Appendix C - Key Equity Concepts Methodology

The following provides detailed methodology for how the three key equity concepts were measured and mapped.

The inputs for each equity measurement range from parcel-level to census-tract data. To create a common geography for all measures (except for jobs diversity, which uses census block groups), the data was normalized to a grid of cells, measuring roughly 1/4 mile on each side—approximately 50 acres in area each—across the entire city. The final maps show overall patterns based on the grid of cells.

Access to Opportunity

Access to Opportunity is measured through a combination of three items:

1. Denver's Department of Environmental Health and Environment (DDPHE's) neighborhood equity index;
2. Access to high-capacity transit
3. Access to centers and corridors

A detailed description of the methodology for calculating Access to Opportunity follows:

1. **Equity Index:** The neighborhood equity index considers socioeconomic, built environment and health conditions at a geographic level and is intended to help strategically target resources to improve access to opportunity. Using GIS, data at the neighborhood geography for the five below items was spatially joined by centroid to the 50-acre grid cells:
    a. Social Determinants of Health measured by a) percent of high school graduates or the equivalent for those 25 years of age or older and b) percent of families below 100% of the Federal Poverty Line;
    b. Built Environment measured by a) percent of residents within ¼-mile walk to a full-service grocery store and b) percent of living units within ¼-mile walk to a quality park or open space;
    c. Access to Health Care measured by the percent of pregnancies without first trimester prenatal care;
    d. Morbidity measured by percent of children that are overweight or obese; and
    e. Mortality measured by the average life expectancy.

Data sources: City and County of Denver GIS data, Vital Statistics data, Colorado BMI Surveillance System.

2. **Access to transit:** Using GIS, a buffer was created to measure proximity to transit. The buffer included:
    - Any area within 1/2-mile from high-capacity transit, which includes the high-capacity transit corridors defined in Denver Moves: Transit (currently none exist but they will be added as they are implemented in the future) and all rail stations in Denver; or
    - Any area within 1/4 mile from the frequent transit network, which is defined by Denver Moves: Transit as 15 min or less headways; 6am-10pm; 7 days per week. The bus lines that currently meet this standard are 15 (E Colfax), 16 (W Colfax) and 0 (S Broadway)

Housing unit data was then spatially joined to the 50-acre grid cells that overlapped the transit area created by the buffer. Each grid cell was scored 1-5 based on how much the grid cell overlapped with the transit buffer. Any grid cell completely outside of the transit buffer scored 1 (least access to transit). For those that overlapped with the transit buffer, natural breaks were created to score the cell based on how many housing units per grid cell overlapped with the transit buffer. The natural breaks led to a score of 2-5 per grid cell (lower scores representing fewer housing units within proximity to transit and higher scores representing more housing units within proximity to transit).

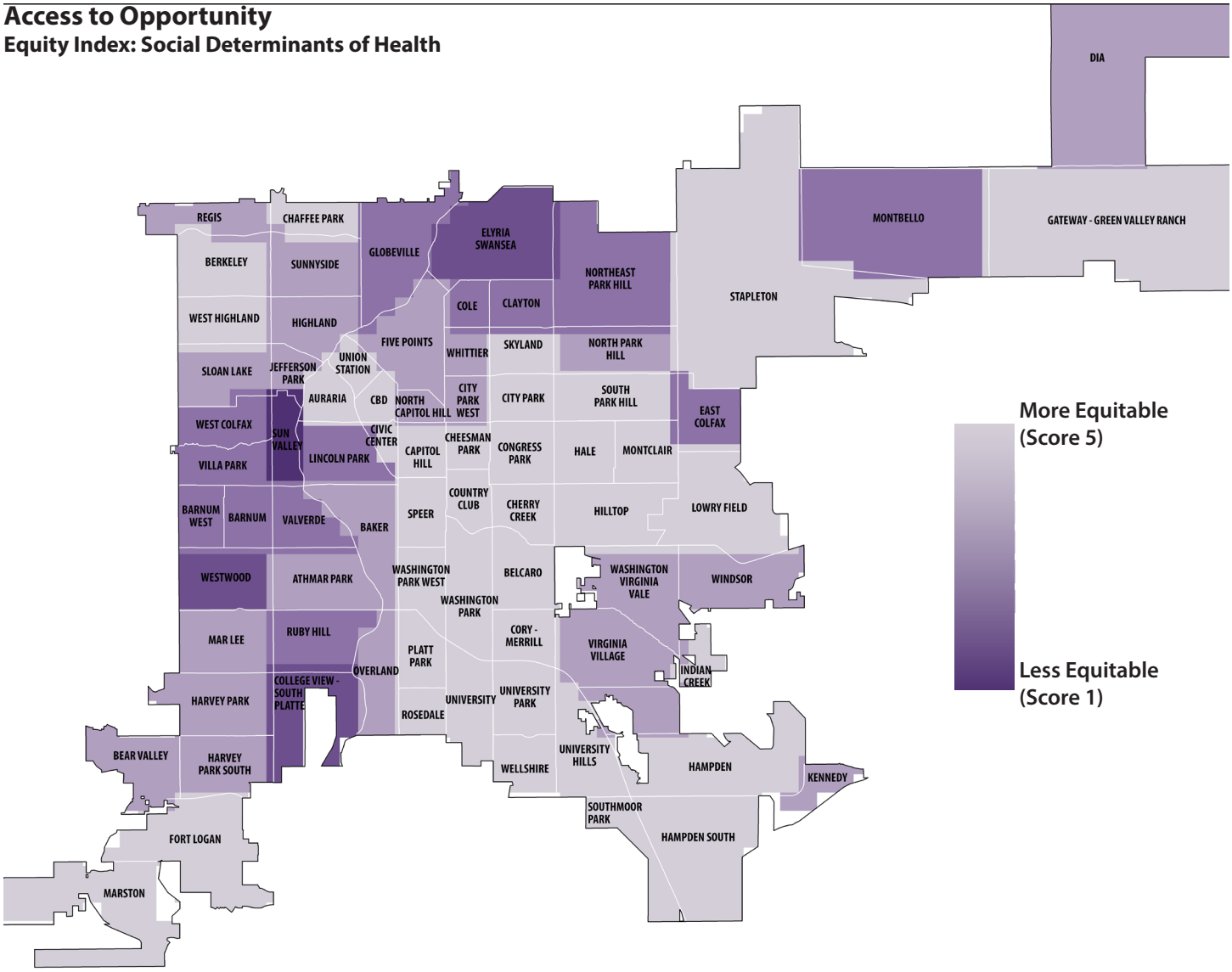
Data source: City and County of Denver GIS data

3. **Access to corridors and centers:** The access analysis adds a walkshed (1/2-mile), bikeshed (2-mile) and driveshed (5-mile) to each local center, local corridor, community center, community corridor and regional center from the future places map. The travel sheds by mode represent a 10-minute travel time. The assessment of walk, bike or drive shed was determined by neighborhood context. Each grid cell was manually scored based on walkshed, bikeshed or driveshed coverage:
    - 0-24% coverage = 1 point
    - 25-49% coverage = 2 points
    - 50-74% coverage = 3 points
    - 75-99% = 4 points
    - 100% = 5 points

The Access to Opportunity map was created by assigning a final score of 1-5 for each grid cell. The score is the average of the score received for each of the above components. A lower score represents less access to opportunity and a higher score represents more access to opportunity.

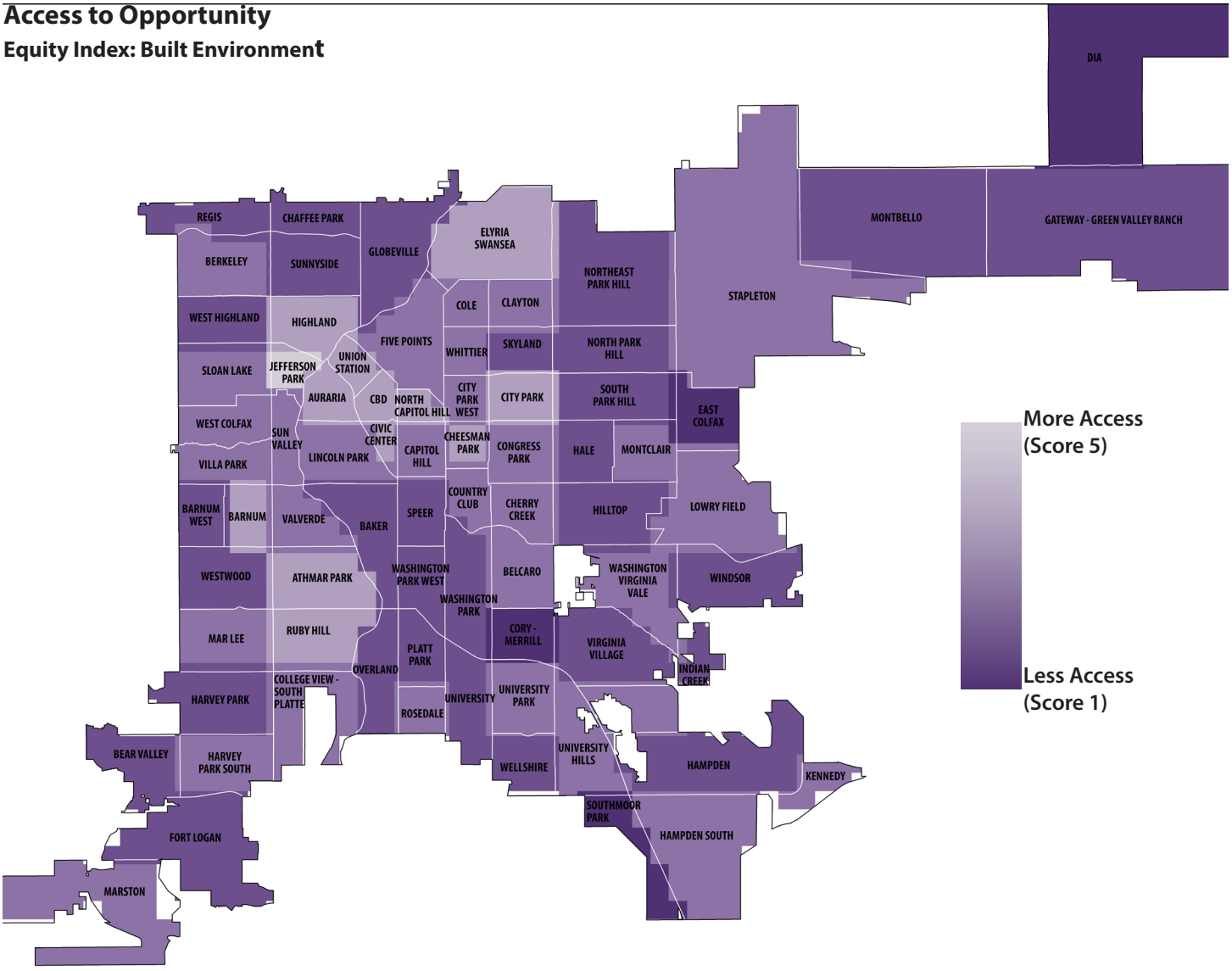
The following pages show each of the component maps/measurements that collectively compose the Access to Opportunity map in Chapter 2.

