, which is consistent with national averages.

Table 5-8: Survey Respondents' Average Bicycling Distances (one-way)

Miles	Percent of Responses
Under 2 miles	17.2 %
3 – 5 miles	26.4 %
6 – 10 miles	24.6 %
11 – 24 miles	21.0 %
25 miles and above	10.8 %
Total	100 %

Source: Alta Planning + Design, March 2009

Table 5-9 shows that survey participants overwhelmingly preferred off-street paths, on-street bike lanes, and bike boulevards to signed routes with no dedicated riding space or unpaved routes. This may reflect the desire for more direct routes for commuting (on arterial bike lanes) as well as a desire for more recreational paths for the large number of people who stated that they ride a bicycle primarily for exercise and recreation.

Table 5-9: Survey Respondents' Bikeway Facility Preferences

Bicycle Facility Type	1 Highly Preferred	2	3	4 Not at all Interested
Off-Street Paved Bike Paths	70.6 %	17.7 %	8.2 %	3.5 %
On-Street Bike Lanes	48.8 %	37.6 %	10.7 %	2.9 %
Bike Routes	28.5 %	33.0 %	27.1 %	11.4 %
Unpaved Trails or Dirt Paths	13.4 %	23.2 %	26.7 %	36.7 %
Bicycle Boulevards	45.7 %	29.7 %	17.8 %	6.8 %
Shared Roadways (no bikeway designation or bicycle facility)	7.1 %	9.7 %	22.8 %	60.4 %

Source: Alta Planning + Design, March 2009

Table 5-10 shows that 64.2% of respondents say that adding more bike lanes on major streets would influence their decision to ride, followed closely by more paved (off-street) bike paths and increased maintenance of bikeways.

Table 5-10: Improvements that Would Influence Ridership According to Survey Respondents

Improvement	Very Likely	Likely	Somewhat Likely	Somewhat Unlikely	Unlikely	Very Unlikely
More Bike Lanes on Major Streets	64.2 %	21.0 %	9.2 %	1.9 %	1.5 %	2.2 %
More Paved (off-street) Bike Paths	59.6 %	17.9 %	11.9 %	4.3 %	3.4 %	2.9 %
Increased Maintenance	53.9 %	23.2 %	13.9 %	5.7 %	2.1 %	1.2 %
Widen Outside/Curb Lanes on Major Streets	47.7 %	23.2 %	19.3 %	6.2 %	2.8 %	0.8 %
Bicycle Boulevards	47.3 %	24.6 %	16.8 %	4.1 %	4.7 %	2.5 %
More Bike Routes	42.3 %	23.7 %	19.2 %	6.9 %	5.4 %	2.5 %
More Education, Encouragement & Enforcement Programs	35.7 %	18.6 %	23.4 %	9.7 %	7.4 %	5.2 %
Showers and Lockers at Work	34.7 %	18.9 %	21.0 %	6.5 %	10.9 %	7.1 %
More On-Road Bike Signage	27.6 %	22.7 %	24.5 %	13.0 %	8.2 %	4.0 %
More Bicycle Parking/Storage	25.8 %	24.6 %	23.6 %	10.6 %	9.8 %	5.6 %

Source: Alta Planning + Design, March 2009

Table 5-11 reports that 83.4% of respondents have used bicycle maps and guides, followed in popularity by 64.8% of respondents having used bicycle information websites.

Table 5-11: Survey Respondents' Program Participation

Program Type	Percent of Responses
Bicycle Maps and Guides	83.4 %
Bicycle Information Websites	64.8 %
Bicycling Incentive Programs	39.7 %
Materials Focused on Bicyclists Rights, Responsibilities, and the Health or Environmental Benefits of Bicycling	35.6 %
Route Planning Services for Bicyclists	29.5 %
Education Programs for Adult Cyclists	18.6 %
Education Programs for Motorists	12.7 %
Education Programs for Elementary, Middle/Junior, and High School Students	12.4 %
Education Programs for Law Enforcement Personnel	2.4 %

Source: Alta Planning + Design, March 2009

Table 5-12 shows that 66.2% of respondents would be highly interested in a public awareness campaign focused on bicyclists rights, responsibilities, and the health and environmental benefits of bicycling, followed closely by interest in user-friendly bicycle maps and guides and interest in bicycling incentive programs.

