

---

# **Pedestrian Priority Model Update and Data Documentation**

---

*Task C of the Multimodal Planning Research Project*

## **Final Report**

*Prepared for:*

**City of San Diego**

*Prepared by:*

**CHEN  RYAN**

3900 5<sup>th</sup> Avenue  
Suite 210  
San Diego, California 92103

November 20, 2015

---

## Table of Contents

<b>1.0</b>	<b>Background .....</b>	<b>1</b>
<b>2.0</b>	<b>Modeling Overview – Suitability Analysis .....</b>	<b>2</b>
<b>3.0</b>	<b>Data Inputs.....</b>	<b>6</b>
<b>4.0</b>	<b>Points and Weights .....</b>	<b>13</b>
4.1	Pedestrian Attractors .....	13
4.2	Pedestrian Generators .....	14
4.3	Pedestrian Detractors .....	18
<b>5.0</b>	<b>GIS Steps .....</b>	<b>20</b>
5.1	Attractor Submodel.....	20
5.2	Generator Submodel.....	26
5.3	Detractor Submodel.....	32
5.4	Final Composite Model .....	36
<b>6.0</b>	<b>Data Output.....</b>	<b>37</b>
6.1	Citywide PPM Composite Model.....	37
6.2	Average PPM Composite Score by Community Planning Area .....	39
	List of References.....	41

## List of Tables

Table 2.1: Example of “Within” and “Between” Suitability Analysis Criteria Ranking .....	3
Table 3.1: Attractor Submodel Inputs.....	7
Table 3.2: Generator Submodel Inputs.....	8
Table 3.3: Detractor Submodel Inputs.....	12
Table 4.1: Pedestrian Attractor Data Inputs and Assigned Points and Weights.....	13
Table 4.2: Pedestrian Attractor Distance-Based Points and Weights.....	14
Table 4.3: Pedestrian Generator Factors and Scoring .....	16
Table 4.4: Pedestrian Detractors Factors and Scoring.....	18
Table 5.1: Point Values for the Transit Ridership Buffer Shapefile (Step 5.6) .....	25

## List of Figures

Figure 2-1: General Suitability Analysis Process .....	4
Figure 2-2: Pedestrian Priority Model Analysis Process .....	5
Figure 4-1: Attractor Model Results.....	15
Figure 4-2: Generator Model Results.....	17
Figure 4-3: Detractor Model Results.....	19
Figure 6-1: Final Citywide PPM Composite Model .....	38

---

## 1.0 Background

This report documents an update to the City of San Diego's Pedestrian Priority Model (PPM), with a particular focus on recording data inputs, analysis methodology and key outputs. The City is updating the PPM since several of the data inputs are out of date. The last PPM model update was in 2009, over five years ago. This report documents PPM data inputs and GIS analysis steps in detail, in order to build capacity among other San Diego consultants and City staff to work fluently with the PPM on a variety of planning efforts.


The PPM was originally developed in 2006 during the Phase I Pedestrian Master Plan process to identify and prioritize pedestrian improvement areas across the City. It was subsequently updated in 2009 during the Phase 2 Pedestrian Master Plan process, and that update was also used in the Phase 4 Pedestrian Master Plan process. An overview of each of the pedestrian master planning phases is provided below as background to the current PPM update.


- ✚ **Phase 1** of the Pedestrian Master Plan project resulted in the Citywide Implementation Framework Report, (December 2006) with the vision to *"create a safe, accessible, connected and walkable pedestrian environment that enhances neighborhood quality and promotes walking as a practical and attractive means of transportation in a cost-effective manner."* Phase 1 of the Pedestrian Master Plan identified the planning context and health trends in support of walkable communities, identified pedestrian issues and solutions, defined pedestrian route type classifications, debuted the Pedestrian Priority Model, and established a guiding framework for future pedestrian planning phases.
- ✚ **Phases 2 and 3** were combined and completed in 2015. In addition to updating the Pedestrian Priority Model, this phase developed Community Pedestrian Plan Development Guidelines and detailed methodologies for updating community-specific pedestrian plans. These methodologies were applied to assess pedestrian conditions in seven pilot communities: Greater North Park, Southeastern San Diego, Greater Golden Hill, Uptown, Normal Heights, Barrio Logan, and City Heights.
- ✚ **Phase 4** of the Pedestrian Master Plan project took place from 2011 to 2013. This phase addressed pedestrian conditions in seven additional community planning areas, including Kensington-Talmadge, College, Midway-Pacific Highway, Ocean Beach, Old Town, Pacific Beach, and San Ysidro.

This report is organized into the following chapters:

- ✚ **Chapter 2.0 Modeling Overview – Suitability Analysis:** This chapter summarizes the overarching methodology utilized to create the PPM, referred to as weighted suitability analysis.
- ✚ **Chapter 3.0 Data Inputs:** This chapter documents data inputs by filename and source to aid in replicating the PPM as necessary in the future.
- ✚ **Chapter 4.0 Points and Weighting System:** This chapter summarizes the point and weight system applied to the data inputs for each submodel of the PPM, as well as provides a map of each of the submodel outputs.

---

 **Chapter 5.0 GIS Steps:** This chapter provides step-by-step guidance for creating the PPM in ArcGIS 10.1.

 **Chapter 6.0 Data Outputs:** This chapter presents the composite PPM and discusses the data normalization used to account for open space and single-family residential land uses when applying the model to community planning areas within San Diego.

## 2.0 Modeling Overview – Suitability Analysis

Suitability analysis in the classical sense of the term refers to the layering of mapped information across a study area in a manner that allows for the simultaneous consideration of multiple factors in support of a decision-making process. The layering of multiple mapped inputs helps to identify the spatial coincidence of these inputs. The analyst may want to locate places where inputs overlap, or where they do not overlap, depending on the decision-making process and the specific inputs assessed.

The PPM was originally developed to identify locations across the City of San Diego with high “pedestrian need” or places that warrant relatively higher consideration for pedestrian infrastructure improvement. The model included three key groupings of criteria to identify these locations: 1) pedestrian trip generation criteria 2) pedestrian trip attraction criteria, and 3) pedestrian detractor criteria. The overarching concept is that locations with high demand for walking (as reflected by pedestrian trip generation and attraction) and high pedestrian detractors warrant higher consideration for pedestrian improvements.

The PPM was specifically developed as a “weighted suitability model” meaning that each input criteria is categorized and ranked, and then weights are assigned to each of the input criteria. This results in the values of each criteria being scaled as “high to low”, and in some criteria having more strength in the overall output than others. In other words, there is a “within” criteria ranking and a “between” criteria ranking.

**Table 2.1** displays this concept of “within” and “between” criteria ranking using a simple set of two inputs, population density and household income.

In terms of population density, the data values are categorized into four classes (>25 persons per acre, 5 – 25 persons per acre; 1-5 persons per acre, and <1 persons per acre). Points are then assigned to the four classes to reflect which class has a relatively higher expected contribution to pedestrian trip generation. The highest class receives the highest point value (3 points), and the lowest class receives the lowest point value (0 points). The same process is applied to the income data – the data are categorized into three classes and points are assigned to reflect higher to lower expected contribution to pedestrian trip generation. This effectively ranks each criteria “within” or relative to itself.

In terms of the “between” criteria ranking, weights are assigned to each of the criteria reflecting how each one is expected to contribute to pedestrian trip generation. In the example presented in Table 2.1, population density is expected to contribute relatively more than household income, thus a higher weighting value is applied to population density than to household income (2 versus 1). A final scoring for each criteria’s class is calculated by multiplying the ranking points and the weights.

**Table 2.1: Example of “Within” and “Between” Suitability Analysis Criteria Ranking**

Pedestrian Generators	Points	Weighted Multiplier	Final Score
Population Density (people per acre)			
> 25	3 (high)	2 (high)	6
5 - 25	2 (medium)		4
1 - 5	1 (low)		2
<1	0		0
Household Income (affects transportation mode)			
< \$34,500	3 (high)	1 (low)	3
\$34,500 - \$63,400	2 (medium)		2
> \$63,400	1 (low)		1

Source: Chen Ryan Associates, November 2015

**Figure 2-1** displays a general overview of the steps taken to perform a weighted suitability analysis as utilized for the development of the PPM.

**Figure 2-2** summarizes the general process for arriving at a final PPM raster file. As shown, the final pedestrian priority raster is a composite of the attractor, generator and detractor submodels.

**Figure 2-1: General Suitability Analysis Process**

## **1 Determine the question to be studied**

- Where in San Diego are pedestrians most likely to be found?
- Which communities in San Diego and what locations within these communities stand to benefit the most from pedestrian infrastructure improvements?

## **2 Define the criteria to be analyzed**

- Determinants of pedestrian priority are described in terms of pedestrian generators, pedestrian attractors, and pedestrian detractors.
- Each of these criteria are comprised of multiple factors that relate to an individual's propensity to make a walking trip or a location's potential need for improvement.

## **3 Develop a point and weight system**

- Each of the factors related to pedestrian attractors, pedestrian generators, and pedestrian detractors is assigned points and weights.

## **4 Determine the GIS tools and procedures needed**

- A variety of GIS tools are used to create the PPM as outlined in detail in Chapter 5.0.

## **5 Perform the analysis**

- A variety of analyses approaches are employed to create the PPM as outlined in detail in Chapter 5.0.

