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Health Assessment

DRAFT Southwest Corridor Existing Conditions Technical Report

January 2012

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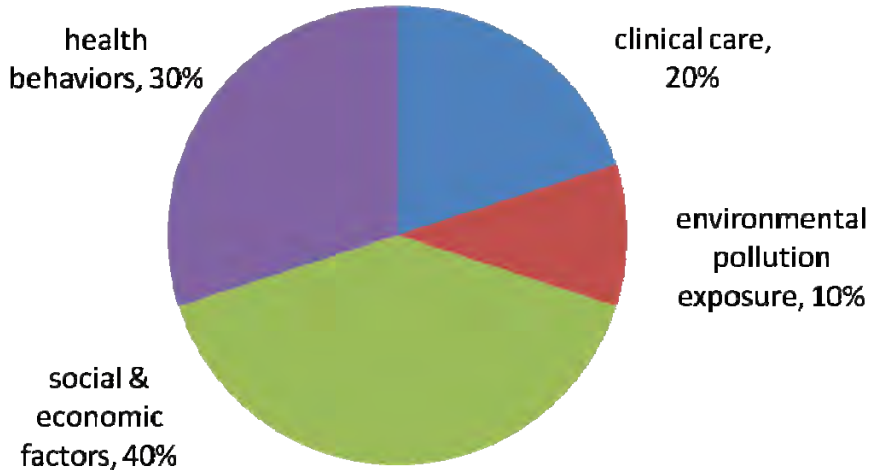
Introduction

Health is defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.[1] According to the University of Wisconsin Population Health Institute, the determinants of health include social and economic factors (40 percent), health behaviors (30 percent), clinical care (20 percent) and environmental pollution exposure (10 percent).

Figure 1: Determinants of health



Source: University of Wisconsin, Population Health Institute

The planning of communities, especially the availability of community infrastructure, and the design of the built environment can especially affect health behaviors and environmental exposure. The design of the built environment can offer opportunities for residents to engage in health behaviors that reduce illness, such as recreation, physical activity and a healthy diet. In addition, the built environment can help to limit exposure to environmental pollution (i.e., air toxins and noise pollution), which have the potential to cause stress-related or air quality-related illnesses. Increased exposure to the natural built environment, such as trails, parks, tree canopy and open spaces, has been shown to reduce stress.

Planning processes and infrastructure investments often address health outcomes. In fact, federal policy calls for the contemplation of health outcomes, but these outcomes are rarely addressed directly in planning documents. The National Environmental Policy Act (NEPA) of 1969 requires the consideration of health in project alternatives decisions. NEPA requires a draft environmental impact statement (DEIS) to "promote efforts that will prevent or eliminate damage to the environment and biosphere, and stimulate the **health and welfare of man**" ; "assure for all Americans **safe, healthful,**

1 World Health Organization (2011). http://www.who.int/en/.

productive, and aesthetically and culturally pleasing surroundings"; and "attain the widest range of beneficial uses of the environment without degradation, **risk to health** or safety, or other undesirable and unintended consequences."[2]

This technical report, the Southwest Corridor Health Assessment, includes three areas of health that research has shown to be affected by the built environment:

1. Physical activity related illnesses (e.g., obesity, cardiovascular disease, diabetes),
2. Air quality related diseases (e.g., asthma), and
3. Mental health diseases (e.g., depression, anxiety).

The purpose of this report is to build a foundation for the future creation and evaluation of land use and transportation policy alternatives and investment decisions. These built environment investments could include sidewalks, trails, bicycle paths, high capacity transit or roadway improvements. Policies could include zoning and comprehensive plan changes. This research will help decision-makers evaluate built-environment community investments in the Southwest corridor based on physical activity level, air quality and mental health factors.

Other areas of the built environment which have health implications, such as safety from traffic injuries and fatalities and access to jobs and opportunities, not included in this report,will be explored in the *Southwest Corridor Transportation Technical Report* and the *Southwest Corridor Housing Technical Report*.