Table 5-12: Survey Respondents' Level of Interest in Developing or Expanding Bicycle Programs

Program Type	1 Highly Interested	2	3	4 Not at all Interested
Public Awareness Campaign Focused on Bicyclists Rights, Responsibilities, and the Health and Environmental Benefits of Bicycling	66.2 %	21.1 %	8.4 %	4.3 %
User-Friendly Bicycle Maps and Guides	58.2 %	29.5 %	7.9 %	4.4 %
Bicycling Incentive Programs	55.9 %	24.6 %	11.7 %	7.8 %
Bicycle Information Websites	54.6 %	28.9 %	12.0 %	4.5 %
Route Planning Services for Bicyclists	51.7 %	29.2 %	13.3 %	5.8 %
Education Programs for Motorists	49.2 %	23.3 %	15.1 %	12.4 %
Education Programs for Elementary, Middle/Junior, and High School Students	47.0 %	27.6 %	13.8 %	11.6 %
Education Programs for Law Enforcement Personnel	39.7 %	25.1 %	19.2 %	16.0 %
Education Programs for Adult Cyclists	34.2 %	33.8 %	19.5 %	12.5 %

Source: Alta Planning + Design, March 2009

Public Workshop

A public workshop was held at the Balboa Park Hall of Champions on June 10, 2009. The purpose of the public workshop was to explain the planning process, familiarize the community with the content of the draft Plan, and collect public comment on the content of the draft Plan. Since this workshop was geared toward presenting information and recording responses, it was held in an open house format. Each station was hosted by a knowledgeable staff person who was able to answer questions and record comments. The input obtained during the workshops assisted with developing the Plan. The open houses were organized into six stations with boards covering the following topics:

- Station 1 – Public Involvement Strategy
- Station 2 – Review of the Current Bicycle Master Plan
- Station 3 – Bicycle Demands Analysis
- Station 4 – Proposed Bicycle Network
- Station 5 – Prioritization Process
- Station 6 – Program Strategies

The Bicycle Master Plan Update public workshop
Photo credits: Vincent Noto

Approximately 125 people attended the workshop – more than twice the number of people who attended the 2001 Bicycle Master Plan public workshop. The comments recorded on comment cards and easel paper tablets are presented in **Appendix C**.

Bicycle Safety and Collision Analysis

Table 5.12 presents the number of collisions and collisions involving bicyclists in San Diego for five consecutive years: 2004, 2005, 2006, 2007 and 2008. This information was obtained from the California Highway Patrol's SWITRS website, which provides collision information by jurisdiction. As the table shows, fatal bicycle-related collisions on average account for nearly 5% of all fatal collisions. On average, almost 6% of collisions resulting in injuries involved bicyclists. Bicycle-involved collision rates seem to be relatively constant over the five-year period for San Diego, with the exception of a significant increase in bicycle-related injuries in 2008 (8.4%). The 512 bicycle-involved injury collisions reported is high in relation to the totals reported for the other years and also high relative to the total number of injury collisions reported for 2008. Fatal bicycle collisions also increased significantly in 2005 (7.1%) however the numbers of fatal collisions reported declined to lower levels in the years following 2005, indicating that no trend can be asserted.

Table 5.12: San Diego Bicycle-Involved Collisions Data 2004 – 2008

Year	Total Collisions		Total Bicycle-Related Collisions		Bicycle-Related Percent of Total Fatal	Bicycle-Related Percent of Total Injury
	Fatal	*Injury*	*Fatal*	*Injury*		
2004	98	7,449	5	430	5.1%	5.8%
2005	98	7,124	7	421	7.1%	5.9%
2006	102	9,583	3	397	2.9%	4.1%
2007	84	6,516	4	392	4.8%	6.0%
2008	81	6,123	3	512	3.7%	8.4%
TOTAL	463	36,795	22	2,152	4.8%	5.8%

Source: Statewide Integrated Traffic Records System (SWITRS) 2004, 2005, 2006, 2007 and 2008 Annual Reports

Safety is a major concern for both existing and potential bicyclists. For those who ride, safety is typically an on-going concern or even a distraction. For those who do not ride, it is one of the most compelling reasons not to ride. Nationwide, the total number of reported cyclist fatalities has dropped by 14% since 1997, with 814 fatalities reported in 1997 and 698 fatalities reported in 2007. Another 44,000 cyclists were injured in traffic collisions in 2007. These numbers account for 2% of all persons killed in traffic crashes and 2% of all people injured in traffic collisions in 2007. Of all California traffic fatalities in 2007, 2.7% (109) were cyclist fatalities. This is significantly higher than the nationwide average of 1.7%. Cyclist fatalities in California represent a fatality rate of 2.98 per million residents.