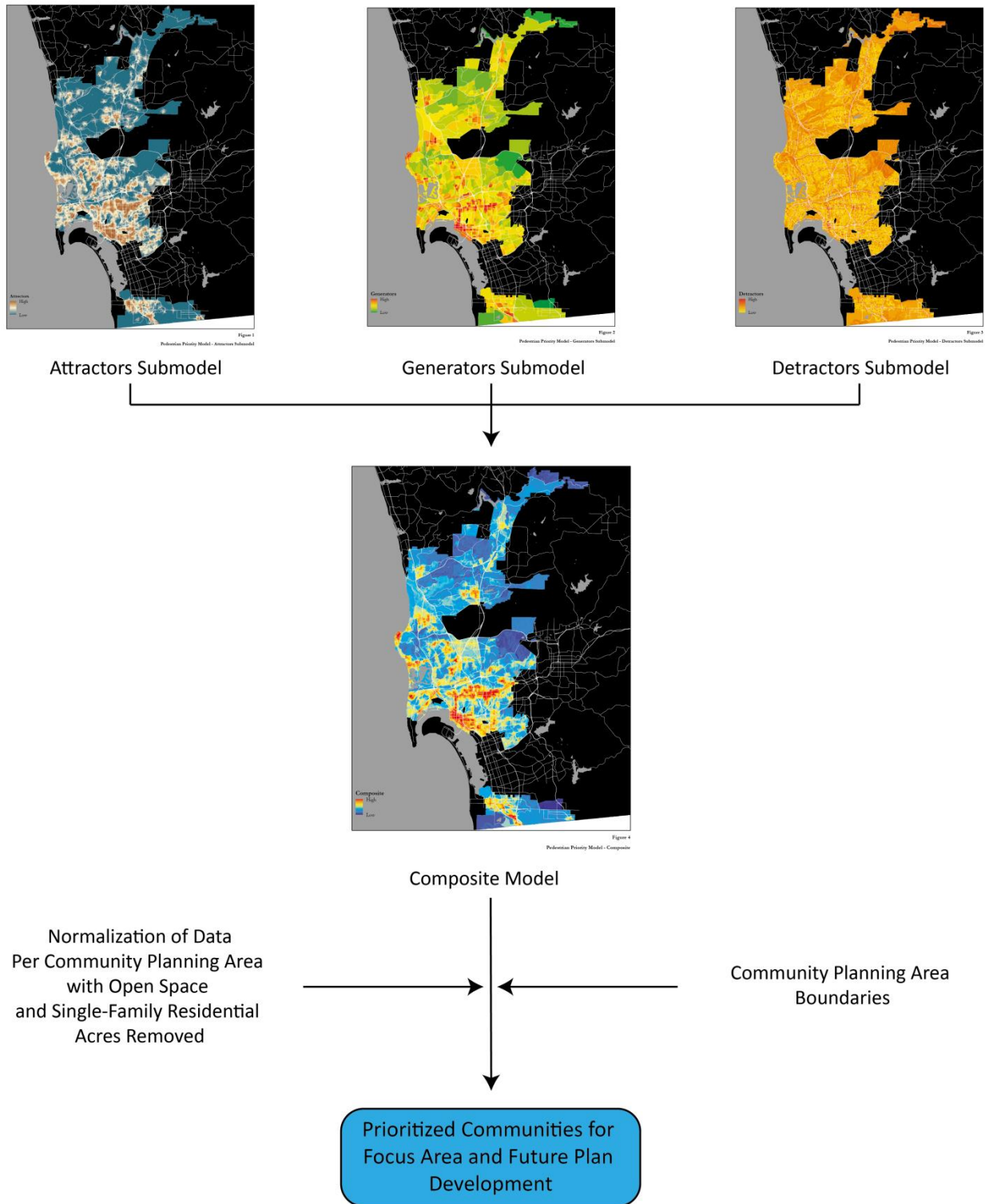
## **6 Make necessary adjustments**

- The PPM was widely vetted with City staff and advisory group members during the PMP Phase I project.

## **7 Making a Decision**

- The final PPM allows for examination and understanding of high pedestrian "need" (high propensity and high barriers) across San Diego communities.
- The final PPM also provides a tool for ranking communities in terms of their relative priority for pedestrian master planning and pedestrian infrastructure improvements.

Figure 2-2: Pedestrian Priority Model Analysis Process



---

## 3.0 Data Inputs

**Table 3-1** displays the filename, field headers, file source, and date of all data used for developing the PPM attractor submodel. **Tables 3.2** and **3.3** present the same information for the PPM generator and detractor submodels, respectively.

The majority of data was obtained from SanGIS, SANDAG, and the U.S. Census Bureau, while data pertaining to mixed-use zoning and pedestrian collisions was provided by the City of San Diego. Data pertaining to railroad tracks was digitized by Chen Ryan Associates to capture locations where multiple railroad tracks run parallel to each other, such as in Downtown San Diego.



**Table 3.1: Attractor Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
1	Pedestrian Intensive Border Crossings	Ports_of_entry.shp	-	Digitized by Chen Ryan	2015	Attractors
2	Transit Ridership <sup>1</sup>	CityofSanDiegoStops2014.shp	Ridership (“total” is original ridership number but stops adjacent to each were other consolidated and assigned into categories)	Metropolitan Transit System	2015	Attractors
3	Elementary Schools	LANDUSE_CURRENT.shp	Elementary School	SanGIS/SANDAG	2015	Attractors
4	Middle Schools	LANDUSE_CURRENT.shp	Junior High School or Middle School	SanGIS/SANDAG	2015	Attractors
5	High Schools	LANDUSE_CURRENT.shp	Senior High School	SanGIS/SANDAG	2015	Attractors
6	Universities and Colleges	LANDUSE_CURRENT.shp	SDSU/CSU San Marcos/UCSD, Junior College, Other University or College – only selected: SDSU, UCSD, USD, PLNU, City College, Mesa College, Grossmont College, Miramar College, Alliant International University	SanGIS/SANDAG	2015	Attractors
7	Civic Facilities	LANDUSE_CURRENT.shp	Government Office/Civic Center, Library, Post Office, Religious Facility	SanGIS/SANDAG	2015	Attractors
8	Retail	LANDUSE_CURRENT.shp	Arterial Commercial, Community Shopping Center, Mixed Use, Neighborhood Shopping Center, Other Retail Trade and Strip Commercial, Regional Shopping Center, Specialty Commercial	SanGIS/SANDAG	2015	Attractors
9	Beaches	LANDUSE_CURRENT.shp	Beach – Active	SanGIS/SANDAG	2015	Attractors
10	Parks and Recreation	LANDUSE_CURRENT.shp	Park – Active	SanGIS/SANDAG	2015	Attractors

Source: Chen Ryan Associates, November 2015

<sup>1</sup> For this iteration of the Pedestrian Priority Model, transit ridership inputs incorporate year 2020 projected ridership at future stations along the San Diego Trolley Mid-Coast Corridor light rail extension. Ridership estimates were obtained Mid-Coast Corridor Travel Forecasting Results Report (2014).

**Table 3.2: Generator Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
1	Census Mobility: People Who Walk to Work	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		MEANS OF TRANSPORTATION TO WORK (Table B08301)	Total, Walked	US Census 2013 American Community Survey 5-year estimates/American Fact Finder Download Center	2013	Generators/Census Tables
2	Population Density	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		ACS_13_5YR_B01003_with_ann [TOTAL POPULATION (Table B01003)]	Total	US Census 2013 American Community Survey 5-year estimates/American Fact Finder Download Center	2013	Generators/Census Tables
3	2012 Employment Density	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		points_2012	c000	US Census/Longitudinal Employer-Household Dynamics OnTheMap	2013	Generators

**Table 3.2: Generator Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
4	Age Density: Senior Citizens per Acre	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		ACS_13_5YR_B01001_with_ann [SEX BY AGE (Table B01001)]	'65 to 66' + '67 to 69' + '70 to 74' + '75 to 79' + '80 to 84' + '85 and over'	US Census 2013 American Community Survey 5-year estimates/American Fact Finder Download Center	2013	Generators/Census Tables
5	Household Income	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		ACS_13_5YR_B19013_with_ann [MEDIAN HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2013 INFLATION-ADJUSTED DOLLARS) (Table B19013)]	Median household income in the past 12 months (in 2013 inflation-adjusted dollars)	US Census 2013 American Community Survey 5-year estimates/American Fact Finder Download Center	2013	Generators
6	Age Density: Children per Acre	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators
		ACS_13_5YR_B01001_with_ann [SEX BY AGE (Table B01001)]	'Under 5' + '5 to 9' + '10 to 14' + ('15 to 17' / 2)	US Census/American Fact Finder Download Center	2013	Generators/Census Tables
7	Disability Density: People	Census_Block_Groups.shp	Join and copy data from table below	US Census TIGER/Line shapefiles	2010	Generators

**Table 3.2: Generator Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
	with Disabilities per Acre	ACS_13_5YR_C21007_with_ann [AGE BY VETERAN STATUS BY POVERTY STATUS IN THE PAST 12 MONTHS BY DISABILITY STATUS FOR THE CIVILIAN POPULATION 18 YEARS AND OVER (Table C21007)]	'18 to 64 years Veteran Income in the past 12 months below poverty level With a disability' + '18 to 64 years Veteran Income in the past 12 months at or above poverty level With a disability' + '18 to 64 years Nonveteran Income in the past 12 months below poverty level With a disability' + '18 to 64 years Nonveteran Income in the past 12 months at or above poverty level With a disability' + '65 years and over Veteran Income in the past 12 months below poverty level With a disability' + '65 years and over Veteran Income in the past 12 months at or above poverty level With a disability' + '65 years and over Nonveteran Income in the past 12 months below poverty level With a disability' + '65 years and over Nonveteran Income in the past 12 months at or above poverty level With a disability'	US Census 2013 American Community Survey 5-year estimates/American Fact Finder Download Center	2013	Generators/Census Tables
8	Housing near Employment	LANDUSE_CURRENT.shp,	Housing: Dormitory, Mixed Use, Mobile Home Park, Multi-Family Residential, Multi-Family Residential Without Units, Other Group Quarters Facility, Single Family Detached, Single Family Multiple-Units, Single Family Residential Without Units, Single Room Occupancy Units (SROs), Spaced Rural Residential	SANDAG	2015	Generators

**Table 3.2: Generator Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
		Census_Block_Groups.shp	2012 Employment Density	US Census TIGER/Line shapefiles	-	Generators
		majoremp.shp	-	SanGIS	-	Generators
9	Housing near Commercial	LANDUSE_CURRENT.shp	Housing: Dormitory, Mixed Use, Mobile Home Park, Multi-Family Residential, Multi-Family Residential Without Units, Other Group Quarters Facility, Single Family Detached, Single Family Multiple-Units, Single Family Residential Without Units, Single Room Occupancy Units (SROs), Spaced Rural Residential	SANDAG	2015	Generators
			Commercial: Arterial Commercial, Community Shopping Center, Mixed Use, Neighborhood Shopping Center, Office (High-Rise), Office (Low-Rise), Other Retail and Strip Commercial, Regional Shopping Center, Specialty Commercial			Generators
10	Proposed Mixed Use	LANDUSE_PLANNED.shp	Mixed Use	SanGIS/SANDAG	2015	Generators

Source: Chen Ryan Associates, November 2015

**Table 3.3: Detractor Submodel Inputs**

Input #	Model Input	Filenames	Field	Source	Year of Data	File Folder
1	Collisions per Year (Last 5 Years)	TCRS_1998_2012_PEDS.shp	-	City of San Diego	2012	Detractors
2	Average Daily Trips	Hwycov2008.shp	UVOL or ADTVL, whichever is greater	SANDAG	2008	Detractors
3	Speed	Hwycov2008.shp	ISPD	SANDAG	2008	Detractors
4	Lack of Street Lighting	Street_Light.shp	-	SanGIS	-	Detractors
5	Railroad Tracks	sdrail.shp	-	Digitized by Chen Ryan	2015	Detractors
6	Freeways	Roads_All	FUNCLASS fields 'F', 'R' and '1'	SanGIS	2015	Detractors
7	Slopes	Elevgrd30.tif	-	SANDAG	-	Detractors

Source: Chen Ryan Associates, November 2015

---

## 4.0 Points and Weights

This chapter summarizes steps taken to analyze the data presented in Chapter 3.0, using the general suitability analysis approach described in Chapter 2.0. In particular, data inputs for each of the PPM submodels are described, along with the point and weight system.