This health assessment contributes to Metro's goals of providing transportation choices and access, decreased greenhouse gas emissions, sustained economic competitiveness, healthy ecosystems, equitable distribution of change and the creation of vibrant, livable communities.

Methodology

This report builds upon Metro's work on the *Lake Oswego to Portland Transit Study Health Impact Assessment* (Oregon Public Health Institute, 2010) and the *East Metro Corridor Health Assessment* (Metro, 2011). It references the data collection and existing conditions analysis conducted for the *Southwest Corridor Active Transportation Technical Report* (Metro, 2011), *Southwest Corridor Transportation Technical Report* (Metro, 2011), the pedestrian and bicycle environment (PSU Transportation Systems, 2011) and the *Community Investment Initiative* (Metro, 2011).

Public health research and studies by Metro and partnering and/or local health providers, non-profits, universities and local governments form the foundation of this report. Some of the recent local, state and national research referenced for this assessment includes:

- *Does Improving the Built Environment Impact Health?*, Providence CORE, 2011
- *Oregon Health Study*, Providence CORE, 2011
- *Pedestrian Network Analysis*, TriMet, 2011

2 National Environmental Protection Act. (2011). NEPA §§2 and 101, 42 USC §§ 4321 and 4331.

- *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*, Booz Allen Hamilton, July 2011
- Letter to Columbia River Crossing, Multnomah County Health Department, June 9, 2008
- *Draft Healthy Eating, Active Living National Policy Scan*, Stacy Humphrey, City of Gresham, May 2011
- *Built Environment Atlas: Active Living, Healthy Eating*, Elizabeth Clapp and Moriah McSharry McGrath, Research Analysts, Multnomah County Health Department, June 2011
- *How Land Use and Transportation Systems Impact Public Health*: *A Literature Review of the Relationship Between Physical Activity and Built Form*, Lawrence D. Frank, Ph.D., and Peter Engelke, City and Regional Planning Program, College of Architecture, Georgia Institute of Technology, Active Community Environments Initiative, 2001
- "Costs and benefits of bicycling investments in Portland, Oregon," Thomas Gotschi, *Journal of Physical Activity & Health,* International Society of Activity and Health, 2011
- "Putting greenways first," Randall Arendt, *Planning,* American Planning Association, August/September 2011
- *Physical Activity Brief*, Alliance for a Healthier Generation, May 2011
- "Physical training as a substance abuse prevention intervention for youth," T.R. Collingwood, *Journal of Drug Education*, 2000
- Oregon Environmental Public Health Tracking, State of Oregon, 2011
- "WHO: Iran, South Asia Ranked Worst in Urban Air Pollution," Nate Berg, *The Atlantic Cities*, Sept. 26, 2011
- "Tackling the global clean air challenge," News Release, World Health Organization, Sept. 26, 2011
- "The 10 Most air-polluted cities in the U.S.," Brian Walsh, *Time,* Sept. 29, 2011
- "Physical activity, exercise, depression and anxiety disorders," Andreas Ströhle, Department of Psychiatry and Psychotherapy, Universitätsmedizin Berlin, *Journal of Neural Transmission*, Aug. 23, 2008
- Behavioral Risk Factor Surveillance System, Centers for Disease Control and Prevention, 2010
- *Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007)*, Oregon Department of Human Services, January 2007
- *Heart disease and stroke in Oregon: Update 2010*, State of Oregon, 2010
- *PATS 2017 Pollutant Modeling Summary,* Portland Air Toxics Solutions Advisory Committee, Jan. 25, 2011
- *The Burden of Asthma in Oregon,* State of Oregon, 2008
- Oregon Behavioral Risk Factor Surveillance System, State of Oregon, 2011

This report was written with the help of, and in partnership with, Kaiser Permanente, Providence CORE, Upstream PublicHealth, Oregon Heath Partnership Institute, Multnomah County Health Department, the Washington County Health Department and the State of Oregon. Combining data from each of these organizations, Metro staff has compiled health outcome data to form a snapshot of health in the Southwest Corridor.