Access to Opportunity
Equity Index: Social Determinants of Health



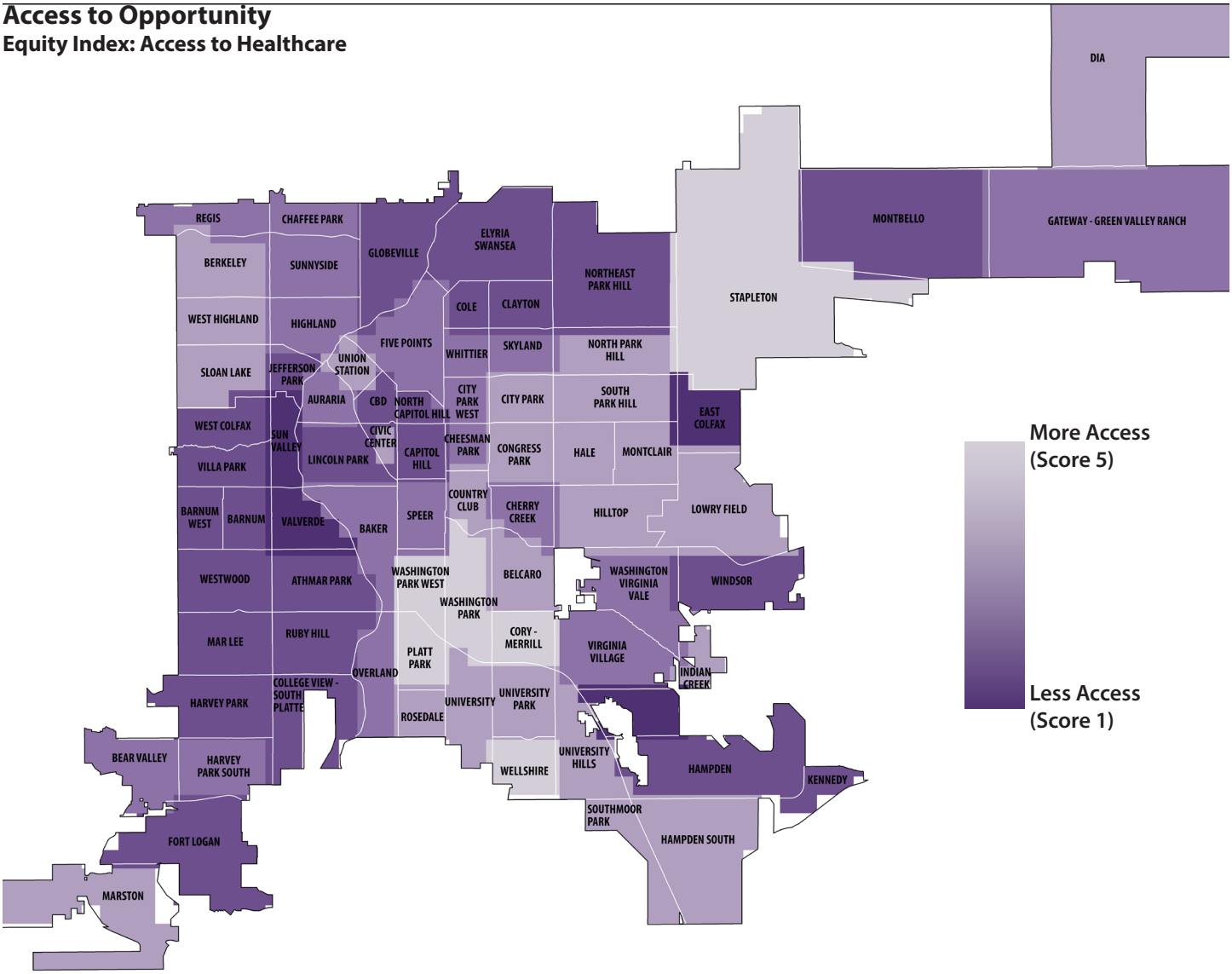
Access to Opportunity

Equity Index: Built Environment

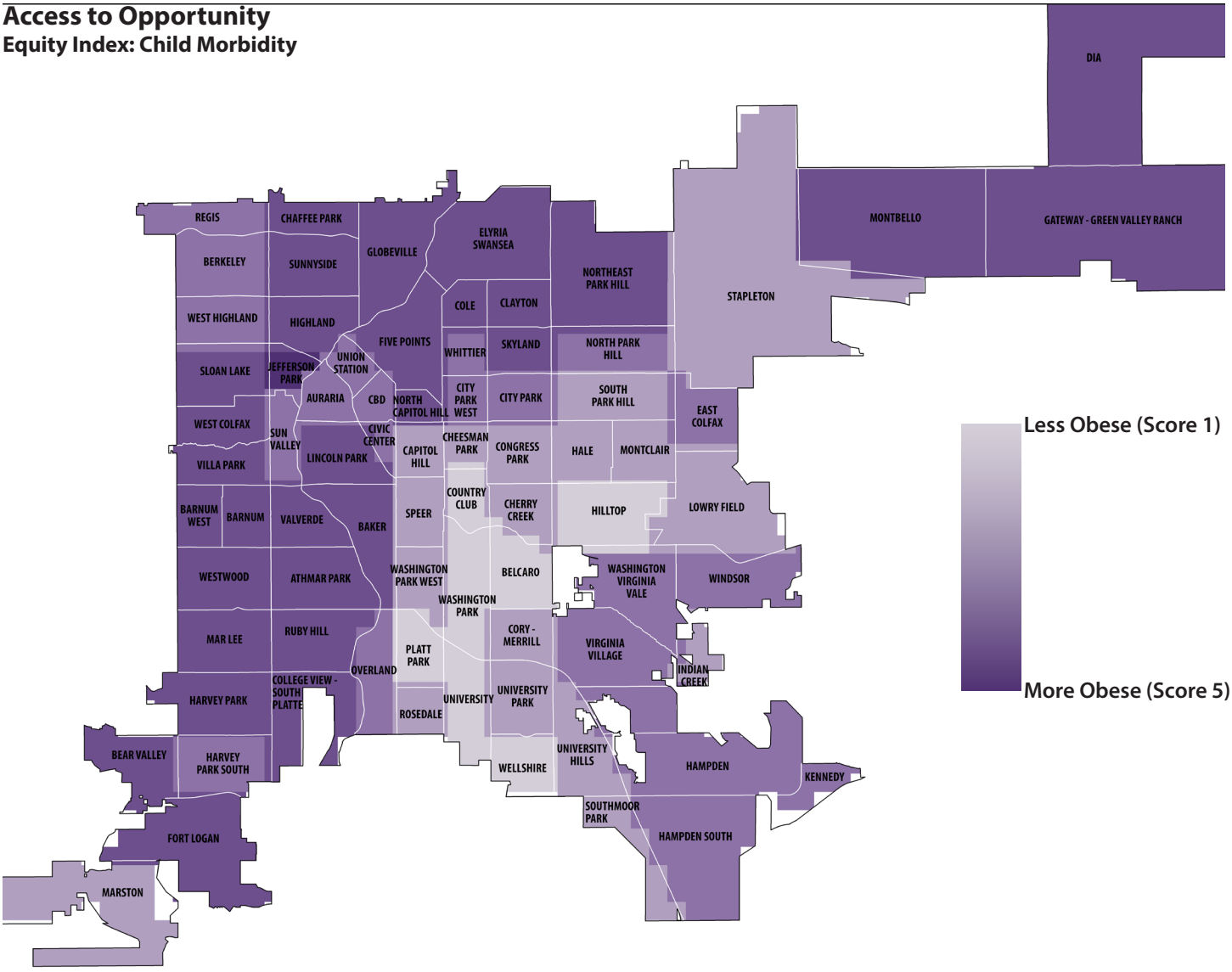


Access to Opportunity

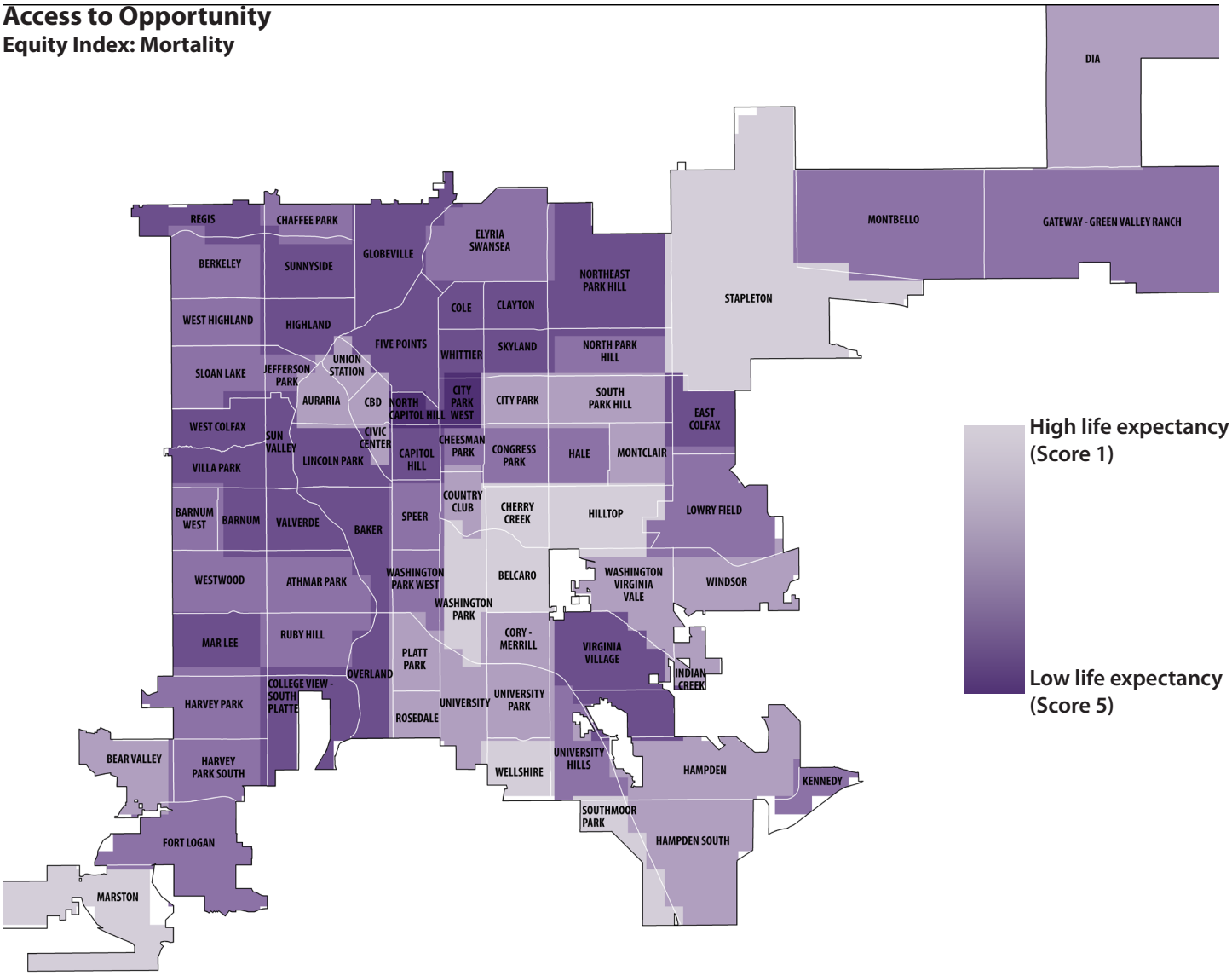
Equity Index: Access to Healthcare



Access to Opportunity
Equity Index: Child Morbidity

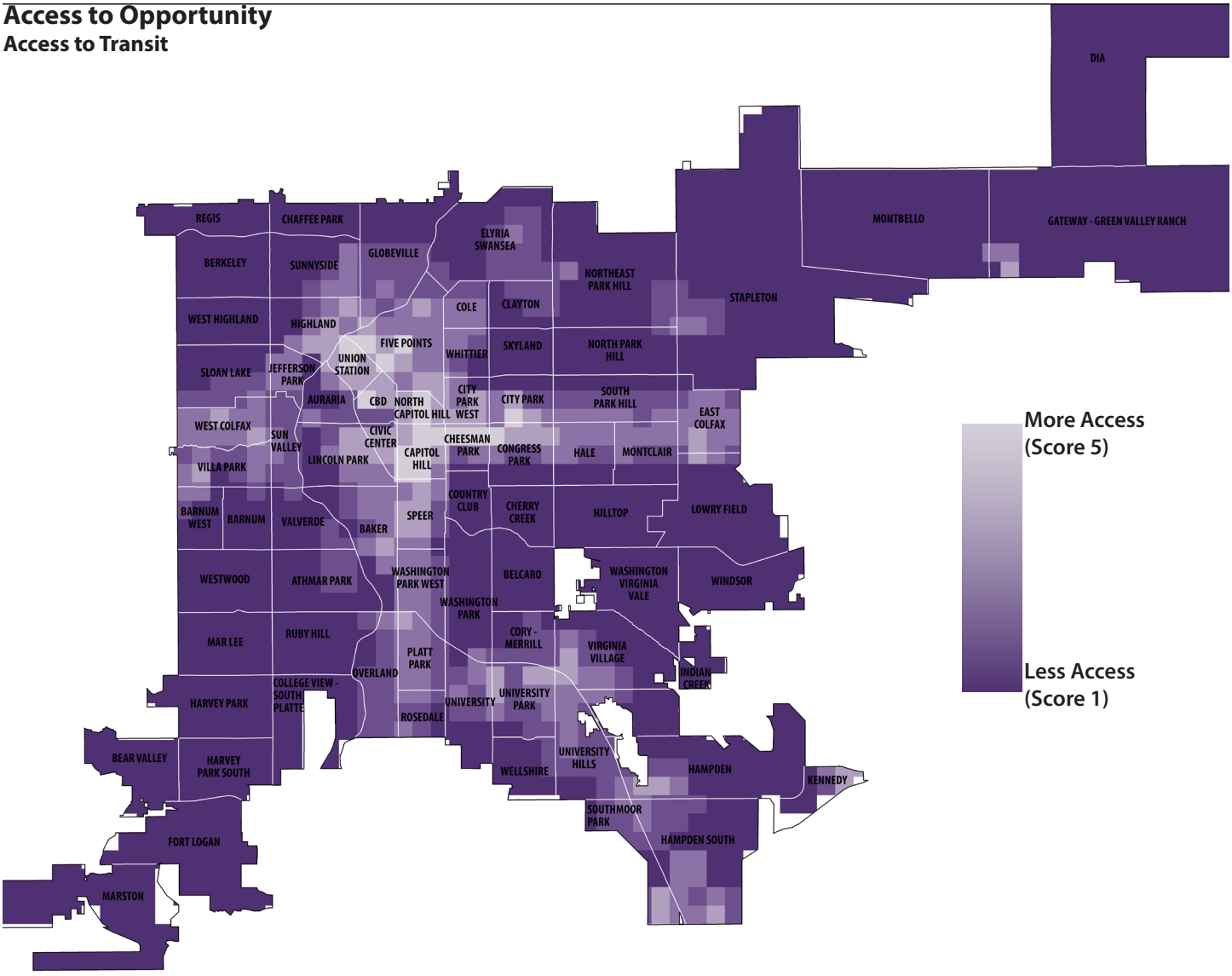


Access to Opportunity
Equity Index: Mortality



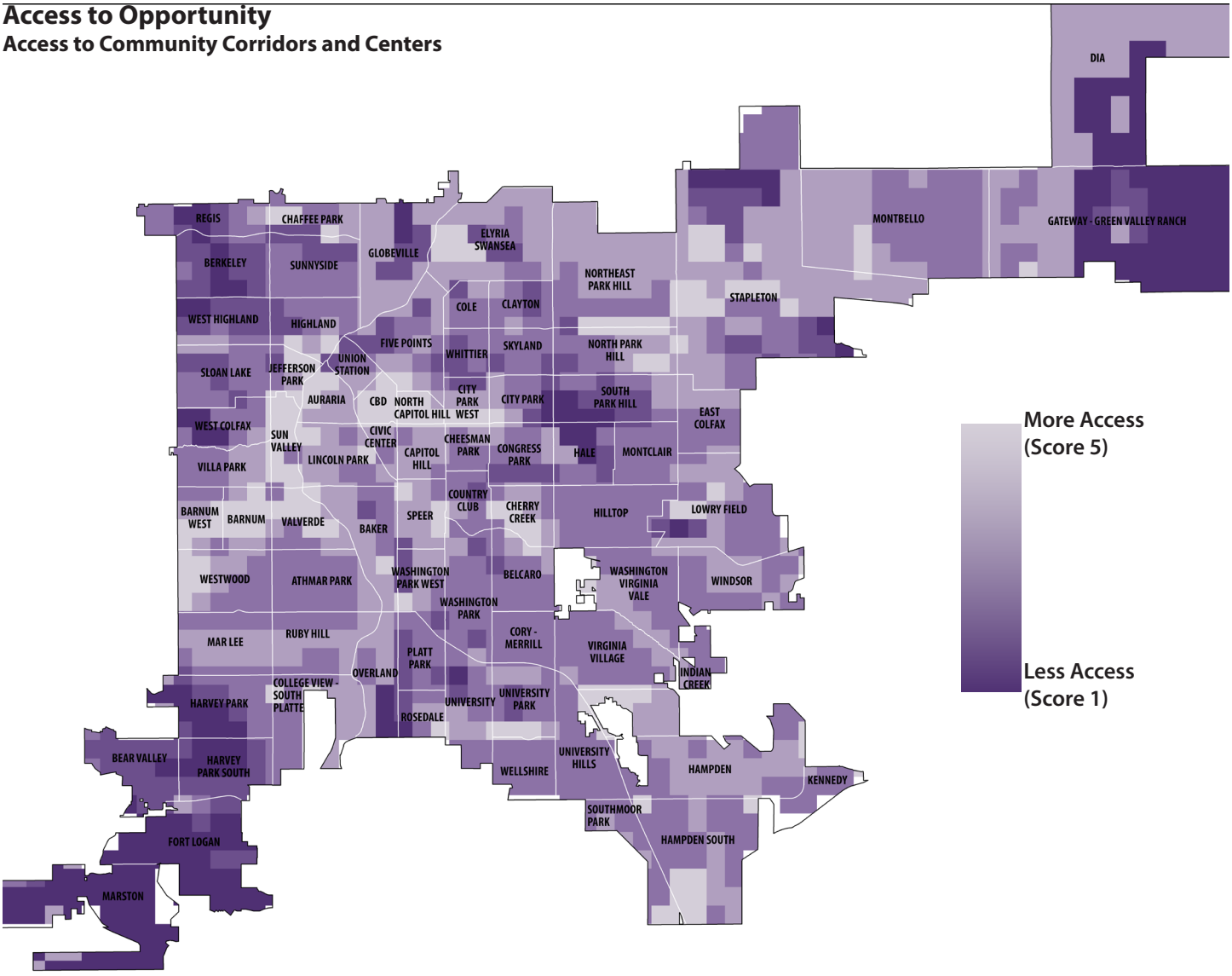
Access to Opportunity

Access to Transit



Access to Opportunity

Access to Community Corridors and Centers