In 2007, adult cyclists (25 and older) accounted for 64% of the total number of cyclist fatalities in the United States; a significantly higher proportion than 46% in 1997. Cyclists under the age of 16 accounted for 15% of the fatalities and 29% of the injuries. However, cyclists under the age of 16 have higher fatality and injury *rates* than other age groups (2.4 fatalities per million population, about 4% higher than the overall cyclist fatality rate (2.31

per million population), and 281 injuries per million population, almost twice the injury rate for cyclists of all ages.)[3]

The proportion of collisions involving fatalities and bicyclists in San Diego was substantially higher at 4.8% compared to the statewide average of 2.7% and the nationwide average of 1.7%. It should be noted that the national injury rate does not take into account the potential for higher per capita bicycle injury and fatality rates in communities with higher than average cycling rates. San Diego's bicycle commuting mode share is consistent with California's (0.9%) and higher than the national average of 0.5%.[4] This may provide partial explanation for why the bicycle fatality collision rate is higher than the national average however it does not explain the severity of the bicycle-related collision proportion relative to bike mode share and total collisions in San Diego. Overall, these statistics indicate that San Diego requires a robust approach to bicycle safety improvements and programs.

Commute Patterns

Understanding how many people bicycle in San Diego is central to developing a baseline against which to measure success and is also imperative information to include in grant applications. This section presents United States Census "Commuting to Work" data as an indication of current bicycle system usage. A major objective of any bicycle facility enhancement or encouragement program is to increase the "bicycle mode split" or percentage of people who choose to bike rather than drive alone. Every saved vehicle trip or vehicle mile represents quantifiable reductions in air pollution and can help lessen traffic congestion. Due to the unstable nature of congestion, even small reductions in the number of vehicles on the road can dramatically improve congestion. **Table 5-14** presents commute to work data estimates reported by the 2006-2008 US Census 2006 – 2008 American Community Survey for the city of San Diego and, for comparative purposes, the United States, California, and County of San Diego.

Table 5.14: Means of Transportation to Work Data

Mode	United States	California	San Diego County	City of San Diego	
				Percent	*Number*
Bicycle	0.5%	0.9%	0.6%	0.9%	5,318
Drove Alone – car, truck or van	75.8%	72.9%	74.7%	75.0%	460,884
Carpool - car, truck or van	10.6%	12.0%	10.9%	9.7%	59,432
Transit	4.9%	5.2%	3.4%	4.1%	25,281
Walked	2.8%	2.8%	3.0%	3.1%	18,986
Other Means	1.4%	1.4%	1.3%	1.1%	7,365
Worked at Home	4.0%	4.8%	6.1%	6.1%	37,317
Total	100%	100%	100%	100%	614,583

Source: U.S. Census Bureau, 2006-2008 American Community Survey

[3] NHTSA National Center for Statistics and Analysis, 2007 Traffic Safety Facts "Bicyclists and Other Cyclists" DOT HS 810 986

[4] U.S. Census Bureau, 2006-2008 American Community Survey 3-Year Estimates

According to the estimates shown in Table 5-14, 0.8 percent of San Diego residents commute predominately by bicycle. This estimated bicycle mode share is slightly higher than the county estimate and above the national estimate but slightly lower than the state estimate. However, it is important to note that this estimate likely underestimates the true amount of bicycling that occurs in San Diego for several reasons. First, data reflects respondents' dominant commute mode and therefore does not capture trips to school, for errands or other bike trips that would supplant vehicular trips. Also, US Census data collection methods only enable a respondent to select one mode of travel, thus excluding bicycle trips if they constitute part of a longer multimodal trip.

The next section of this chapter presents a more realistic estimate of the bicycle mode share in the city based on adjustments for the likely under-estimations. The next section also estimates the potential number of future bicycle commuters in San Diego and calculates the reductions in vehicle-based air pollution that would result from increasing the number of cyclists in San Diego.