I.MAKING THE CASE: THE BUILT ENVIRONMENT CONNECTION TO HEALTH OUTCOMES

Physical activity

Active transportation, such as walking and biking, engages people in healthy physical activity while they accomplish the task of traveling from place to place. The shape and nature of our communities can promote or limit opportunities for residents to engage in active transportation. Public transit can augment walking and bicycling trips, and adequate walking and biking facilities make transit more practical.

According to the Centers for Disease Control and Prevention, physical activity is good for everyone's overall health. Physical activity is recommended to be of moderate intensity for at least 30 minutes most days and can include everyday physical activities such as walking, gardening or window washing. Physical activity lowers the risk of early death, heart disease, stroke, Type 2 diabetes, high blood pressure, adverse blood lipid profile, metabolic syndrome and some kinds of cancers. Lack of physical activity contributes to obesity in conjunction with dietary factors. [3]

Planning and physical activity

Active transportation, biking and walking, is positively associated with high levels of street connectivity, residential density and land use mixes. Residents in neighborhoods with shorter block lengths are more likely to walk to their destinations, especially when connected to a mix of urban amenities. Neighborhoods with walkable, mixed-use designs have stronger social networks and interactions than neighborhoods that are car-dependent.[4]

Spread-out patterns of suburban development are associated with decreased physical exercise, higher weight and increased hypertension rates.[5] Urban and suburban residents, living in homes built before 1946, are more likely to walk long distances with some frequency than those living in newer homes. Homes built before 1946 are most often located in neighborhoods with sidewalks, a grid street pattern and a mix of uses.[6],[7] One study found that a five percent increase in neighborhood walkability, described as sidewalks and ease of reaching places, was associated with a 32 percent increase in active transportation.[8]

Biking and walking levels are affected by infrastructure, connectivity, length of blocks and access to public transit. Pedestrian and bicycle infrastructure received $1.04 billion in 2010, which is 2 percent

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3 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

4 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

5 Ewing, Reid et al. (September 2003). Relationship between urban sprawl and physical activity, obesity, and morbidity. *American Journal of Health Promotion*.

6 Berrigan, D., & Troiano, R.P. (2002). The association between urban form and physical activity in U.S. adults. *American Journal of Preventative Medicine*. *Quoted by* Reid Ewing et al. (September 2003). Relationship between urban sprawl and physical activity, obesity, and morbidity. *American Journal of Health Promotion*, 48.

7 Humphrey, Stacy (May 2011). *Draft Healthy Eating, Active Living National Policy Scan.* City of Gresham.

8 Clapp, Elizabeth, & McSharry, Moriah (June 2011). *Built Environment Atlas: Active Living, Healthy Eating*. Multnomah Country Health Department.

of the federal surface transportation budget nationwide.[9] Investing in pedestrian and bicycle infrastructure has been shown to result in increases in walking and bicycling, especially when combined with complementary policies. Infrastructure that supports active transportation includes:

- **Pedestrian-supportive infrastructure** sidewalks, lighting, wayfinding, multi-use trails, pedestrian crossings, pedestrian signals, medians and other pedestrian "refuges," high-visibility crosswalk striping, raised pedestrian crossings, in-pavement lighting, overhead illuminated crosswalks, recessed stop lines, warning signs, sidewalk extensions and narrowed roadways.
- **Bicycle-supportive infrastructure** bicycle lanes and paths, multi-use trails, wayfinding, cycle tracks, bicycle boulevards, paved shoulders, striped bicycle lanes, demand activated traffic signals and bicycle-actuated signals.[10]

Principal catalysts for walking and biking include adequate lighting, continuous bike lanes and trails. Pedestrians and bicyclists consider numerous factors when they select a route, including bicycle facilities, ease, security and travel distance. Bicyclists go out of their way to use bicycle boulevards, especially those with continuity over the two- to-five-mile distance of an average urban bicycle trip. In addition, wayfinding indirectly impacts the decision to walk or bicycle.[11]