Vulnerability to Displacement

Vulnerability to Displacement is measured using the vulnerability to displacement index in Denver Economic Development and Opportunity's *Gentrification Study: Mitigating Involuntary Displacement* (2016). The vulnerability to displacement index is calculated at the census tract level using primarily census data. It combines three variables:

1. The tract's percent of residents with less than a bachelor's Degree is higher than Denver's percent of residents with less than a bachelor's Degree;

2. The tract's percent of renter-occupied units is higher than Denver's percent of renter-occupied units in 2016; or

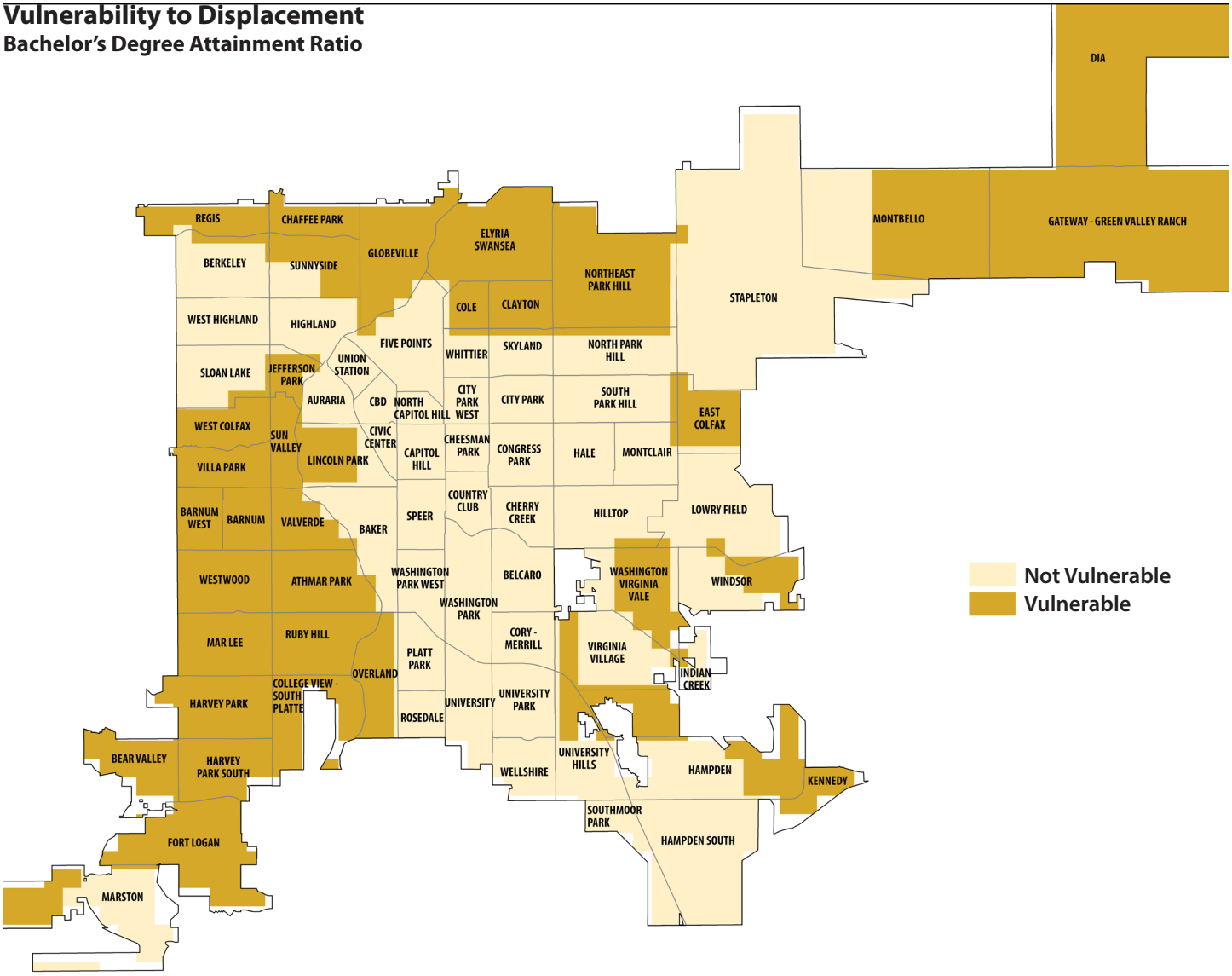
3. The tract's median household income is lower than Denver's median household income in 2016.

Each 50-acre grid cell received a score of 0 (less vulnerability) to 3 (more vulnerability) based on the three variables above.

Data source: American Community Survey (ACS) 2016 5-year estimates (Census Tract level). For more on this measurement and its data source, see the Denver Economic Development and Opportunity's *Gentrification Study: Mitigating Involuntary Displacement* (2016).