Trip Reduction and Potential Air Quality Benefits

Replacing vehicular trips with bicycle trips has a significant impact on reducing human-generated greenhouse gases (GHGs) in the atmosphere that contribute to climate change. Fewer vehicle trips and VMT translates into fewer mobile source pollutants, such as carbon dioxide, nitrogen oxides and hydrocarbons, being released into the air. This section first discusses the status of San Diego's air quality and then estimates potential air quality improvements that could be realized through implementation of this Plan.

Air Quality in San Diego

The city of San Diego lies within the San Diego Air Basin, which is regulated by the Air Pollution Control District (District) of the County of San Diego. The 4,255 square mile San Diego Air Basin is monitored for several air pollutants, including ozone, carbon monoxide, nitrogen dioxide and fine particles (PM10 and PM2.5).

Though air pollution in San Diego has improved dramatically in the last thirty years, and pollution levels meet the federal standards, pollution still exceeds the maximum allowable state limits for some portion of the year. In 2008, the city exceeded state 8-hour ozone standards 4 days of the year and exceeded the state ozone 1-hour standard 1 day of the year. The city exceeded the state annual arithmetic mean PM 2.5 standard by 0.3 micrograms, exceeded the state annual arithmetic mean PM10 standard by 6.2 micrograms, and exceeded the state 24-hour PM10 standard by 3.0 micrograms.[5]

According to the San Diego Air Pollution Control District's 2008 Report, motor vehicles are responsible for approximately 46% of ozone (smog) emissions. Reducing vehicle miles traveled (VMTs)[6] by providing residents safe and functional ways to get to work, school, or

5 2008 San Diego Air Pollution Control Board Annual Report.

6 Vehicle Miles Traveled is a measurement of the extent of motor vehicle operation, a sum of all miles traveled by motor vehicles over a given period.

shopping without using a motor vehicle will aid in reducing the amount of these pollutants produced by motor vehicles.

Future Ridership and Potential Air Quality Benefits

This section presents a revised estimate of current bicycling levels in San Diego using US Census data along with several adjustments for likely Census underestimations. This section also presents forecast future bicycle ridership for the city along with forecast trip reduction and air quality benefits associated with bicycle trips replacing automobile trips. While these revised estimates and forecasts are ambitious, they are important to building a case for investing in bicycle facilities and programs over time.

By supplementing US Census and SANDAG data with estimates of bicycle mode share for students and transit riders, this plan estimates that the actual current number of daily bicycle commuters in San Diego is closer to 47,399 riders, making 94,799 daily trips and saving an estimated 29,061 VMTs per weekday. The calculations behind this estimate are described in **Table 5.15**.

Table 5.16 quantifies the estimated increase in bicyclists and resulting reduction in VMTs in San Diego assuming completion of the bicycle network by the year 2030. It is predicted that upon completion of the proposed regional bicycle network, the total number of work, transit-bicycle bicycle commuters could increase from the current estimate of 47,399 to 112,378, resulting in an estimated decrease of 1,714 pounds of hydrocarbons per weekday, 1,197 pounds of mono-nitrogen oxides (NOx) per weekday, 1,711 pounds of PM10 (particulate matter) per year, and 121,397,271 pounds of carbon dioxide (CO2) per year. Predicted increases in cycling are based on increases in cycling on newly built bikeways in San Francisco, California; Portland, Oregon; and Seattle, Washington.[7]

[7] San Francisco saw 61% corridor increase at 20% network completion, translating to 305% adjusted increase. Portland saw 137% corridor increases at 50% system completion, translating to 274% adjusted increase. Seattle saw 90% corridor increase at 35% system completion, translating to 257% adjusted increase. This translates into an average 279% increase upon system completion. Adjusted increase reflects the projected amount of bicycling that will occur when the system is completed, based on studies of communities with completed or nearly completed bikeway systems. Corridor increases refers to the average increase in bicycling in the corridors in each city, before and after bikeways were installed. System completion refers to the percent completion of the citywide bikeway network in each city.