### 4.1 Pedestrian Attractors

Pedestrian attractors are defined as activity areas and geographic features that are likely to attract pedestrians. **Table 4.1** displays the specific attractors used for the PPM. As shown, five specific types of pedestrian attractors are represented:

- Schools,
- Transit stations,
- Recreation facilities, such as parks and beaches,
- Neighborhood and community retail, and
- Neighborhood and community serving civic facilities (libraries, post offices, and religious facilities).

The point system implies that the international border has the highest pedestrian trip attracting propensity, while parks, recreations and high schools have the lowest pedestrian attracting propensity.

**Table 4.1: Pedestrian Attractor Data Inputs and Assigned Points and Weights**

Pedestrian Attractors	Points	Weighting	Final Score
Pedestrian Intensive International Border	6	1	6
Major Multi-Modal Transit Center (>10,000 boardings and alightings per day)	5		5
Major Transit Stops (1,000-10,000 boardings and alightings per day)	4		4
Transit Stops (100-1,000 boardings and alightings per day)	3		3
Elementary Schools (including private)	3		3
Middle Schools	2		2
Universities and Colleges	2		2
Neighborhood Civic Facilities (Libraries, Post Offices, and Religious Facilities)	2		2
Neighborhood and Community Retail	2		2
Pedestrian Intensive Beaches	2		2
Parks and Recreation (excludes non-usable open space)	1		1
High Schools	1		1

Source: Chen Ryan Associates, November 2015

**Table 4.2** displays the distance-based points and weights applied to pedestrian attractors. As shown, higher points are assigned to locations within closer proximity of pedestrian attracting land uses.

**Table 4.2: Pedestrian Attractor Distance-Based Points and Weights**

Weighting Values Based on Distance to Attractor	Points	Weighting	Final Score
1/8 Mile	1.5	1	1.5
1/4 Mile	1		1
1/3 Mile	0.75		0.75
1/2 Mile	0.5		0.5

Source: City of San Diego Pedestrian Master Plan Report, 2006

After the point system is developed, buffers are drawn around each pedestrian attracting land use at increasing distances from their center point. The distance-based weighted values are assigned to each buffer. For example, a 1/8-mile radius buffer is assigned a higher value than a 1/2-mile radius buffer, since more people are likely to walk 1/8 of a mile than 1/2 of a mile.

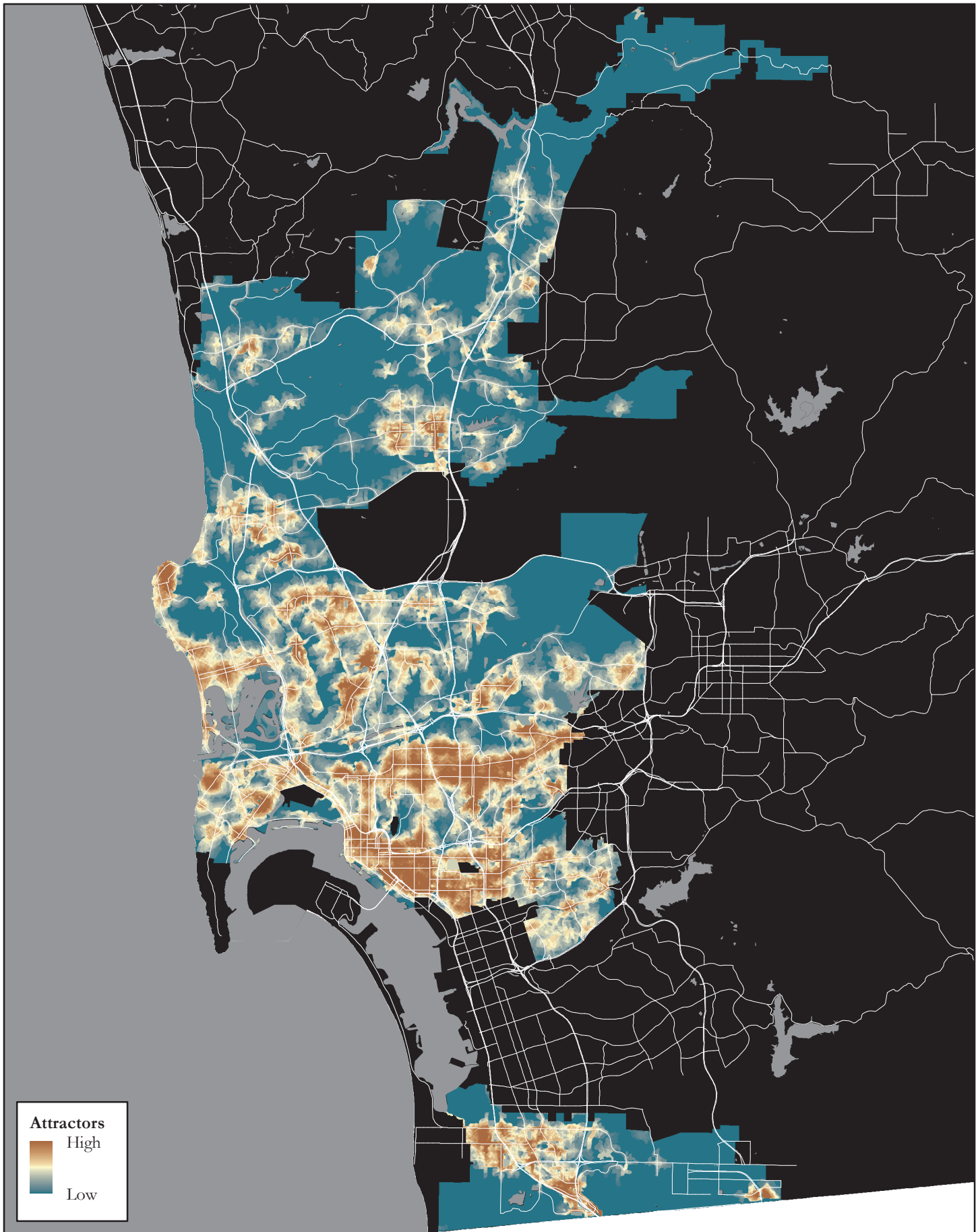
**Figure 4-1** displays the resulting pedestrian attractor submodel raster.

## 4.2 Pedestrian Generators

Pedestrian generators are defined in terms of population sub-groups and employment likely to generate a walking trip. **Table 4.3** displays the specific factors used to reflect pedestrian generation, along with the point and weighting system applied to these inputs.