Research also illustrates that parks impact physical activity level. Residents who live within walking distance of a park are 25 percent more likely to achieve recommended minimum weekly levels of exercise.[12] Natural environments can also reduce individual's allostatic load, the negative repercussions of accumulated stress. Allostatic load is a contributing factor to many chronic diseases, including obesity, cardiovascular disease and diabetes. Epidemiological data supports the theory that the presence of nature reduces stress, decreases the allostatic load and helps to prevent chronic disease.[13]

Health outcomes and physical activity

Over one-third of Americans reported having taken no walking trips in the previous week. Many Americans often believe that distances are too long. According to public health research, time spent in vehicles is inversely related to physical activity level and directly related to obesity rates. One study found that every additional daily commute time of 30 minutes indicated a 3 percent greater likelihood of obesity. Another study showed that every additional daily commute time of 60 minutes indicated a 6 percent greater likelihood of obesity.[14],[15]

According to the U.S. Surgeon General's 1996 Report on Physical Activity and Health, mortality rates and the prevalence of chronic diseases decrease as physical activity level increases. The Centers for Disease Control and Prevention's Guide to Community Preventive Services states, the number of

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9 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

10 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities.*

11 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*. Boo

12 Frank, Lawrence et al. (2005). Linking objectively measured physical activity with objectively measured urban form: Findings from SMARTRAQ. *American Journal of Preventive Medicine*.

13 Van de Berg et al. (2010).

14 Lopez, R. (2004). Urban sprawl and risk for being overweight or obese. *American Journal of Public Health,94(*9): 1574–1579.

15 Frank L.D., Andresen, M.A., & Schmid, T.L. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *American Journal of Preventive Medicine, 27*(2):87-96.

people who are physically active three times a week can increase by 25 percent with improved access to active transportation. Walking and bicycling levels in the United States decreased to 67 percent between 1960 and 2000. During the same time period, obesity levels increased by 241 percent.[16] According the Centers for Disease Control and Prevention, one-third of the American population participates in regular, sustained exercise and one-third of the population is wholly inactive.

Vulnerable populations

Females, people of color, older adults, people with low levels of educational attainment and people with low incomes have greater rates of inactivity.[17] Remaining physically active can help prevent falls and reduce depression among older adults.[18]

Since 1969, the percentage of school-aged children in the U.S. who walk or bicycle to school has dropped by more than half, and the portion of children traveling to school by car has tripled. Today, half of all children travel to school by car. Distance and community design contribute to the change in proportions. Approximately half of students in 1969, compared to a quarter of students in 2001, lived within a mile of their schools. [19]

Over the last forty years, numerous studies have analyzed data and found a link between physical activity level and academic performance. In one research paper studying 12,000 U.S adolescents, active adolescents, (e.g., those participating in team sports, physical education or sports with their parents), were twenty percent more likely to receive an 'A' in English or math than their inactive peers. The findings of the Texas Youth Fitness Study in 2010 indicate small, but consistent, correlations between activity and academic achievement and school attendance, with highest results in the middle school grades [20]. Another study of third grade students in 2000-2001 found a relationship between Body Mass Index (BMI), physical activity level and academic achievement. Students with higher level of physical activity had higher grades and learned faster than inactive peers. Obese children performed academically below peers.[21]

According to a 1999 study, approximately half those aged 12 to 21 years engage in regular, vigorous physical activity, and preschool children spend the majority of their playtime in sedentary activities.[22]

Mental health outcomes and physical activity

Mental well-being is generally defined as the absence of, or effective accommodation or treatment for, significant behavioral health problems, such as depression or anxiety.[23] The World Health

16 Thunderhead Alliance (2007). Bicycling and walking in the U.S. *Thunderhead Alliance Benchmarking Report*.

17 Frank, Lawrence D., & Engelke, Peter (2000). How Land Use and Transportation Systems Impact Public Health: A Literature Review of the Relationship Between Physical Activity and Built Form. Active Community Environments Initiative..