Table 5.15: Adjusted Estimates of Current Bicycle Commute and Air Quality Benefits

Current Commuting Statistics and Estimates		Source/Calculation
City of San Diego Population	1,336,865	*SANDAG 2008 Total Population Estimate*
Number of Employed Persons	668,022	*2006-2008 ACS 3-Year Estimates, US Census*
Bicycle-to-Work Mode Share	0.9%	*2006-2008 ACS 3-Year Estimates, US Census*
Number of Bicycle Commuters	6,012	*Employed persons multiplied by bike-to-work mode share*
Work-at-Home Mode Share	6.1%	*2006-2008 ACS 3-Year Estimates, US Census*
Estimated Work-at-Home Bicycle Commuters	20,375	*Assumes 50% of population working at home makes at least one bicycle trip per day*
Existing Transit-to-Work Mode Share	4.1%	*2006-2008 ACS 3-Year Estimates, US Census*
Estimated Transit Bicycle Commuters	6,847	*Employed persons multiplied by transit mode share. Assumes 25% of transit riders access transit by bicycle.*
School Children Grades K-8	135,535	*2006-2008 ACS 3-Year Estimates, US Census*
Estimated School Children Bicycling Mode Share	2.0%	*National Safe Routes to School surveys (2003)*
Estimated School Bicycle Commuters	2,711	*School children population multiplied by school children bike mode share*
Number of College Students in Region	114,546	*2006-2008 ACS 3-Year Estimates, US Census*
Estimated College Student Bicycling Mode Share	10.0%	*National Bicycling & Walking Study, FHWA, Case Study No. 1, 1995. Review of bicycle commute share in seven university communities (10%)*
Estimated College Bicycle Commuters	11,455	*College student population multiplied by college student bicycling mode share*
Adjusted Current Estimated Total Number of Daily Bicycle Commuters	47,399	*Total of bike-to-work, transit, school, and college bicycle commuters. Does not include recreation or utilitarian.*
Adjusted Current Estimated Total Daily Bicycle Trips	94,799	*Total bicycle commuters x 2 (for round trips)*
Current Vehicle Miles and Trip Reductions Estimates		**Source/Calculation**
Reduced Vehicle Trips per Weekday	29,061	*Assumes 73% of bicycle trips replace vehicle trips for adults/college students and 53% for school children Based on survey results from 10 California cities conducted by Alta between 1990 and 1999, L.A. Countywide Policy Document survey (1995), and National Bicycling & Walking Study, FHWA, 1995.*
Reduced Vehicle Trips per Year	7,584,906	*Reduced number of weekday vehicle trips multiplied by 261 (weekdays in a year).*
Reduced Vehicle Miles per Weekday	222,431	*Assumes average round trip travel length of 8 miles for adults/college students and 1 mile for schoolchildren*
Reduced Vehicle Miles per Year	58,054,452	*Reduced number of weekday vehicle miles multiplied by 261 (weekdays in a year).*
Estimated Current Air Quality Benefits		**Source/Calculation**
Reduced Hydrocarbons (pounds/weekday)	667	*Daily mileage reduction multiplied by 1.36 grams per reduced mile (Emissions rates from EPA report 420-F-05-022 "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." 2005.)*
Reduced PM10 (pounds/weekday)	3	*Daily mileage reduction multiplied by 0.0052 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM2.5 (pounds/weekday)	2	*Daily mileage reduction multiplied by 0.0049 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced NOX (tons/weekday)	466	*Daily mileage reduction multiplied by 0.95 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*

Table 5.15: Adjusted Estimates of Current Bicycle Commute and Air Quality Benefits (continued)

Reduced CO (pounds/weekday)	6,081	*Daily mileage reduction multiplied by 12.4 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced C02 (pounds/weekday)	180,949	*Daily mileage reduction multiplied by 369 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced Hydrocarbons (pounds/year)	174,064	*Yearly mileage reduction multiplied by 1.36 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM10 (pounds/year)	666	*Yearly mileage reduction multiplied by 0.0052 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM2.5 (pounds/year)	627	*Yearly mileage reduction multiplied by 0.0049 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced NOX (tons/year)	121,589	*Yearly mileage reduction multiplied by 0.95 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced CO (pounds/year)	1,587,053	*Yearly mileage reduction multiplied by 12.4 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced C02 (pounds/year)	47,227,630	*Yearly mileage reduction multiplied by 369 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*