**Figure 4-2** displays the resulting pedestrian generator submodel.





Pedestrian Priority Model Update

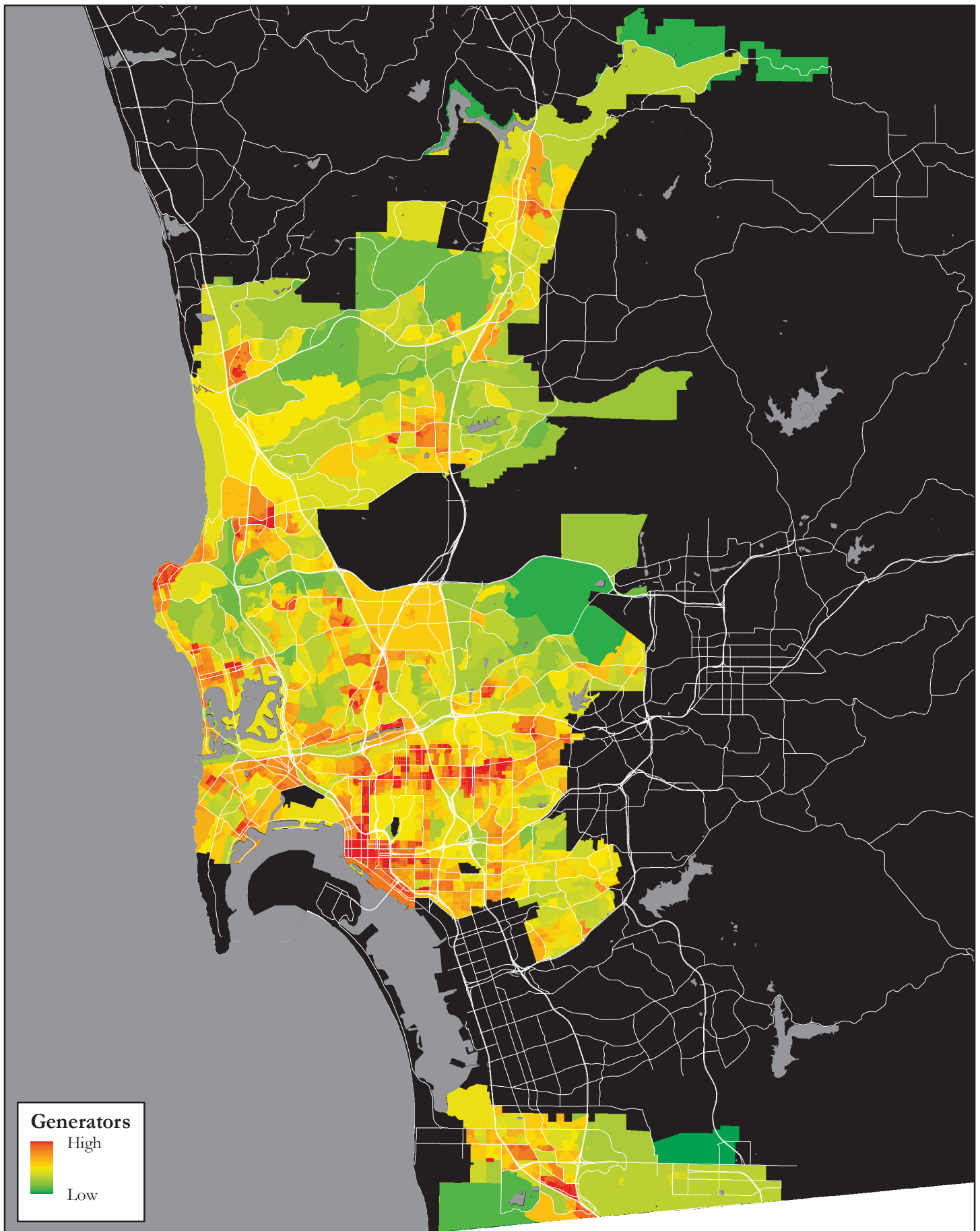
Figure 4-1

Attractors Model Results

**Table 4.3: Pedestrian Generator Factors and Scoring**

Pedestrian Generators	Points	Weighting	Final Score
Census Mobility (Percent of commuters who walk to work by Census Block Group)			
> 2	3	2	6
1 - 2	2		4
0.25 - 1	1		2
< 0.25	0		0
Population Density (Persons per acre by Census Block Group)			
> 25	3	2	6
5 - 25	2		4
1 - 5	1		2
<1	0		0
Employment Density (Employees per acre by Census Block Group)			
> 15	3	2	6
5 - 15	2		4
1 - 5	1		2
<1	0		0
Senior Density (Persons 65 years of age or younger per acre by Census Block Group)			
> 10	3	2	6
5 - 10	2		4
1 - 5	1		2
< 1	0		0
Household Income (Annual Median Household Income by Census Block Group)			
< \$34,500	3	1	3
\$34,500 - \$63,400	2		2
> \$63,400	1		1
Youth Density (Persons 16 years of age or younger per acre by Census Block Group)			
> 10	3	1	3
5 - 10	2		2
1 - 5	1		1
< 1	0		0
Disability Density (Disabled persons per acre by Census Block Group)			
> 5	3	1	3
2 - 5	2		2
1 - 2	1		1
< 1	0		0
Existing Mixed Land Use Adjacencies			
Housing near employment and commercial	3	1	3
Housing near commercial	2		2
Housing near employment	1		1
Proposed Mixed Use			
As shown in adopted Community Plan	2	1	2

Source: City of San Diego Pedestrian Master Plan Report, 2006



### 4.3 Pedestrian Detractors

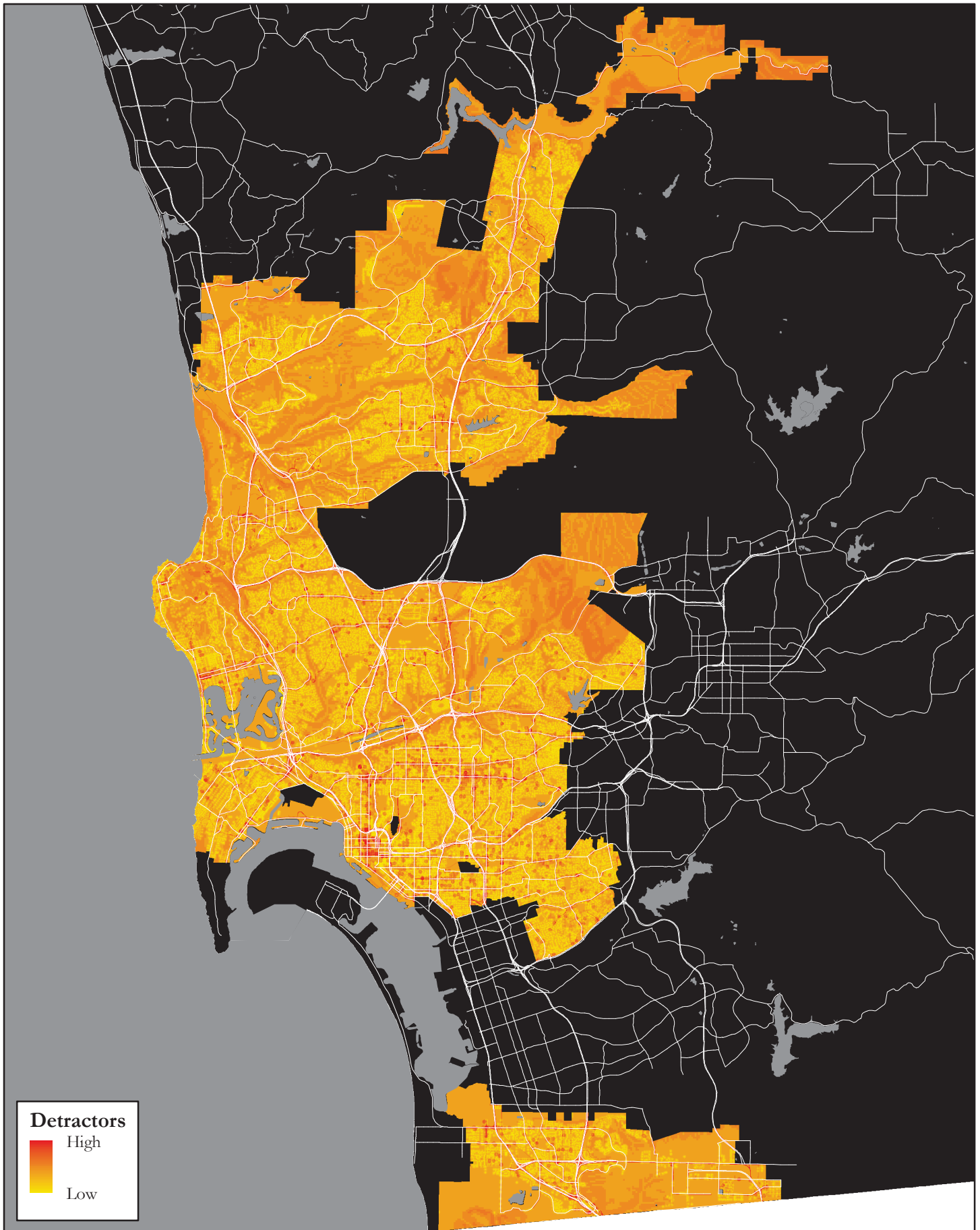
Pedestrian detractors are defined as features likely to discourage people from walking. **Table 4.4** displays the detractors used in the PPM.

Pedestrian detractors represent locations with features that limit walking or may present safety issues. Areas with the potential for higher levels of walking, based on attractors and generators, but that pose barriers to walking, should receive a high priority for funding and treatments. **Figure 4-3** displays the resulting pedestrian detractor submodel.

**Table 4.4: Pedestrian Detractors Factors and Scoring**

Pedestrian Detractors	Points	Weighted Multiplier	Final Score
Collisions Per Year (1/16 mile buffer applied to each collision)			
1 +	3	3	9
0.5 – 0.9	2		6
0 – 0.5	1		3
0	0		0
Average Daily Trips (affects crossing wait time, safety and visibility)			
> 45,000	3	2	6
35,000 – 45,000	2.5		6
25,000 – 35,000	2		4
15,000 – 25,000	1.5		3
10,000 – 15,000	1		2
5,000 – 10,000	0.5		1
< 5,000	0		0
Speed Limit (affects the ability to cross safely)			
> = 45 mph	3	1	3
35 – 40 mph	2		2
30 mph	1		1
< = 25 mph	0		0
Lack of Street Lighting			
Pedestrian walking more than 300 ft from street lights	3	1	3
150 – 300 ft	2		2
75 – 150 ft	1		1
0 – 75 ft	0		0
Railroads/Light Rail as Barriers to Pedestrian Travel			
If present	1	1	1
Freeways as Barriers to Pedestrian Travel			
If present	1	1	1
Slope and Canyons as Barriers to Pedestrian Travel			
Landform feature with slope > 25%	2	1	2
Landform, walkway or street slope 10 - 25%	1		1
Walkway slope < 10%	0		0

Source: Chen Ryan Associates, November 2015



Pedestrian Priority Model Update

Figure 4-3

Detractor Model Results



---

## 5.0 GIS Steps

This section of the report presents detailed analysis steps for developing the PPM in ArcGIS 10.1. It is intended to facilitate other consultant's and City staff's ability to replicate or modify the inputs and model development process. Section 5.1 presents GIS steps for creating the pedestrian attractor submodel, Section 5.2 presents the pedestrian generator submodel, Section 5.3 summarizes GIS steps to create the pedestrian detractor submodel, and Section 5.4 summarizes steps to create the final PPM composite model.

To facilitate ease of reading, the following formatting rules were applied:

- Single quotes are used ( ' ') to denote text input in ArcGIS 10.1.
- ArcGIS tools and tool suites are noted in blue, bold text.
- All fieldnames are capitalized.
- All data inputs are referred to by the "Model Input" and "Input #" fields from Tables 3.1, 3.2, and 3.3.

### 5.1 Attractor Submodel

There are a total of 10 inputs used to create the PPM attractor submodel. Eight of these inputs are land use polygon shapefiles (Inputs #3-#10 in Table 3.1), while two of these inputs are point shapefiles (Inputs #1 and #2 in Table 3.1). Development of the attractor submodel requires 6 key steps as summarized in the list below:

- **Step 1.0** describes how to develop the land use inputs from the regional land use shapefile.
- **Steps 2.0** and **3.0** describe the process for creating a network dataset and developing street network buffers around the attractor inputs.
- **Step 4.0** describes buffer creation, rasterization and point assignment for the eight land use inputs and the pedestrian intensive border crossings input (Inputs #1, #3-#10).
- **Step 5.0** explains how Input #2 (transit ridership) was processed in its entirety, since this data type is different than the other attractor inputs.
- **Step 6.0** describes the map algebra employed to sum the points associated with each of the attractor inputs into a common raster surface reflecting pedestrian attractors.

Each of these steps is described in detail in terms of the ArcGIS 10.1 techniques employed.

---

## Step 1.0: Create Attractor Input Shapefiles (*Inputs #3-#10 shown in Table 3.1*) from the Regional Land Use Shapefile

### 1.1 Export attractor input land use shapefiles from the LANDUSE\_CURRENT shapefile.

Refer to Table 3.1 for documentation of which land use category names comprise each land use input in the attractor submodel. Use [Select by Attributes](#) to select the land use category names needed for each attractor input, then export data.

### 1.2 Generate point shapefiles from each attractor input shapefile.

- a) Add each of the attractor input land use shapefiles into the [Feature Vertices to Point](#) tool, which is located in the [ArcToolbox](#) under [Data Management Tools/Features](#).
- b) Use the [Select by Location](#) tool on the point shapefile generated in Step 1.2a to select all points within 65 feet of the roads centerline shapefile. Export selection.