18 Booz Allen Hamilton (July 2011). Transportation and Health: Policy Interventions for Safer, Healthier People and Communities.

19 Booz Allen Hamilton (July 2011). Transportation and Health: Policy Interventions for Safer, Healthier People and Communities.

20 http://www.rwjf.org/files/research/64693final.pdf

21 Alliance for a Healthier Generation (May 2011). Physical Activity Brief.

22 Frank, Lawrence D., & Engelke, Peter (2000). *How Land Use and Transportation Systems Impact Public Health: A Literature Review of the Relationship Between Physical Activity and Built Form. Active Community Environments Initiative.*

Organization defines mental well being as: "Every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community."

A number of studies on developmental, neurobiological and psychological factors describe an association of physical activity and exercise to having positive effects on mood and anxiety. People who exercise experience reduced incidence rates of depression and anxiety disorders. Exercise may be used in the prevention of some mental disorders, and intervention studies have demonstrated the anti-depressive activity of exercise in healthy subjects and patients. Physical inactivity may also be associated with the development of mental disorders. Some clinical and epidemiological studies have shown associations between physical activity and symptoms of depression and anxiety in cross-sectional and prospective-longitudinal studies. [24]

Additionally, research provides evidence that vigorous exercise, such as jogging or running, is related to lower emotional distress. Epidemiological cross-sectional studies have consistently associated high self-reported levels of habitual physical activity with better mental health and an association between habitual exercise level and low depression (but not anxiety) has been described in adolescents and elderly subjects. In one study, exercise was associated with lower depression in 16,483 undergraduates. In another study, a total of 55,000 subjects in Germany, U.S. and Canada, the self-reported level of recreational physical activity was associated with better mental health, including fewer symptoms of both anxiety and depression. In another study in the European Union, a total of 16,230 respondents age 15 years and above were studied; in some of the 15 nations, evidence for a dose-response relationship between physical activity and mental health was found. These studies controlled and adjusted for socio-demographic data.[25]

One diagnostic study analyzed the data of the U.S. National Comorbidity Survey and found significant association between regular physical activity and lower prevalence of current major depression, social phobia, specific phobia and agoraphobia. In older adults, one study reported a protective effect of physical activity on the development of depression. Studying 1,900 subjects for eight years one study discovered that regular exercise reduced the risk of developing depression.

Naturally occurring physical activity is inversely related to depressive symptoms during early adolescence. In a sample of 2,548 adolescents and young adults, subjects with regular physical activity had substantially lower overall incidence of any and comorbid mental disorders after four years and a lower incidence of depression and some anxiety disorders.[26]

Studies also show that physical activity and exercise can also be used in the treatment of depression and anxiety disorders. In patients with high trait anxiety or generalized anxiety disorder, aerobic exercise training was comparable effective as cognitive behavior therapy. Thus, the effects of physical activity might stimulate a complex system and trigger a cascade of events, which, result in higher resilience against stress-related mental disorders. [27]

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23 Oxman, Gary, & Bhat, Maya (2011). *Built Environment and Health.* Multnomah County Health Department.

24 Ströhle, Andreas (Aug. 23, 2008). Physical activity, exercise, depression and anxiety disorders. *Journal of Neural Transmission*.

25 Ströhle, Andreas (Aug. 23, 2008). Physical activity, exercise, depression and anxiety disorders. *Journal of Neural Transmission*.

26 Ströhle, Andreas (Aug. 23, 2008). Physical activity, exercise, depression and anxiety disorders. *Journal of Neural Transmission*.

27 Ströhle, Andreas (Aug. 23, 2008). Physical activity, exercise, depression and anxiety disorders. *Journal of Neural Transmission*.