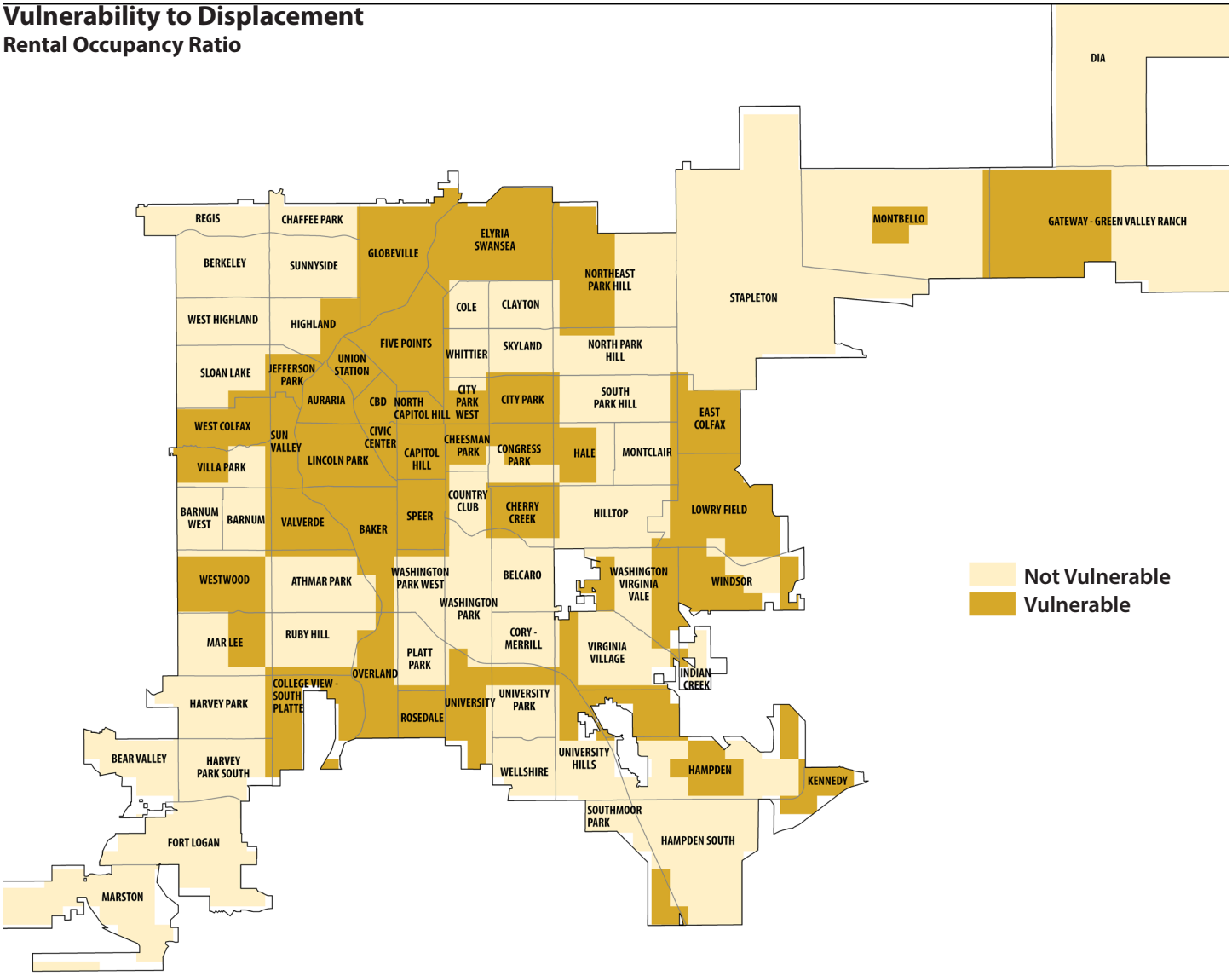
The following pages show each of the component maps/ measurements that collectively compose the Vulnerability to Displacement map in Chapter 2.

Vulnerability to Displacement
Bachelor's Degree Attainment Ratio



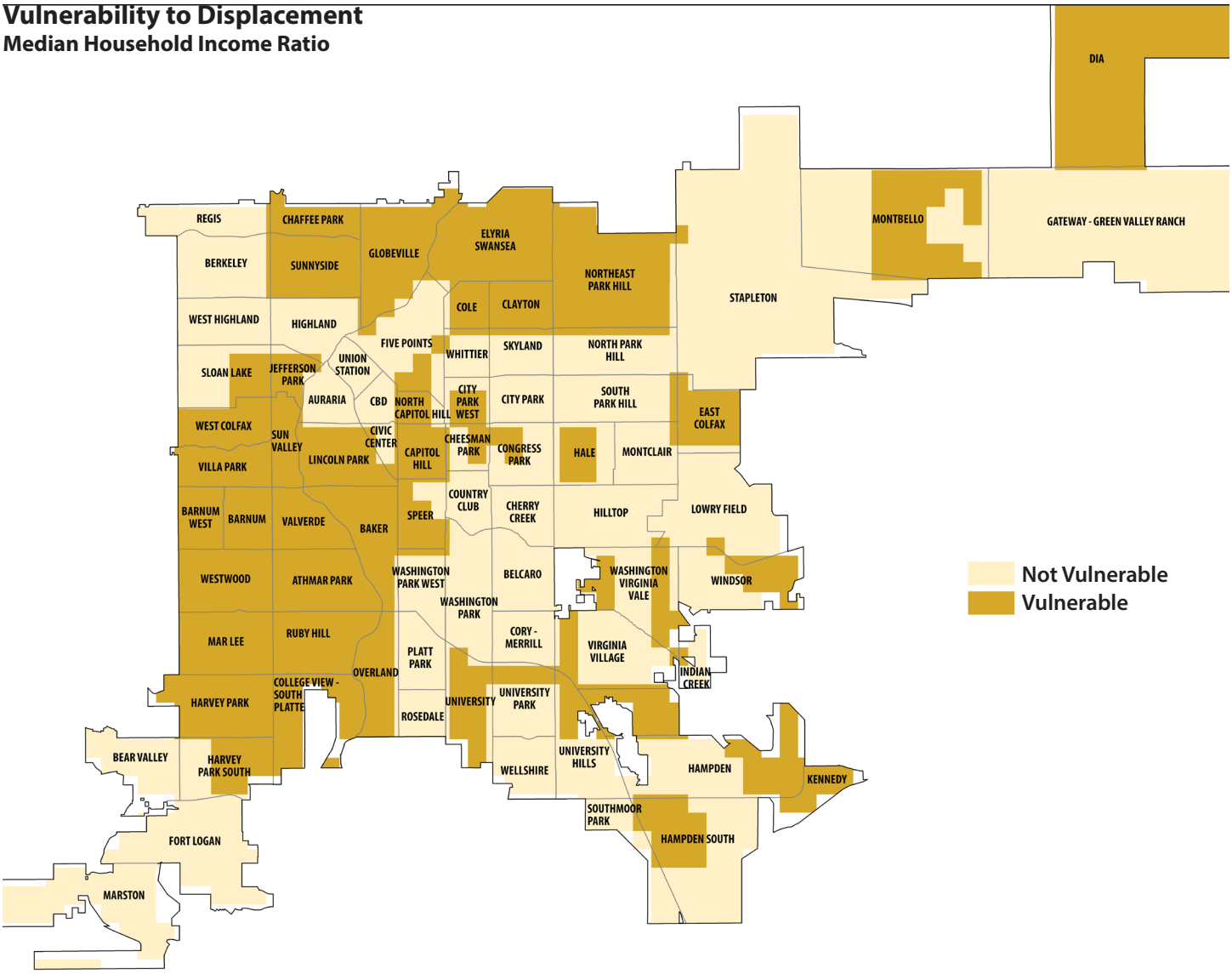
Vulnerability to Displacement

Rental Occupancy Ratio



Vulnerability to Displacement

Median Household Income Ratio



Housing and Jobs Diversity

There are two measurements: housing diversity and jobs diversity.

Housing Diversity

This measurement examines the diversity of housing for an area. Every census tract is evaluated for the following metrics:

1. Housing diversity
2. Home size diversity
3. Tenure diversity
4. Housing costs
5. Number of affordable (income-restricted) housing units

Housing diversity was measured by looking at the percentage of middle density housing (2-19 units) in a census tract. Middle density housing was used to capture diversity in both predominantly single family and predominantly multifamily areas. This percentage was compared to the city, which has approximately 19% middle density housing; if an area had over 20% middle density housing units, it was considered "diverse", if it was less than 20% middle density it was considered "not diverse."

Data source: ACS 2016 5-year estimates (Census Tract level)

Home size diversity was measured by comparing the number of housing units with 0-2 bedrooms to the number of units with 3 or more bedrooms. If this ratio was less than 0.5, it was considered "High" (skewed to larger units); if it was between 0.5 and 2.5 it was considered "Mixed"; if it was greater than 2.5, it was considered "Low" (skewed to smaller units). Tracts that scored "Low" or "High" were categorized as "Not Diverse" while those scored "Mixed" were categorized as "Diverse"

Data source: ACS 2016 5-year estimates (Census Tract level)

Tenure diversity was measured by calculating the percentage of owners/renters in a tract, and comparing that to the citywide split (49% owners, 51% renters). If a tract was within a 60/40 split, it was considered to be "within city range"; if a tract was between 60/40 and 70/30, it was considered to be "slightly disparate", and if it had a split greater than 70/30, it was considered to be "extremely disparate"

Data source: ACS 2016 5-year estimates (Census Tract level)

Housing costs calculated the ratio of housing units affordable to households earning up to 80% of the city's median income to housing units affordable to households earning over 120% of the city's median income in each census tract. For reference, the citywide ratio is 1.16. This ratio for all census tracts was broken into 3 tertiles for classification. If an area had a low cost housing: high cost housing ratio of less than 0.9, it was considered "Low" (skewed to more housing affordable to households earning up to 80% AMI); if it had a ratio of between 0.9 and 2.36 it was considered "Mixed"; if it had a ratio of over 2.36 it was considered "High" (skewed to more housing affordable to households earning over 120% AMI). Areas that scored either "Low" or "High" were categorized as "Not Diverse"

Data Source: ACS 2016 5-year estimates (Census Tract level)