### 1.3 Perform Steps 1.1 and 1.2 for all attractor inputs which are polygon shapefiles (*all inputs except for Transit Ridership Input #2 and Pedestrian Intensive Border Crossings Input #1*).

## Step 2.0: Prepare Roads Shapefile for Network Analysis

### 2.1 Eliminate unwanted features from roads shapefile.

Modify the Roads\_all shapefile by selecting and removing (or exporting the inverse of the selection) all functional classification categories (fieldname = FUNCLASS) which should not be included in the pedestrian network. The following FUNCLASS categories were deemed unsuitable to include in the network dataset and should be removed:

- Freeway (F)
- Ramps (R)
- Expressway (E)
- Military Base Roads (M)
- Paper Streets (P)
- Alleys (A)
- Freeway-to-Freeway Ramps (1)

### 2.2 Create a network dataset.

Create a network dataset from the modified or newly exported Roads\_all shapefile. Open [ArcCatalog](#) and browse to the location of the shapefile. Right-click and choose New, then choose [New Network Dataset](#) to open the new network dataset wizard.

### 2.3 Follow the steps of the new network dataset wizard:

- a) Enter a name for the network dataset. Click Next.
- b) Choose No for modeling turns. Click Next.
- c) Select End Point for the connectivity policy. Click Next.

- 
- d) Choose Using Elevation Fields and specify the fields F\_LEVEL under From End and T\_LEVEL under To End. Click Next.
  - e) Double-click Length and specify the length attribute fieldname from the modified Roads\_all shapefile (make sure your length attribute is in feet). Remove One-Way so that Length is the only attribute. Click Next.
  - f) Choose No for establishing driving directions. Click Next. Click Finish.
  - g) Choose Yes to build the network dataset.

#### 2.4 Activate the **Network Analyst Extension**.

Go to **Customize** on the Main Menu, choose Extensions and check the box next to Network Analyst. Click Close.

#### 2.5 Add the **Network Analyst Toolbar** to your screen.

Go to **Customize** on the Main Menu, choose Toolbars, then choose **Network Analyst**.

### Step 3.0: Create Street Network (or Service Area) Buffers from the Attractor Inputs

#### 3.1 Perform service area analysis.

From the **Network Analyst Toolbar** drop-down list, choose **New Service Area**. Activate the network analyst window by clicking on the button next to the **Network Analyst Toolbar** drop-down list.

#### 3.2 Establish correct service area settings under the various properties tabs.

- a) Click the Service Area Properties box in the network analyst window.
- b) Under the Polygon Generation tab, make sure the Detailed, Merge by Break Value and Rings setting buttons are selected.
- c) Under the Network Locations tab, make sure the Exclude Restricted Portions of the Network box in the lower left corner is checked.
- d) Under the Analysis Settings tab, enter '660, 1320, 1760, 2640' into the text box. These are the buffer distances used in the attractor submodel. Close out of the service area properties window when these settings are completed. Once these settings are made, they will remain unchanged.

#### 3.3 Load attractor input point shapefile into Facilities in the network analyst window.

In the network analyst window, right-click Facilities and choose Load Locations. When the load locations window opens, specify the attractor input point shapefile to be analyzed. Choose OK and the locations will begin loading.

#### 3.4 Solve service area.

Once the locations have been loaded, click the **Solve** tool on the **Network Analyst Toolbar**. This will generate a set of street network buffers at the four specified distances set in Step 3.2d.



---

### 3.5 Export buffer outputs.

Right-click the word Polygon in the network analyst window and export buffer outputs as a shapefile.

### 3.6 Repeat Steps 3.3 through 3.5 for all attractor inputs except for the Transit Ridership Input #2.

Repeat Steps 3.3 through 3.5 for each attractor input point shapefile except for the Transit Ridership Input #10. Prior to each new buffering process for each subsequent attractor input, delete the cached Facilities and Polygons from the previous attractor input analyzed in the network analyst window. Step 5.0 explains how to process the Transit Ridership Input #2.

## Step 4.0: Create Raster Files from Buffer Outputs

### 4.1 Generate a raster file from the street network buffer shapefile created in Step 3.5.

Use the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster tool window opens, add the street network buffer shapefile created in Step 3.5 under Input Features. Specify 'Name' under Value. Specify a location for saving the raster output file. Change Cellsize to '75'. Hit OK.

### 4.2 Add point values to the street network buffer raster from the previous step using the **Reclassify** tool.

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the street network buffer raster under Input Raster. The Old Values should display the distance ranges. Under New Values, enter the point values associated with land use attractor points, weights and buffer distances presented in Tables 4.1 and 4.2. The **Reclassify** tool does not recognize decimals, so each point value will have to be multiplied by 4 (the lowest common denominator of distance multipliers which creates whole numbers). Assign '0' points under NoData. Specify a location for saving the output under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

### 4.3 Repeat Steps 4.1 and 4.2 for each remaining attractor input point shapefile except for Transit Ridership Input #2.

## Step 5.0: Create Street Network Buffers and Rasters from Transit Ridership Input #2

### 5.1 Separate the Transit Ridership Input #2 into three unique point shapefiles based on the ridership categories specified in Table 4.1.

### 5.2 Perform Steps 3.3 through 3.5 (creating buffers) for each of the three transit ridership point shapefiles resulting from Step 5.1.

### 5.3 Attribute the three transit ridership buffer shapefiles resulting from Step 5.2 with an identification field.

In each of the three transit ridership buffer shapefiles, open the attribute table and fill the blank FacilityID field with the same identification number for all records. For the highest category transit ridership buffer shapefile, fill the blank FacilityID field with the value '10000' (10,000 riders and up).

---

For the middle range transit ridership buffer shapefile, fill the blank FacilityID field with the value '1000' (1,000 to 10,000 riders). For the lowest level transit ridership buffer shapefile, fill the blank FacilityID field with the value '100' (100 to 1,000 riders).

*5.4 Combine the three ridership buffer shapefiles using the **Union** tool.*

- a) Use the **Union** tool to combine the three shapefiles. The tool is located in the **ArcToolbox** under **Analysis Tools/Overlay**.
- b) Right-click the transit ridership union shapefile in the Table of Contents and go to Properties. Navigate to the Fields tab and uncheck all fields to make them invisible, except for the fields titled FacilityID and Name. There should be three FacilityID fields and three Name fields, some of which will have an underscore and number (e.g. \_1, \_2, \_12) in the fieldname.

*5.5 Add a field to the transit ridership union shapefile with the fieldname Points.*

Open the attribute table of the transit ridership union shapefile. There should be six fields visible, three with the fieldname FacilityID and three with the fieldname Name. Click Table Options, located in the upper left corner of the attribute table and select Add Field. Specify the new field as a short integer and give it the fieldname Points.

*5.6 Attribute point values in the transit ridership union shapefile using Table 5.1.*

- a) Table 5.1 presents the points assigned to each combination of FieldID and Name value. As discussed in Step 5.3, the FieldID attribute contains transit ridership level information. The Name attribute contains buffer distance information. Varying points are assigned to each possible combination of ridership level and buffer distance.
- b) Open the transit ridership union shapefile and use the FacilityID and Name attributes to select records with each of the unique combinations of FieldID and Name values as described in the first column of Table 5.1.
- c) Use the **Field Calculator** to fill the Points field with the specified points from Table 5.1. There are varying points for each unique combination of ridership level and buffer distance.

**Table 5.1: Point Values for the Transit Ridership Buffer Shapefile (Step 5.6)**

'FacilityID' and 'Name' Combinations	Points to be Assigned	Special Instruction
'10000' and '0 – 660'	30	--
'1000' and '0 – 660'	24	Prior to attributing, unselect any features already attributed with 30 points
'10000' and '660 – 1320'	20	Prior to attributing, unselect any features already attributed with 24-30 points
'100' and '0 – 660'	18	Prior to attributing, unselect any features already attributed with 20-30 points
'1000' and '660 – 1320'	16	Prior to attributing, unselect any features already attributed with 18-30 points
'10000' and '1320 – 1760'	15	Prior to attributing, unselect any features already attributed with 16-30 points
'1000' and '1320 – 1760'	12	Prior to attributing, unselect any features already attributed with 15-30 points
'100' and '660 – 1320'	12	Prior to attributing, unselect any features already attributed with 15-30 points
'10000' and '1760 – 2640'	10	Prior to attributing, unselect any features already attributed with 12-30 points
'100' and '1320 – 1760'	9	Prior to attributing, unselect any features already attributed with 12-30 points
'1000' and '1760 – 2640'	8	Prior to attributing, unselect any features already attributed with 12-30 points
'100' and '1760 – 2640'	6	Prior to attributing, unselect any features already attributed with 8-30 points

Source: Chen Ryan Associates, August 2015

#### 5.7 Generate a raster file from the transit ridership union shapefile created in the Step 5.6.

Use the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster window opens, add the transit ridership union shapefile under Input Features. Select the Points field under Value. Specify a location for saving the transit ridership raster output file. Change Cell size to '75'. Hit OK.

#### 5.8 Add point values to transit ridership raster from Step 5.7 using the **Reclassify** tool.

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the transit ridership raster from Step 5.7 under Input Raster. The Old Values should display the point values assigned in Step 5.6. Keep the point values the same under New Values, and assign '0' points under NoData. Specify a location for saving the file under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

### Step 6.0: Combine Input Rasters to Create Attractor Submodel

#### 6.1 Create a composite attractor raster from the reclassified rasters generated in Step 4.2 and Step 5.8

Open the **Raster Calculator** tool located in the **ArcToolbox** under **Spatial Analyst Tools/Map Algebra**. Add each reclassified raster into a summation equation. Specify a location for saving the output rasters and hit OK. This last step generates the final attractor submodel raster surface.

---

## 5.2 Generator Submodel

There are a total of 10 inputs used to create the PPM generator submodel. Seven of these inputs are obtained from census data (Inputs #1 - #7 in Table 3.2). Inputs #8 and #9 are generated from a combination of land use and census data. Input #10 is created from the regional land use shapefile. Development of the generator submodel requires 8 key steps as summarized in the list below:

- **Step 1.0** describes how to download and prepare tabular census data used to create generator Inputs #1, #2, and #4 - #7.
- **Steps 2.0** and **3.0** describe the process for preparing a Census Block Group (CBG) shapefile for joining and processing tabular census data.
- **Step 4.0** describes the process for calculating Input #3 (employment density) and joining the data to the CBG shapefile.
- **Step 5.0** describes the rasterization and point assignment used for Inputs #1 - #7.
- **Step 6.0** explains how Inputs #8 and #9 (housing near employment and housing near commercial) were processed.
- **Step 7.0** explains how Input #10 (proposed mixed land uses) was processed.
- **Step 8.0** describes the map algebra employed to sum the points associated with each of the generator inputs on a common raster surface.