Children's self-esteem and physiological well-being has also been associated with physical activity level. A study of 329 youth in a 12-week physical fitness program demonstrated a correlation of increased physical activity with significant decreases in low self-esteem, poor school attendance, anxiety, depression and number of friends who used alcohol and drugs.[28],[29]

Economic impacts

The lack of physical activity cost $24 billion in treatments of morbidities, such as coronary heart disease, hypertension, Type 2 diabetes, colon cancer, depression and anxiety and osteoporotic hip fractures.[30] An estimated national health care cost of $23.7 billion in 2001 stem from cardiovascular disease attributable to inactivity. Per capita, that translates into $544 in health care costs attributable to inactivity.[31] Of the annual deaths in the United States, 32 to 35 percent are attributable to coronary heart disease, colon cancer or diabetes, which are prevented in part by physical activity. Coronary heart disease from physical inactivity costs the U.S. economy an estimated $5.7 billion per year. [32]

One 2011 study conducted a cost-benefit analysis on Portland's past and planned bicycle infrastructure investments and associated health benefits. Bicycle infrastructure investments were found to be cost-effective. Costs of investment plans were compared with health care cost savings and value of statistical life savings. This study found that by 2040, investments in the range of $138 to $605 million would result in health care cost savings of $388 to $594 million and fuel savings of $143 to $218 million.[33] In addition, according to a 2011 American Planning Association article, for every mile a person walks, society saves 24 cents on medical and associated costs.[34]

Air quality

Planning and air quality

Planning and policy affect air quality in the region. Active transportation infrastructure, transit, street connectivity, parks and open spaces and mixed-use zoning have the potential to reduce air pollution. When walking or bicycling replaces a motor vehicle trip, there is the added benefit of reduced harmful transportation-related emissions. [35] Bicycling in Portland is estimated to avoid

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28 Collingwood, Thomas R., Sunderlin, Jeff, Reynolds, Roger, & Kohl, Harold W. III (2000). Physical training as a substance abuse prevention intervention for youth. *Journal of Drug Education, 30*(4). http://www.ncjrs.gov/App/Publications/abstract.aspx?ID=189427

29 Alliance for a Healthier Generation (May 2011). *Physical Activity Brief*.

30 Gotschi, Thomas (2011). Costs and benefits of bicycling investments in Portland, Oregon. *Journal of Physical Activity and Health, 8*(Suppl 1), S49-S58.

31 Gotschi, Thomas (2011). Costs and benefits of bicycling investments in Portland, Oregon. *Journal of Physical Activity and Health, 8*(Suppl 1), S49-S58.

32 Frank, Lawrence D., & Engelke, Peter (2000). *How Land Use and Transportation Systems Impact Public Health: A Literature Review of the Relationship Between Physical Activity and Built Form. Active Community Environments Initiative.*

33 Gotschi, Thomas (2011). Costs and benefits of bicycling investments in Portland, Oregon (2 wei. *Journal of Physical Activity and Health, 8*(Suppl 1), S49-S58.

34 Arednt, Randall (August/September 2011). Putting greenways first. *, Planning*. American Planning Association.

35 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

between 540 and 830 million metric tons of CO^2 by the year 2040.[36] Urban flora provide air filtration and have pollution capture capacity. It is estimated that the total tree canopy of Portland reduces the concentration of airborne particulate matter by one percent.[37]

Transportation-related emissions such as carbon monoxide, nitrogen dioxide, ozone (e.g., smog), particulate matter, sulfur dioxide and toxins (e.g., lead) have a direct effect on human health. In 2009, transportation was responsible for 33 percent of total CO^2 emissions, and 64 percent of those were from passenger cars and light-duty trucks. From 1990 to 2008, overall national air quality has improved significantly: Ozone is down 14 percent; lead is down 78 percent; nitrogen dioxide has fallen 35 percent; carbon monoxide has been cut 68 percent; and sulfur dioxide has reduced by 59 percent. Annual PM concentrations also dropped by 17 percent between 2001 and 2008. However, from 1990 to 2009, transportation's total greenhouse gas emissions rose 17 percent. [38]