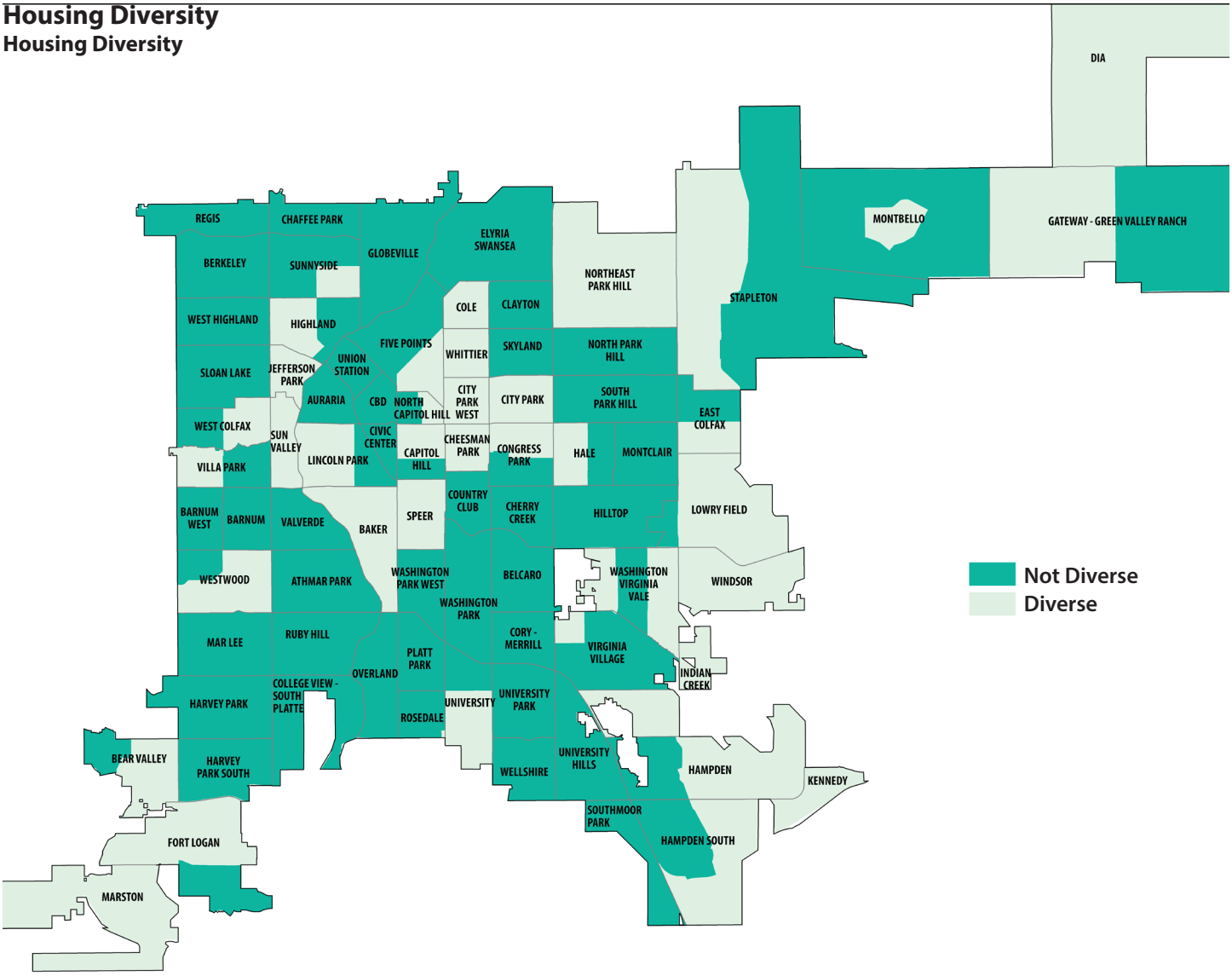
Number of affordable (income-restricted) housing units calculates the number of income restricted units in a census tract. Any census tract with affordable units equal to or greater than the citywide average (160.8 units per census tract) scored a point for housing diversity. Any census tract below the citywide average scored 0 and was considered not diverse.

Data Source: Denver Economic Development and Opportunity

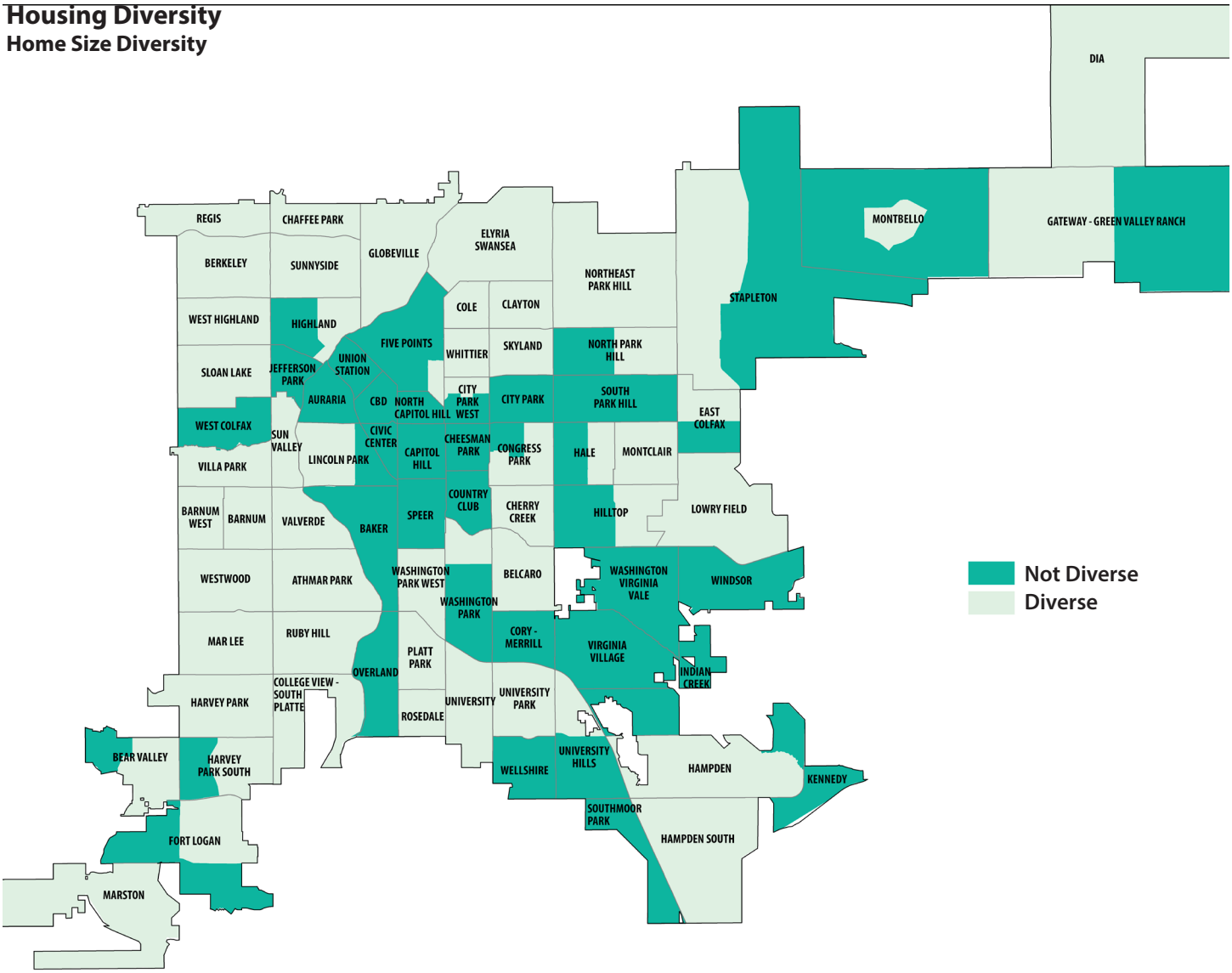
The following pages show each of the component maps/ measurements that collectively compose the Housing Diversity map in Chapter 2.