Each of these steps is described in detail in terms of the ArcGIS 10.1 techniques employed.

### Step 1.0: Download and Prepare Census Data

*1.1 Use the US Census American Fact Finder Download Center to download the 2013 American Community (ACS) Survey 5-Year Estimate tabular datasets for all CBGs in San Diego County.*  
[http://factfinder.census.gov/faces/nav/jsf/pages/download\\_center.xhtml](http://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml)

The follow census tables should be downloaded by CBG:

- TOTAL POPULATION (Table B01003)
- MEANS OF TRANSPORTATION TO WORK (Table B08301)
- SEX BY AGE (Table B01001)
- MEDIAN INCOME IN THE PAST 12 MONTHS (IN 2013 INFLATION-ADJUSTED DOLLARS) (Table B19013)
- AGE BY VETERAN STATUS BY POVERTY STATUS IN THE PAST 12 MONTHS BY DISABILITY STATUS FOR THE CIVILIAN POPULATION 18 YEARS AND OVER (Table C21007)

---

*1.2 Open each dataset from Step 1.1, remove unnecessary data fields, and then prepare the spreadsheet for tabular joining in GIS.*

Refer to Table 3.2 to determine which data fields from the downloaded ACS datasets are necessary for producing the generator inputs. Some inputs may require calculation of multiple fields, as shown in Table 3.2. After cleaning each spreadsheet, save them as .csv files.

## **Step 2.0: Prepare the Census Block Group Shapefile**

*2.1 Download the 2010 CBG shapefile for San Diego County.*

A CBG shapefile may be downloaded from the US Census TIGER/Line Data Clearinghouse.  
<https://www.census.gov/cgi-bin/geo/shapefiles2010/main>

*2.2 Change the coordinate system of the data frame to AD\_1983\_StatePlane\_California\_VI\_FIPS\_0406\_Feet.*

Open a new map document. Right-click Layers in the Table of Contents and choose Properties. Navigate to the Coordinate System tab. Set your data frame coordinate system to *NAD\_1983\_StatePlane\_California\_VI\_FIPS\_0406\_Feet*.

You can type the coordinate system name into the search box for instant navigation.

*2.3 Re-export the CBG shapefile so that it assumes the coordinate system of the data frame.*

Re-export the CBG shapefile. When the export data window appears, click the button next to Use the Same Coordinate System as the Data Frame. Discard the previous CBG shapefile and use the newly exported CBG shapefile.

*2.4 Add new fields to the CBG shapefile to store generator inputs and acreage data.*

- a) Open the CBG shapefile attribute table and add new fields (using the Double field type) called Population, Population Density, Total Commuters, Walk Commuters, Percent Walk Commuters, Youth Population, Youth Density, Senior Population, Senior Density, Median Income, Disabled Population and Disabled Density, Employment and Employment Density. There are character limits on field headers, so choose abbreviated titles for each.
- b) Add three additional fields (using the Double field type) to the attribute table of the CBG shapefile named Acres, Water Acres and Adjusted Acres. Select Area in the calculate geometry window under Properties. Select Acres US [ac] in the calculate geometry window under units.

*2.5 Merge the ocean and lakes shapefiles and intersect with the CBG shapefile.*

Download the SanGIS lakes and Pacific Ocean shapefiles. Combine them by activating **Edit Mode** on the lakes shapefile and select, copy and paste the Pacific Ocean feature into the lakes shapefile. Save edits and exit **Edit Mode**. Use the **Intersect** tool in the **ArcToolbox** under **Analysis/Overlay** to intersect the lakes and ocean shapefile with the CBG shapefile.

*2.6 Calculate and summarize water acreage by CBG and then join water acreage to CBG shapefile.*

- a) Open the lakes and ocean intersect shapefile and create a new Field (using the Double field type) called Water Acres. Right-click the header of the Water Acres field and choose **Calculate Geometry**. Select Area in the calculate geometry window under Properties. Select Acres US [ac]

---

under Units in the calculate geometry window. Right-click the field called CBG ID, choose **Summarize**. Select the Water Acres field in the window, summarize and check Sum. Click OK and add the newly created Water Acres summary table to the map document.

- b) Join the Water Acres summary table to the CBG attribute table, and copy Water Acres from the summary file to the Water Acres field in the CBG shapefile using **Field Calculator**. Calculate the Adjusted Acres by subtracting Acres from Water Acres using the **Field Calculator**. All density calculations should be processed using the Adjusted Acres.

### **Step 3.0: Join the Tabular Census Data and Calculate Population Densities in the CBG Shapefile**

#### *3.1 Join the tabular census data to the CBG shapefile.*

Add each .csv file created in Step 1.2. Join each .csv file to the CBG shapefile and copy the relevant data, which includes population, percent walk commuters, youth population, senior population, median income and disabled population into the attribute fields created in Step 2.4a. Join, copy data and remove each joined .csv file one-by-one.

#### *3.2 Calculate densities for population, youth population, senior population and disabled population.*

Right-click the respective Density fieldnames and use **Field Calculator** to divide the relevant census data by Adjusted Acres. For instance, to calculate Population Density, divide Population by Adjusted Acres.

### **Step 4.0: Join the Employment Data to the CBG Shapefile**

#### *4.1 Add the employment shapefile from (points\_2012 shapefile) to the map document and perform a spatial join with the CBG shapefile.*

Join the points\_2012 shapefile to the CBG shapefile. When the join window opens, change the drop-down from “What do you want to join to this layer?” to “Join data from another layer based on spatial location.” In the upper drop-down, choose points\_2012.shp. In the lower dropdown, make sure the first button is selected and check the box next to Sum. Specify a location for saving the spatial join output file and click OK.

#### *4.2 Perform a tabular join using the spatial join shapefile from Step 4.1 to the CBG shapefile.*

Populate the Employment field in the CBG shapefile with the field called Sum\_c000 from the spatial join shapefile. In the Employment Density field, divide Employment by Adjusted Acres.

### **Step 5.0: Generate Rasters from the Population and Employment data in the CBG Shapefile**

#### *5.1 Generate raster files from the data in the CBG shapefile.*

Use the **Polygon to Raster** tool in the **ArcToolbox** under **Conversion Tools/To Raster**. When the **Polygon to Raster** tool window opens, add the CBG shapefile under Input Features. Under Value, specify one of following fields:

- Population Density
- Youth Density

- Senior Density
- Percent Walk Commuters
- Disabled Density
- Median Income
- Employment Density

Specify a location for saving the population and employment raster output files. Change the Cellsize to '75.' Hit OK.

*5.2 Repeat Step 5.1 until a raster output file has been created for each of the population and employment inputs.*

*5.3 Add point values to the population and employment rasters from the previous Step 5.2 using the **Reclassify** tool.*

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add one of the population and employment rasters under Input Raster. Click the Classify button to set the category breaks specified in Table 4.3. Click OK. In the reclassify tools window, the Old Values will now show the class breaks. Under New Values, specify the Final Points values, also listed in Table 4.3, for the respective generator input being processed. Assign '0' points under NoData. Specify a location for saving the output file under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

*5.4 Repeat Step 5.3 until a reclassified raster file has been created for all population and employment inputs listed in Step 5.1.*

## **Step 6.0: Generate Housing near Employment and Housing near Commercial Rasters**

*6.1 Export a housing shapefile from the LANDUSE\_CURRENT shapefile.*

Refer to Table 3.2 for documentation of which residential categories are included in the housing category input. Use **Select by Attributes** to select each category and export data.

*6.2 Export a commercial shapefile from the LANDUSE\_CURRENT shapefile.*

Refer to Table 3.2 for documentation of which commercial categories are included in the commercial input. Use **Select by Attributes** to select each category and export data.

*6.3 Export features from the CBG shapefile which have an employment density greater than 10 jobs per acre.*

Use **Select by Attributes** from Selection on the Main Menu to select all CBGs with an employment density greater than 10 jobs per acre and export data.

---

6.4 *Generate a point shapefile from the commercial shapefile created in Step 6.2.*

- a) Input the commercial shapefile into the **Feature Vertices to Point** tool, which is located in the **ArcToolbox** under **Data Management Tools/Features**.
- b) Use the **Select by Location** tool on the points shapefile generated in Step 6.4a to select all points within 65 feet of the roads centerline shapefile. Export selection.

6.5 *Follow Step 3.0 Create Street Network Buffers from Attractor Inputs in Section 5.1 Attractors Submodel.*

6.6 *Intersect the housing shapefile with the commercial quarter-mile buffer shapefile.*

- a) The **Intersect** tool is located in the **ArcToolbox** under **Analysis Tools/Overlay**.
- b) In the housing and commercial intersect shapefile, add a new field (using the Text field type) called Land Use. Fill the field with the word 'Commercial' using the **Field Calculator**.

6.7 *Intersect the housing shapefile with the employment >10 shapefile generated in Step 6.3.*

- a) The **Intersect** tool is located in the **ArcToolbox** under **Analysis Tools/Overlay**.
- b) In the housing and employment intersect shapefile, add a field (using the Text field type) called Land Use. Fill the field with the word 'Employment' using the **Field Calculator**.

6.8 *Combine the housing-commercial and housing-employment shapefile outputs created in Steps 6.6 and 6.7 using the **Union** tool.*

- a) Use the **Union** tool to combine the previously intersected shapefiles. The **Union** tool is located in the **ArcToolbox** under **Analysis Tools/Overlay**. The union shapefile will be used to create the Housing Near Employment and Housing Near Commercial Inputs #8 and #9 shapefiles.
- b) Right-click the union shapefile in the Table of Contents and go to Properties. Navigate to the Fields tab, and uncheck all fields, except for the fields previously created with Land Use in the title. There should be two fields that remain visible in the union attribute table. One of the fields may have an underscore and number (e.g. \_1) in the header.

6.9 *Add a Points field to the union shapefile.*

Open the attribute table of the union shapefile. There should be two fields visible – each one with the words Land Use in the fieldname. Click Table Options, located in the upper left corner of the attribute table, to add a new field. Specify the new field as a short integer and name it 'Points'.