Source: Alta Planning + Design, February 2010

Table 5.16: Future Bicycle Commute and Air Quality Benefits Estimates

Current Commuting Statistics and Estimates		Source/Calculation
City of San Diego Population	1,656,257	*SANDAG 2030 Total Population Forecast*
Number of Employed Persons	1,010,157	*SANDAG 2030 Total Employed Persons Forecast*
Bicycle-to-Work Mode Share	2.7%	*Assumption based on the experiences of other major cities*
Number of Bicycle Commuters	27,274	*Employed persons multiplied by bike-to-work mode share*
Work-at-Home Mode Share	10.0%	*Estimate based on historic work-at-home population growth*
Estimated Work-at-Home Bicycle Commuters	50,508	*Assumes 50% of population working at home makes at least one bicycle trip per day*
Existing Transit-to-Work Mode Share	4.1%	*Estimate based on historic transit-to-work trends*
Estimated Transit Bicycle Commuters	10,354	*Employed persons multiplied by transit mode share. Assumes 25% of transit riders access transit by bicycle.*
School Children Grades K-8	181,297	*SANDAG 2030 Population Forecasts*
Estimated School Children Bicycling Mode Share	2.5%	*Assumes increase in usage based on SR2S efforts and network development*
Estimated School Bicycle Commuters	4,532	*School children population multiplied by school children bike mode share*
Number of College Students in Region	140,781	*Estimate based on historic percent population*
Estimated College Student Bicycling Mode Share	14.0%	*National Bicycling & Walking Study, FHWA, Case Study No. 1, 1995. Review of bicycle commute share in seven university communities (10%)*
Estimated College Bicycle Commuters	19,709	*College student population multiplied by college student bicycling mode share*
Adjusted Current Estimated Total Number of Daily Bicycle Commuters	112,378	*Total of bike-to-work, transit, school, and college bicycle commuters. Does not include recreation or utilitarian.*
Adjusted Current Estimated Total Daily Bicycle Trips	224,756	*Total bicycle commuters x 2 (for round trips)*
Current Vehicle Miles and Trip Reductions Estimates		**Source/Calculation**
Reduced Vehicle Trips per Weekday	73,571	*Assumes 73% of bicycle trips replace vehicle trips for adults/college students and 53% for school children Based on survey results from 10 California cities conducted by Alta between 1990 and 1999, L.A. Countywide Policy Document survey (1995), and National Bicycling & Walking Study, FHWA, 1995.*
Reduced Vehicle Trips per Year	19,202,012	*Reduced number of weekday vehicle trips multiplied by 261 (weekdays in a year).*
Reduced Vehicle Miles per Weekday	571,752	*Assumes average round trip travel length of 8 miles for adults/college students and 1 mile for schoolchildren*
Reduced Vehicle Miles per Year	149,227,306	*Reduced number of weekday vehicle miles multiplied by 261 (weekdays in a year).*
Estimated Current Air Quality Benefits		**Source/Calculation**
Reduced Hydrocarbons (pounds/weekday)	1,714	*Daily mileage reduction multiplied by 1.36 grams per reduced mile (Emissions rates from EPA report 420-F-05-022 "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." 2005.)*
Reduced PM10 (pounds/weekday)	7	*Daily mileage reduction multiplied by 0.0052 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM2.5 (pounds/weekday)	6	*Daily mileage reduction multiplied by 0.0049 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced NOX (tons/weekday)	1,197	*Daily mileage reduction multiplied by 0.95 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced CO (pounds/weekday)	15,630	*Daily mileage reduction multiplied by 12.4 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*

5.16: Future Bicycle Commute and Air Quality Benefits Estimates (continued)

Reduced C02 (pounds/weekday)	465,124	*Daily mileage reduction multiplied by 369 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced Hydrocarbons (pounds/year)	447,426	*Yearly mileage reduction multiplied by 1.36 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM10 (pounds/year)	1,711	*Yearly mileage reduction multiplied by 0.0052 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced PM2.5 (pounds/year)	1,612	*Yearly mileage reduction multiplied by 0.0049 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced NOX (tons/year)	312,540	*Yearly mileage reduction multiplied by 0.95 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced CO (pounds/year)	4,079,475	*Yearly mileage reduction multiplied by 12.4 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*
Reduced C02 (pounds/year)	121,397,271	*Yearly mileage reduction multiplied by 369 grams per reduced mile (Emissions rates from EPA report 420-F-05-022, 2005.)*

Source: Alta Planning + Design, February 2010