Housing Diversity

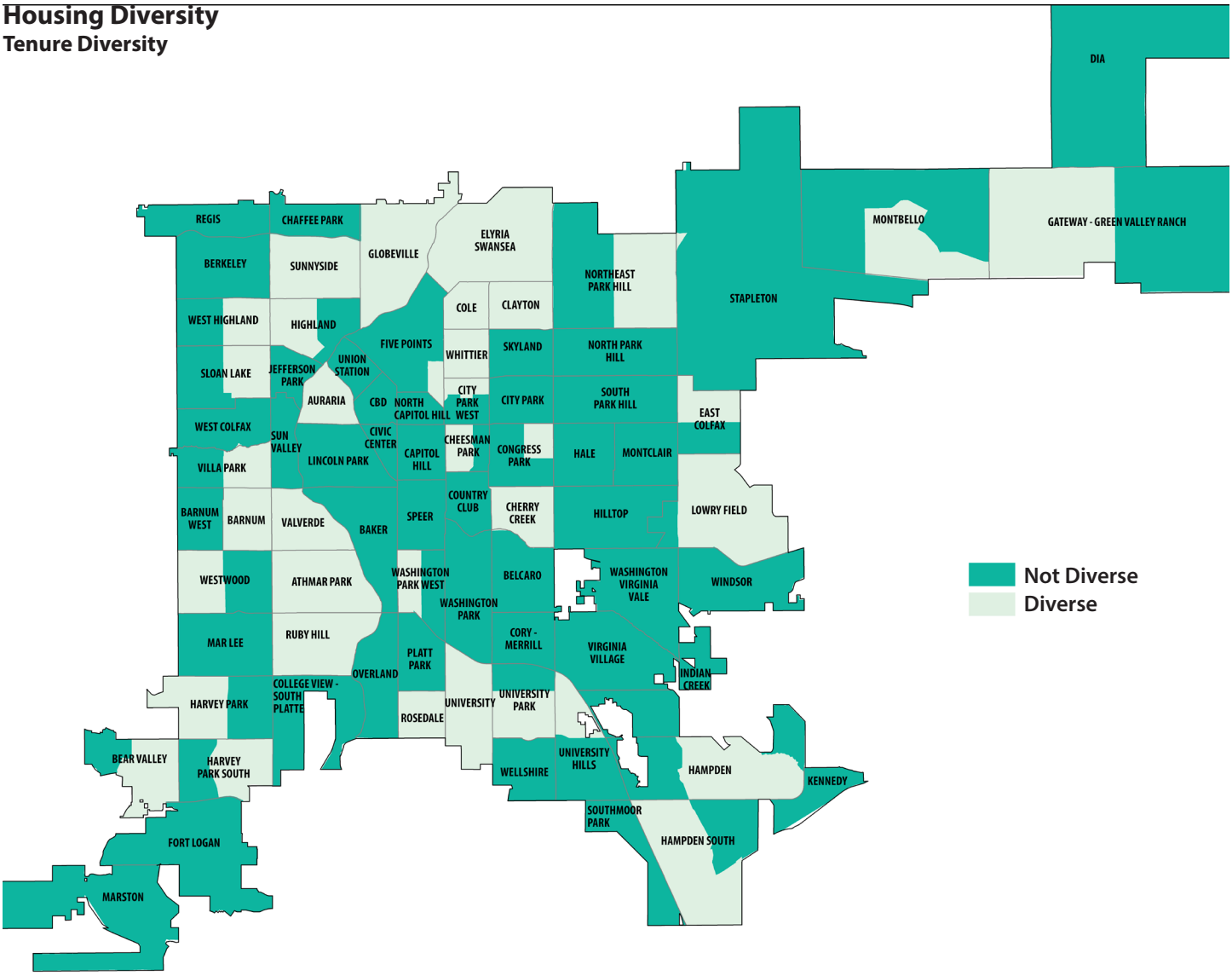
Housing Diversity



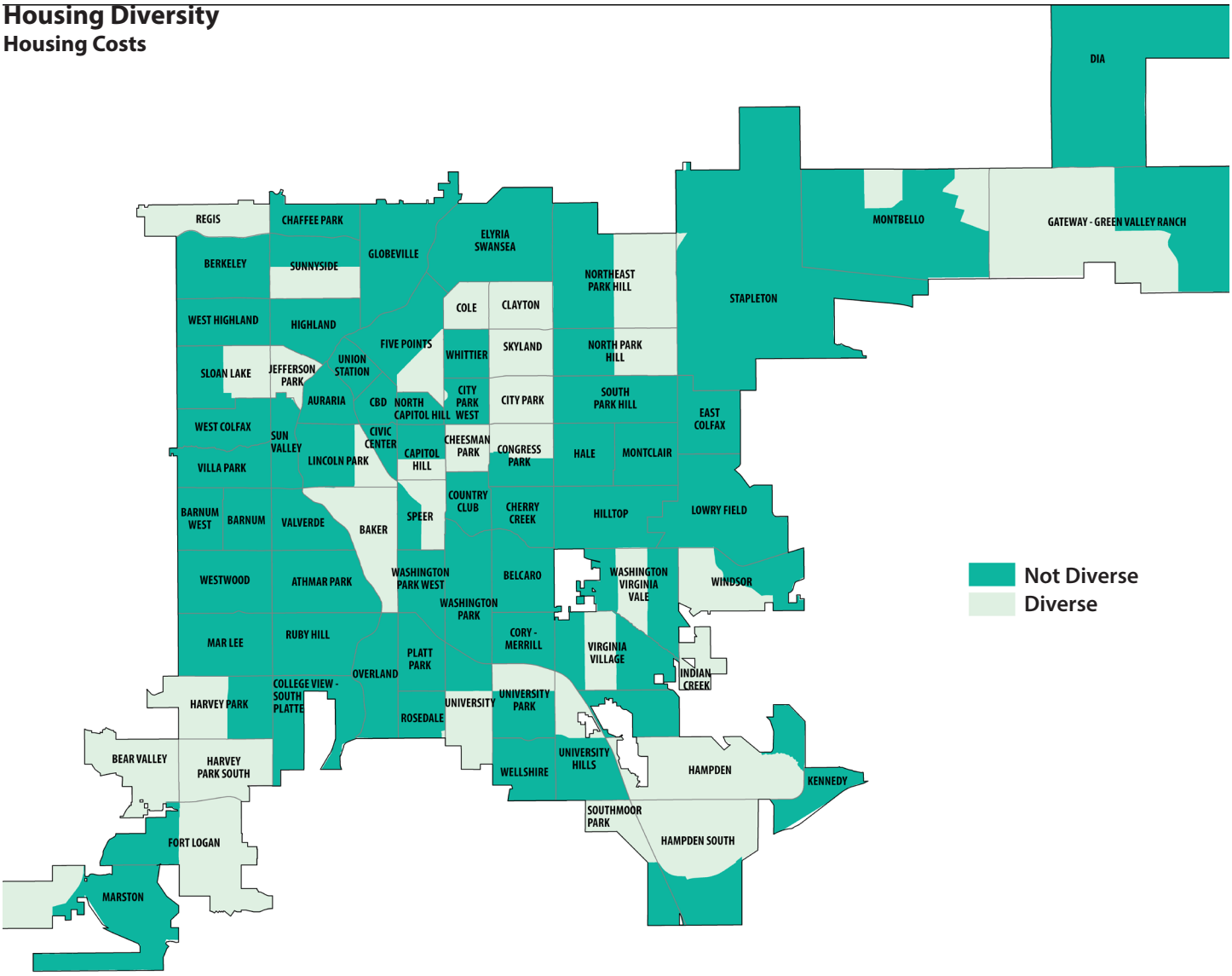
Housing Diversity
Home Size Diversity



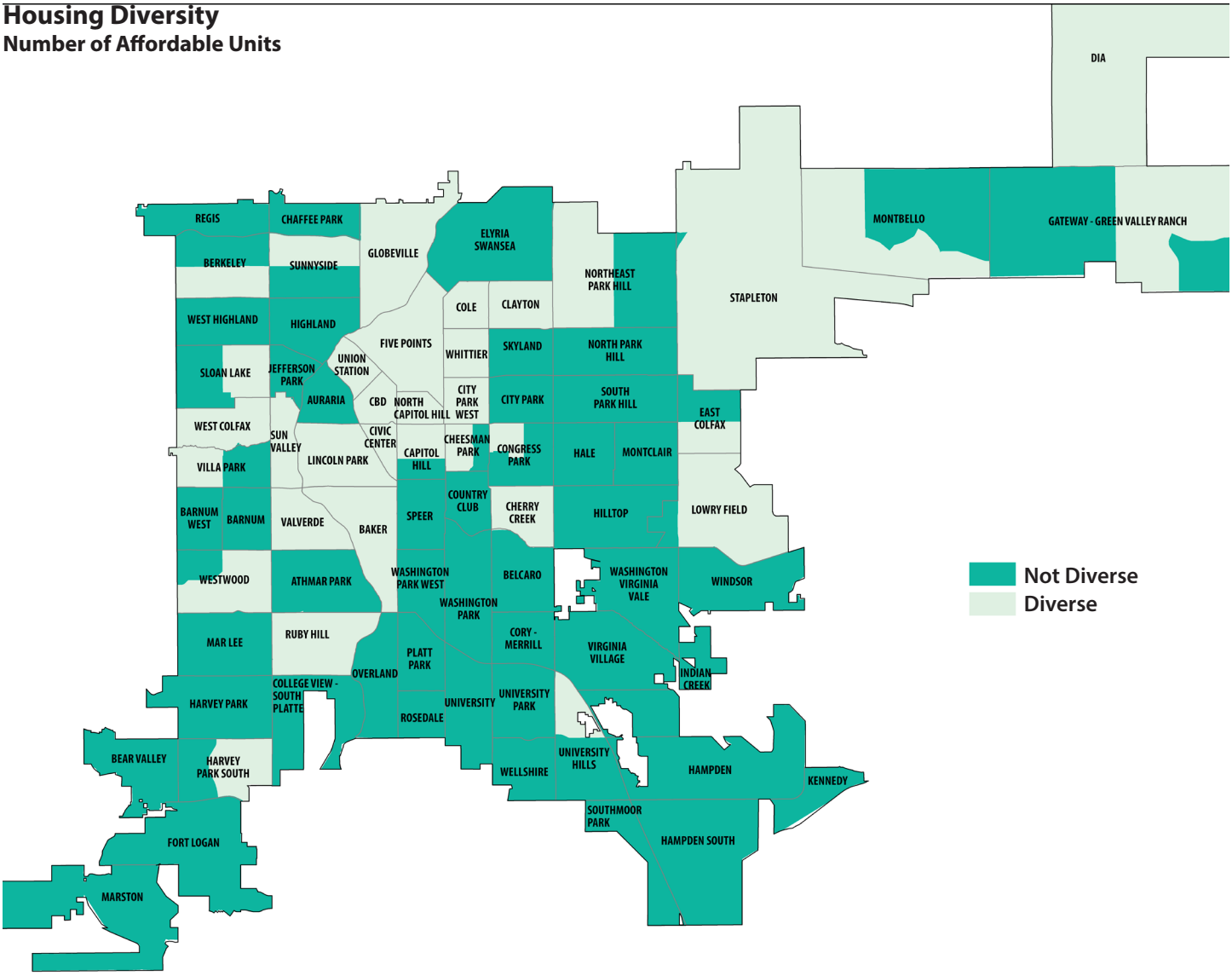
Housing Diversity
Tenure Diversity



Housing Diversity
Housing Costs



Housing Diversity
Number of Affordable Units



Jobs Diversity

This measurement examines the diversity of employment in census block groups based on

1. Job density (amount of jobs)
2. Industry diversity (types of jobs)

Job density was determined by calculating the number of jobs per acre. Using natural breaks, this data was broken into four classes. Block groups were then assigned a level of transparency based on their job density class. Lighter shades reflect a lower density and darker shades a higher density.