Health outcomes and air quality

Short-term exposure to these pollutants can exacerbate asthma and chronic obstructive pulmonary disease and respiratory diseases symptoms. The effects of transportation-related emissions on asthma are strongest among those who live within 475 feet (0.09 miles) of a main road.[39]

Long-term exposure to theses pollutants results in higher rates of cardiopulmonary mortality and adverse pregnancy outcomes (e.g., pre-term birth, low birth weight). For example, long-term exposure to pollutants might be produced by residing near high-traffic roadways. [40]

Air quality and particulate matter

Particle size determines the potential to cause health effects. Particles larger than 10 micrometers do not usually reach the lungs, but can irritate the eyes, nose and throat. Coarse particles (PM10) have diameters from 2.5 to 10 micrometers. Fine particles (PM2.5) have diameters that are 2.5 micrometers or less. These are the particles that are most hazardous to health.[41]

Fine particulates (PM2.5) have been extensively studied. Their small size allows them to become deeply lodged in the lungs. Often carrying known carcinogens and cancer causing pollutants, these tiny particles can move past human lung tissue and enter the bloodstream. PM2.5 sources include motor vehicle engines, older diesel engines, power plants, wood burning and some industrial processes. Exposure is greatest within the first 950 feet (0.18 miles) of a major source, with levels decreasing to ambient upwind concentrations at distances greater than that.[42] Particulate matter can cause heart disease, lung cancer, asthma and other life-threatening diseases and conditions.[43] Long-term exposure is associated with a variety of cardiovascular and respiratory health effects, including

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36 Gotschi, Thomas (2011). Costs and benefits of bicycling investments in Portland, Oregon (2 wei. *Journal of Physical Activity and Health, 8*(Suppl 1), S49-S58.

37 Nowak et al, 2006.

38 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

39 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

40 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

41 Oregon Environmental Public Health Tracking.

42 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

43 Berg, Nate (Sept. 26, 2011). WHO: Iran, South Asia ranked worst in urban air pollution. *The Atlantic Cities*.

respiratory illness and death (cardiopulmonary mortality). EPA issues National Ambient Air Quality Standards (NAAQS) for particulate matter. The revised 2006 standards for 24-hour fine particle standard is 35 µg/m3 and for the annual fine particle standard is 15 µg/m3.[44]

The World Health Organization ranked 1,100 cities around the world on their amount of particulate air pollution between 2003 and 2009. According to the study, 1.34 million and 1.15 million premature deaths in 2008 and 2004 were attributable to urban outdoor air pollution, respectively.[45] If air pollution had been reduced to the WHO standards, an estimated 1.09 million deaths could have been prevented in 2008.[46] Of the U.S. locations ranked in that study, the highest levels of particulate matter are found in the Central Valley of California, in cities such as Bakersfield, Fresno, Modesto and Hanford-Corcoran; Fairbanks, Alaska; and Pittsburgh, Pennsylvania.[47]

Economic impact

Each year, direct costs for disease treatment and premature deaths associated with exposure to transportation-related emissions nationwide total $50 to $80 billion (2008 dollars). In addition to direct costs, related diseases cost the economy in productivity losses. In 2008, over half (59 percent) of all child and a third (33 percent) of adult asthma sufferers missed some school or work as the result of an asthma attack.[48] The monetized value of the public health impacts of PM2.5 exposure is estimated to be in the tens of billions of dollars annually.[49]

Food access

Planning and food access

According to research, people choose healthier food options when they have access to the locations that provide it.[50] Eating more fruits and vegetables and maintaining a healthy weight is associated with residing near full-service grocery stores that provide a variety of produce. Inversely, an increased risk of obesity is associated with living near convenience stores and fast food restaurants. Convenience stores rarely carry fresh produce and often price it higher than grocery stores. Areas lacking healthier food options are called food deserts.[51]