6.10 *Add point values in the union shapefile.*

Sort one of the Land Use columns by descending order and fill the Points field with the values described in Table 4.3 under mixed use adjacencies. For features with both Land Use columns populated by a land use, assign '3' points. For commercial only, assign '2' points. For employment only, assign '1' point.



---

6.11 Generate a raster file from the union shapefile created in Step 6.10.

Use the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster window opens, add the union shapefile under Input Features. Specify Points under Value. Specify a location for saving the output raster file. Change Cellsize to '75.' Hit OK.

6.12 Process the union raster file from the previous Step 6.11 using the **Reclassify** tool.

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the union raster under Input Raster. The Old Values should display the Points field. Keep the point values the same under New Values but assign '0' points under NoData. Specify a location for saving the union raster under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

## **Step 7.0: Generate the Proposed Mixed Use Input #10 and Raster**

7.1 Select and export the land use category called mixed use from the LANDUSE\_PLANNED shapefile.

7.2 Generate a raster file from the proposed mixed use shapefile created in the previous Step 7.1.

Use the polygon to raster tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster tool window opens, add the shapefile under Input Features. Specify a location for saving the proposed mixed use raster output file. Change Cellsize to '75.' Hit OK.

7.3 Process the raster from the previous step using the **Reclassify** tool.

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the proposed mixed use raster under Input Raster. Assign '2' points in the New Data column, assign '0' points under NoData. Specify a location for saving the proposed mixed use raster file under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

## **Step 8.0: Combine Input Rasters to Create the Generator Submodel**

8.1 Create a composite generators raster from the reclassified rasters generated in Steps 5.3, 5.4, 6.12 and 7.3.

Open the **Raster Calculator** tool located in the **ArcToolbox** under **Spatial Analyst Tools/Map Algebra**. Add each reclassified raster into a summation equation. Specify a location for saving the generators raster output file and hit OK. This last step generates the final generator submodel raster surface.

---

## 5.3 Detractor Submodel

There are a total of 7 inputs (Inputs #1 - #7 from Table 3.3) used to create the PPM detractor submodel. Development of the detractor submodel requires 6 key steps as summarized in the list below:

- **Step 1.0** explains how Inputs #5 and #6 (railroad tracks and freeways) are processed.
- **Step 2.0** explains how Inputs #2 and #3 (speed and average daily trips) are processed.
- **Step 3.0** explains how Input #1 (collisions per year) is processed.
- **Step 4.0** explains how Input #7 (slopes) is processed.
- **Step 5.0** explains how Inputs #4 (lack of street lighting) is processed.
- **Step 6.0** describes the map algebra employed to sum the points associated with each of the inputs and create a single raster surface.

### Step 1.0: Generate Rail and Freeway Inputs and Rasters

#### 1.1 Add the Railroad Tracks Input #5 to a map document and create a 50 foot buffer around the shapefile.

Open the **Buffer** tool in the **ArcToolbox** under **Analysis/Proximity**. Under the Input Features, add the railroad tracks shapefile. Specify a filename and location for saving the rail buffer output file under Output Feature Class. Enter '50' feet in the Linear Unit box. Change the Dissolve Type setting from NONE to ALL. Click OK.

#### 1.2 Generate a raster from the railroad tracks buffer shapefile.

Generate a raster file from rail buffer shapefile using the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the **Polygon to Raster** tool window opens, add the rail buffer shapefile under Input Features. Under Value, choose any field. Specify a location for saving the output file. Change Cellsize to '75.' Hit OK.

#### 1.3 Export a freeway shapefile from the Roads\_all shapefile and create a 50 foot buffer around the shapefile.

Refer to Table 3.3 for documentation about which Roads\_all categories are included in the freeway input. Use **Select by Attributes** to select the FUNCLASS categories and export data. Open the **Buffer** tool located in the **ArcToolbox** under **Analysis/Proximity**. Under the Input Features, add the freeway shapefile. Specify a filename and location for saving the freeway buffer output file under Output Feature Class. Enter '50' feet in the Linear Unit box. Change the Dissolve Type setting from NONE to ALL. Click OK.

#### 1.4 Generate a raster file from the freeway buffer shapefile.

Generate a raster file from the freeways shapefile using the **Polyline to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the **Polyline to Raster** tool window opens,

---

add the freeway shapefile under Input Features. Under Value, choose any field. Specify a location for saving the output file. Change Cellsize to '75.' Hit OK.

*1.5 Process the rail and freeway buffer rasters from Steps 1.2 and 1.4 using the **Reclassify** tool.*

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the rail raster under Input Raster. Assign '1' point in the New Data column, assign '0' points under NoData. Specify a location for saving the file under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool. Repeat this process for the freeway raster file.

## **Step 2.0: Generate Speed and Volume Rasters**

*2.1 Add the hwyconv2008 shapefile to the map document and create a 50 foot buffer around the shapefile.*

Open the **Buffer** tool located in the **ArcToolbox** under **Analysis/Proximity**. Under the Input Features, add the hwyconv2008 shapefile. Specify a filename and location for saving the hwyconv2008 buffer output file under Output Feature Class. Enter '50' feet in the Linear Unit box. Leave the Dissolve Type setting from NONE. Click OK.

*2.2 Generate a raster file from the hwyconv buffer shapefile for both the Speed Input #2 and Average Daily Trips Input #3.*

Generate a speed raster file using the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the **Polygon to Raster** tool window opens, add the hwyconv2008 shapefile under Input Features. Under Value, select the ISPD fieldname (posted speed).

Specify a location for saving the speed raster output file. Change Cellsize to '75'. Hit OK. Repeat this process for traffic volumes by selecting UVOL under Value.

*2.3 Process the speed and volume buffer rasters from the previous step using the **Reclassify** tool.*

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add one of the rasters under Input Raster. Click the Classify button to set the category breaks specified in Table 4.4. Click OK. In the reclassify tool window, the Old Values will now show the class breaks. Under New Values, specify the Final Score values, also listed in Table 4.4, for the respective detractor inputs being processed. Assign '0' points under NoData. Specify a location for saving the raster file under Output Raster. Click the Environments button, expand Processing Extent, choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

*2.4 Repeat Step 2.2 until a reclassified raster file has been created for both inputs (speed and traffic volume).*

---

## Step 3.0: Generate Pedestrian Collisions Raster

*3.1 Add the TCRS\_1998\_2012\_PEDS shapefile (pedestrian collision shapefile) to the map document and use the **Collect Events** Tool to summarize the number of collisions occurring at the same location.*

The **Collect Events** tool is located in the **ArcToolbox** under **Spatial Statistics Tools/Utilities**. Under Input Incident Features, load the pedestrian collisions shapefile. Specify a location for saving the pedestrian collision events output shapefile. Click OK.

*3.2 Calculate collisions per year using the pedestrian collision events shapefile.*

In the pedestrian collision events shapefile, create a new field (using the Double field type) called Collision Rate. Right-click on the new Collision Rate fieldname and use the **Field Calculator** to divide the collision events by '5' years, which is the timespan of the data. Add another field (using the Short Integer field type) called Points. Right-click on the new Point fieldname and use the **Field Calculator** to assign the Final Score values associated with the collision rates, as presented in Table 4.4.

*3.3 Create a 1/16 mile as-the-crow-flies buffer of the collision events shapefile.*

Open the **Buffer** tool located in the **ArcToolbox** under **Analysis/Proximity**. Under the Input Features, add the collision events shapefile. Specify a filename and location for saving the collision buffer output file under Output Feature Class. Enter '330' feet in the Linear Unit box. Change the Dissolve Type setting from NONE to LIST, and check the box next to the Points field. Click OK.

*3.4 Generate a raster file from the collision events buffer shapefile created in the previous Step 3.3.*

Use the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster tool window opens, add the collision events buffer shapefile to Input Features. Select the Points field under Value. Specify a location for saving the output file. Change the Priority Field from NONE to Points. Change Cellsize to '75'. Click OK.

*3.5 Process the collision event buffer raster from the previous Step 3.4 using the **Reclassify** tool.*

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the events buffer raster under Input Raster. Under Old Values, select the Points field. Keep the point values the same under New Values but assign '0' points to NoData. Specify a location for saving the file under Output Raster. Click the Environments button, expand Processing Extent, choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

## Step 4.0: Generate Slope Raster

*4.1 Add the Elevgrd30.tif raster to the map document and generate a slope raster using the **Slope** tool.*

The **Slope** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Surface Analysis**. Under Input Raster, add the elevation raster file. Under Output Raster, specify a filename and location for saving the output file. Change the Output Measurement to PERCENT. Click OK.

*4.2 Process the slope raster from the previous Step 4.1 using the **Reclassify** tool.*

---

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the slope raster under Input Raster. Click the Classify button to set the slope category breaks specified in Table 4.4. Click OK. In the reclassify tool window, the Old Values will now show the class breaks. Under New Values, specify the Final Score values, also listed in Table 4.4, for the respective slope ranges. Assign '0' points to NoData. Specify a location for saving the output file under Output Raster. Click the Environments button, expand Processing Extent, and choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

## **Step 5.0: Generate a Proximity to Street Lights Raster**

### *5.1 Add the Street\_Light shapefile and calculate a multiple-ring buffer.*

The **Multiple-Ring Buffer** tool is located in the **ArcToolbox** under **Analysis Tools/Proximity**. Add the street\_light shapefile under Input Features. Specify a filename and location for saving the buffer output file under Output Feature Class. Enter the distances '75', '150', '300' feet. Under Dissolve Option, select ALL. Click OK.

### *5.2 Generate a raster file from the multi-ring street light buffer shapefile created in the previous Step 5.1.*

Use the **Polygon to Raster** tool located in the **ArcToolbox** under **Conversion Tools/To Raster**. When the polygon to raster tool window opens, add the multi-ring street light buffer shapefile under Input Features. Specify the Distance attribute under Value. Specify a location for saving the output file. Change Cellsize to '75'. Click OK.

### *5.3 Process the street light buffer raster from the previous Step 5.2 using the **Reclassify** tool to generate point values.*

The **Reclassify** tool is located in the **ArcToolbox** under **Spatial Analyst Tools/Reclass**. When the reclassify tool window opens, add the street light buffer raster under Input Raster. Add the point values assigned to the distance ranges specified in Table 4.4. Assign '3' points to NoData. Specify a location for saving the output file under Output Raster. Click the Environments button, expand Processing Extent, choose the City of San Diego boundary shapefile. Click OK to exit Environments. Click OK to run the tool.