Industry diversity was determined by classifying LEHD job sectors into three categories:

Retail
- Utilities
- Construction
- Retail trade
- Real estate and rental and leasing
- Administrative and support and waste management and remediation services
- Health care and social assistance
- Accommodation and food services
- Other services (except public administration)
- Public administration

Innovation
- Mining, quarrying, and oil and gas extraction
- Transportation and warehousing
- Information
- Finance and insurance
- Professional, scientific, and technical services
- Management of companies and enterprises
- Educational services
- Arts, entertainment, and recreation

Manufacturing
- Agriculture, forestry, fishing, and hunting
- Manufacturing
- Wholesale trade

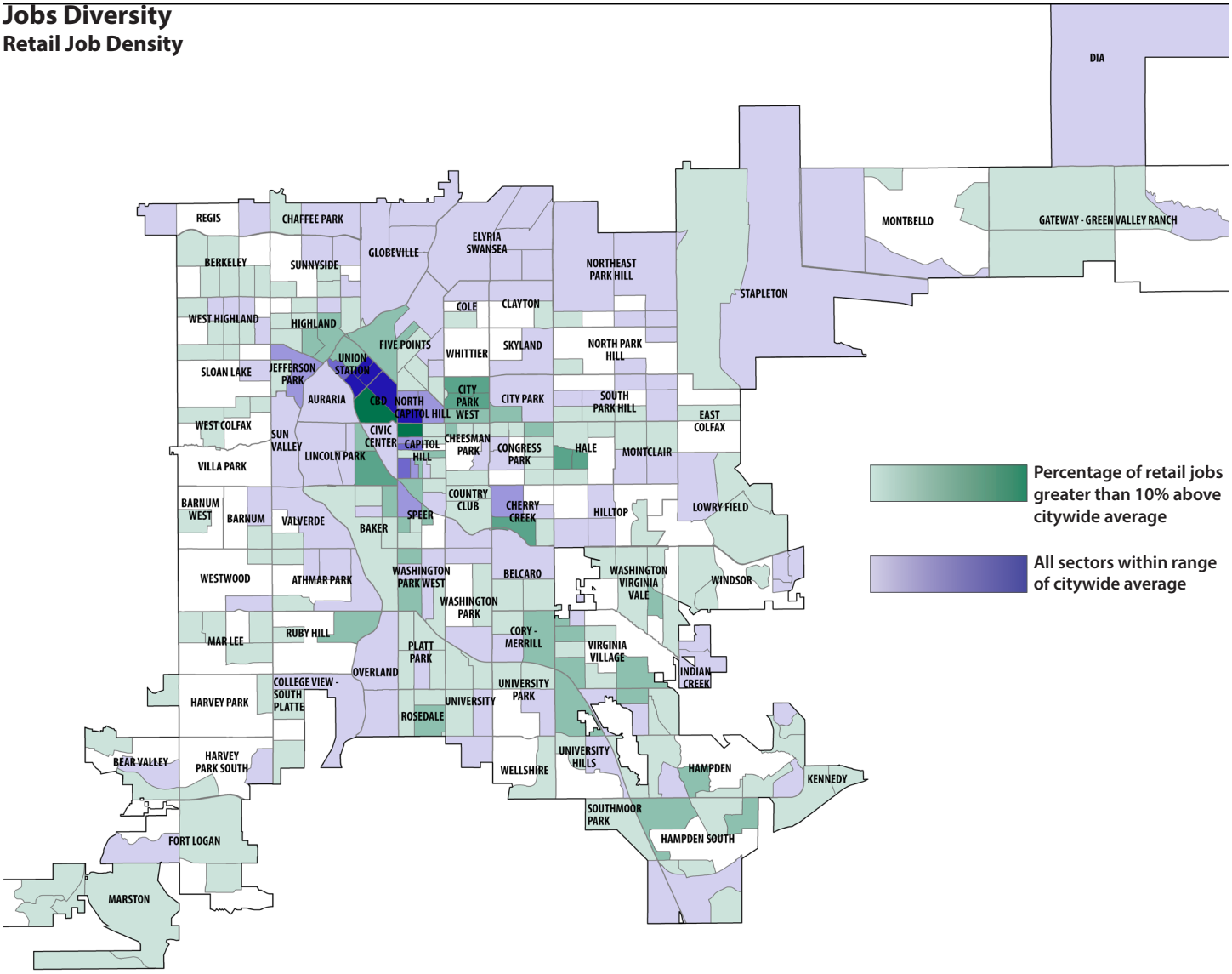
The percentages of retail, innovation, and manufacturing jobs were calculated by block group and compared to the citywide breakdown (retail – 52.1%, innovation – 37.4%, and manufacturing – 10.4%). If block groups had greater than 10% of any of the citywide percentages then they were considered skewed towards that sector. This determined the color of the block group on the map.

Block groups with less than 100 total jobs were removed from the map.

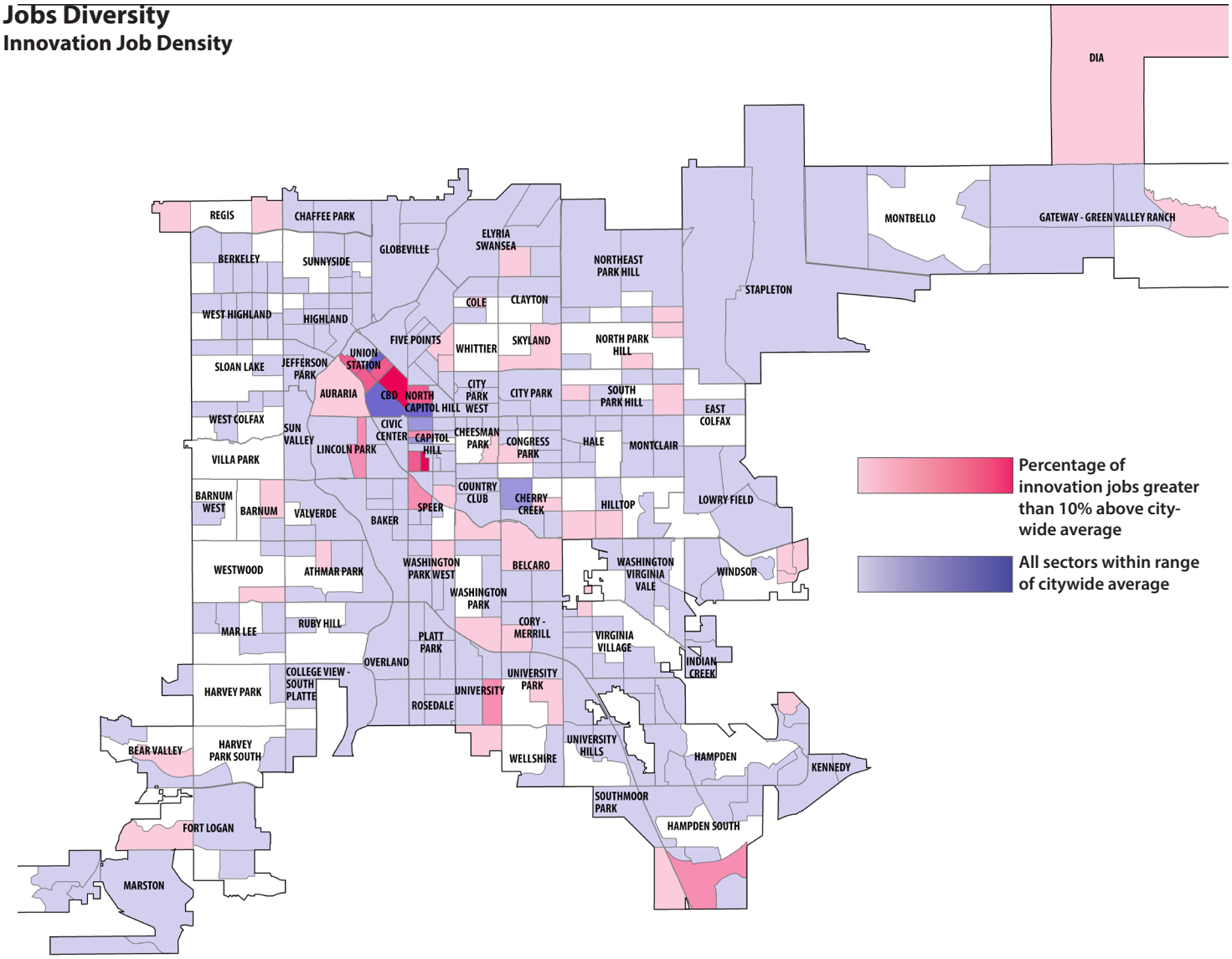
Data source: LEHD 2015 jobs data (Block level, aggregated up to Census Block Group)

The following pages show each of the component maps/ measurements that collectively compose the Jobs Diversity map in Chapter 2.

Jobs Diversity
Retail Job Density



Jobs Diversity
Innovation Job Density



Jobs Diversity

Manufacturing Job Density