## **Step 6.0: Combine the Input Rasters to Create the Detractor Submodel**

### *6.1 Create a composite detractor raster from the reclassified rasters generated in Steps 1.3, 2.3, 2.4, 3.5, 4.2 and 5.3.*

Open the **Raster Calculator** tool located in the **ArcToolbox** under **Spatial Analyst Tools/Map Algebra**. Add each reclassified raster into a summation equation. Specify a location for saving the output raster and hit OK. This last step generates the final detractor submodel raster surface.

---

## 5.4 Final Composite Model

### Step 1.0: Create a final composite raster from the three PPM submodels (Attractors, Generators and Detractors)

Open the **Raster Calculator** tool located in the **ArcToolbox** under **Spatial Analyst Tools/Map Algebra**. Add each reclassified raster into a summation equation. Specify a location for saving the output raster and hit 'OK.' In the formula box, add parentheses around the attractors raster and divide its value by 4<sup>2</sup>. Specify a location for saving the final composite raster output file and hit OK.

---

<sup>2</sup> Because the Reclassify tool does not recognize decimals, all attractor submodel inputs have to be multiplied by 4 to properly capture the decimals from the buffer weights (as noted in Step 4.2 of the Attractors submodel). For the final PPM composite, the attractors submodel should be divided back down by four so that it is not four-times more weighted than the other two submodels.

---

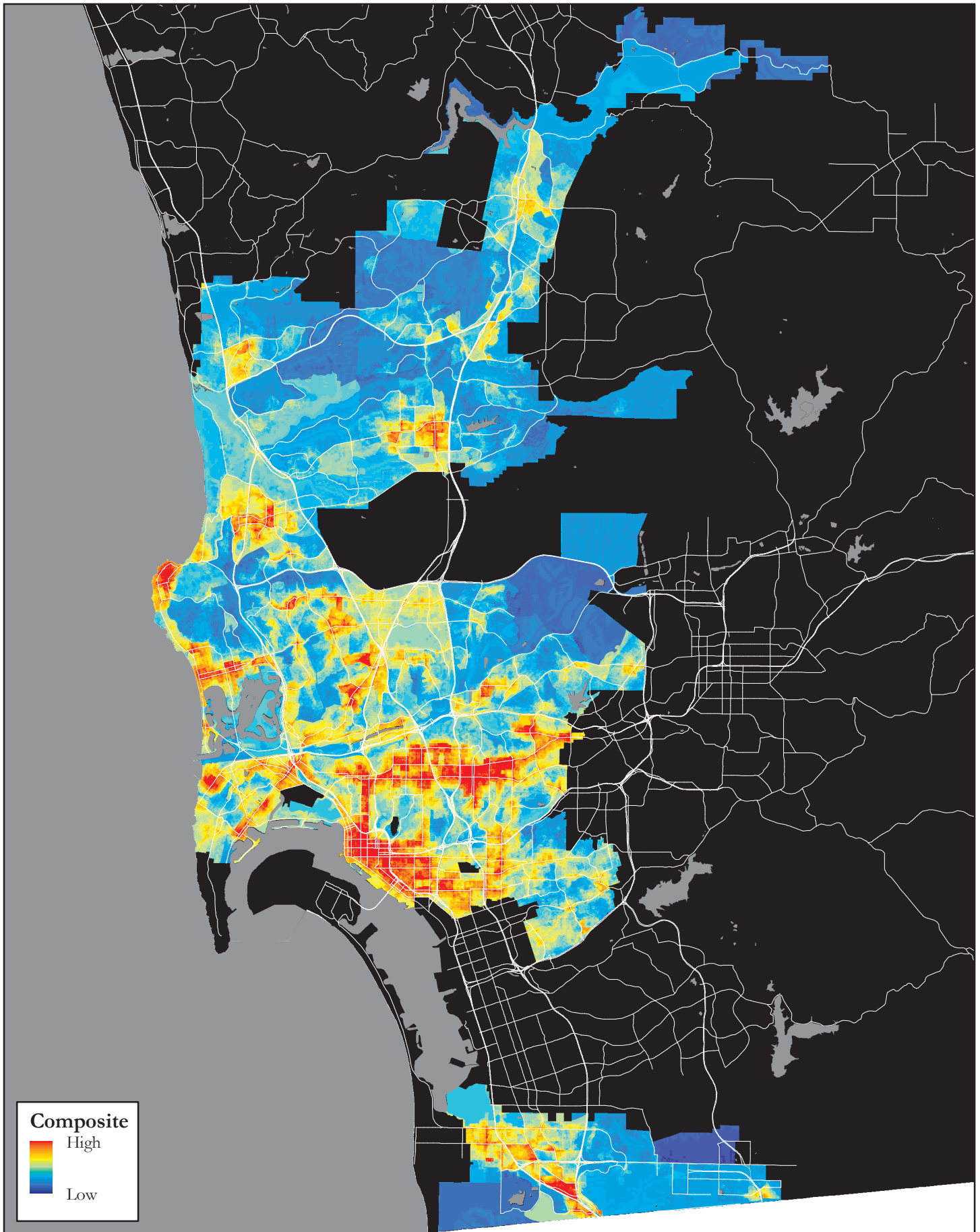
## 6.0 Data Output

This chapter summarizes the final citywide PPM composite model, created by synthesizing the three submodels discussed in Chapters 3.0 and 4.0, using the GIS steps outlined in Chapter 5.0. The final citywide PPM composite model is presented in Section 6.1. Section 6.2 presents average PPM composite scores by community planning area, calculated using only composite values from raster cells without open space or single family residential land uses.

### 6.1 Citywide PPM Composite Model

The final citywide PPM composite model combines the attractors, generators and detractors described in the previous chapters to identify areas that have the highest PPM composite scores. **Figure 6-1** displays the resulting final citywide PPM composite model for the City of San Diego.





Pedestrian Priority Model Update

Figure 6-1

Final Citywide PPM Composite Model



## 6.2 Average PPM Composite Score by Community Planning Area

Each community planning area was ranked by totaling the raw PPM composite scores of the cells within the community boundary and dividing by the acreage of the community. To avoid penalizing communities with large open space areas and single family residential areas, cell scores and acreages of associated with those two land use types were excluded from the averaging. The passive open space and single family residential land use acreages removed during the normalization process include:

- Bay or Lagoon
- Beach – Passive
- Lake/Reservoir/Large Pond
- Open Space Park or Preserve
- Undevelopable Natural Area
- Vacant and Undeveloped Land
- Water
- Single Family Detached
- Single Family Residential Without Units
- Spaced Rural Residential

**Table 6-1** presents the ranking and average composite score per acre by community. The list of communities was divided into tiers of ten communities, resulting in six tiers. **Figure 6-2** displays the community ranking by tier.

**Table 6.1: Community Ranking Normalized by Acreage**

Rank	Community	Average Score per Acre
1	DOWNTOWN	255.3
2	OLD TOWN SAN DIEGO	225.4
3	BARRIO LOGAN	220.3
4	SOUTHEASTERN SAN DIEGO	213.7
5	UPTOWN	213.2
6	GREATER NORTH PARK	211.0
7	MID-CITY:CITY HEIGHTS	210.6
8	MID-CITY:NORMAL HEIGHTS	210.0
9	OCEAN BEACH	206.1
10	GREATER GOLDEN HILL	204.3
11	MIDWAY-PACIFIC HIGHWAY	199.8
12	SAN YSIDRO	194.4
13	COLLEGE AREA	189.5
14	PACIFIC BEACH	185.4
15	MID-CITY:KENSINGTON-TALMADGE	183.9
16	MID-CITY:EASTERN AREA	174.0
17	LINDA VISTA	173.7
18	MISSION BEACH	171.9
19	PENINSULA	167.0

**Table 6.1: Community Ranking Normalized by Acreage**

Rank	Community	Average Score per Acre
20	ENCANTO NEIGHBORHOODS	161.0
21	SERRA MESA	156.7
22	OTAY MESA-NESTOR	153.6
23	CLAIREMONT MESA	151.8
24	KEARNY MESA	148.8
25	UNIVERSITY	147.5
26	MISSION VALLEY	140.3
27	LA JOLLA	140.2
28	BALBOA PARK	134.3
29	SKYLINE-PARADISE HILLS	133.2
30	CARMEL VALLEY	128.6
31	NAVAJO	125.5
32	SABRE SPRINGS	124.9
33	MIRA MESA	123.2
34	TORREY PINES	122.5
35	RANCHO BERNARDO	120.5
36	CARMEL MOUNTAIN RANCH	115.7
37	RESERVE	115.5
38	MISSION BAY PARK	112.7
39	TORREY HILLS	107.1
40	RANCHO PENASQUITOS	105.1
41	LOS PENASQUITOS CANYON	96.0
42	NCFUA SUBAREA II	92.3
43	SCRIPPS MIRAMAR RANCH	91.6
44	TORREY HIGHLANDS	90.9
45	MIRAMAR RANCH NORTH	90.1
46	TIERRASANTA	88.1
47	TIJUANA RIVER VALLEY	80.2
48	DEL MAR MESA	78.0
49	FAIRBANKS RANCH COUNTRY CLUB	75.5
50	BLACK MOUNTAIN RANCH	74.5
51	VIA DE LA VALLE	70.5
52	OTAY MESA	68.9
53	EAST ELLIOTT	68.3
54	PACIFIC HIGHLANDS RANCH	68.1
55	RANCHO ENCANTADA	67.2
56	SAN PASQUAL	66.7

Source: Chen Ryan Associates, November 2015

---

The results of the community rankings are mostly consistent with the previous iterations of the PPM. Eight of the top ten communities from the updated model are the same as the previous iteration of the model and only one Community Planning Area, Peninsula, is a new entrant in the top 20 ranking. Another noticeable jump in rankings was made by Carmel Valley, which placed 30<sup>th</sup> in the current iteration after being 39<sup>th</sup> in the previous version. Explanations for the ranking changes for Peninsula and Carmel Valley may include recent development. Documentation for how the community rankings were conducted in previous iterations of the PPM were unavailable, so it is possible changes in the ranking may be due to different approaches in the normalizing process.

### **List of References**

City of San Diego. *San Diego Pedestrian Master Plan Citywide Implementation Framework Report*. 2006.

City of San Diego. *City of San Diego Pedestrian Master Plan Volume 2B - Phase Four Communities*. 2013.

City of San Diego. *Final Draft Pedestrian Master Plan*. 2015.

City of San Diego. *City of San Diego Pedestrian Master Plan Volume 2A – Urban Core Communities*. 2015.