The provision of healthy food options is influenced by planning through zoning, comprehensive plan policies, existing land uses and economic development efforts. Access to healthy food options is

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44 U.S. Environmental Protection Agency (2006). *Particulate Matter Standards Revision* – 2006. http://www.epa.gov/oar/particlepollution/naaqsrev2006.html

45 U.S. Environmental Protection Agency (2006). *Particulate Matter Standards Revision* – 2006. http://www.epa.gov/oar/particlepollution/naaqsrev2006.html

46 World Health Organization (Sept. 26, 2011). Tackling the global clean air challenge. *News Release*.. http://www.who.int/mediacentre/news/releases/2011/air_pollution_20110926/en/index.html

47 Walsh, Brian (Sept. 29, 2011). The 10 most air-polluted cities in the U.S. *Time*.

48 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

49 Booz Allen Hamilton (July 2011). *Transportation and Health: Policy Interventions for Safer, Healthier People and Communities*.

50 Stair, Peter, Wooten, Heather, & Raimi, Matt (2008). How to Create and Implement Healthy General Plans, Public Health Law & Policy and Raimi & Associates..

51 Humphrey, Stacy (May 2011). Draft Healthy Eating, Active Living National Policy Scan. City of Gresham.

supported or hindered by the existence of biking and walking infrastructure, connectivity and length of blocks, and access to public transit.

Health outcomes

In one study, students with a fast food restaurant within one half-mile of their school ate fewer fruits and vegetables, drank more soda and were more likely to be overweight or obese than students at schools with no fast food outlets nearby.[52] In 1990, an estimated 300,000 U.S. deaths could be attributed to improper diet and inactivity patterns.[53]

52 Clapp, Elizabeth, & McSharry, Moriah (June 2011). *Built Environment Atlas: Active Living, Healthy Eating*. Multnomah Country Health Department.

53 Frank, Lawrence D., & Engelke, Peter (2000). *How Land Use and Transportation Systems Impact Public Health: A Literature Review of the Relationship Between Physical Activity and Built Form. Active Community Environments Initiative.*

II. SOUTHWEST CORRIDOR HEALTH OUTCOMES

Study area description

The 14.4 mile long Southwest corridor contains significant levels of employment, services and educational facilities. However, it is constrained by topography, limited connectivity, and a lack of transportation options and capacity. The Southwest corridor generally follows Interstate 5 (I-5) and state highway OR 99W (99W), which is Barbur Boulevard within the city of Portland. The corridor serves as the primary southern gateway to the region and connects agricultural industries of the Willamette Valley to the Portland Central City and I-5 to OR 217. The corridor traverses the cities of Portland, Tigard, Tualatin, King City and Sherwood.

The majority of the Southwest corridor is characterized by post-war auto-oriented commercial development and single-family residential neighborhoods. Pedestrian connectivity is limited and bicycle paths are discontinuous. The arterial, collector and local street network in much of the vicinity of the corridor is winding and discontinuous as a result of the hilly topography and suburban style development patterns. Sidewalks and crosswalks are lacking in much of the area, which impedes walking.

The Southwest Corridor Plan study area contains 19 percent of the jobs and 10 percent of the population in the region, and nearly 60,000 enrolled students between three institutions of higher education. The study area includes Oregon Health & Science University (OHSU), Portland State University (PSU) and Portland Community College (PCC) Sylvania campus. Significant natural resource areas and open spaces exist within the study area.

Methodology

The data contained within this document was provided by Kaiser Permanente, Providence CORE, Upstream Public Health, Oregon Heath Partnership Institute, Multnomah County Health Department and the Washington County Health Department. Data from each of these organizations is combined to form a snapshot of health in the Southwest Corridor. Other data sources include the Behavioral Risk Factor Surveillance System (BRFSS) and the State of Oregon. It should be noted that health outcome data access and dissemination is regulated by patient confidentiality law; therefore, it is difficult to obtain comprehensive health outcome data.

This snapshot is not intended to a be a comprehensive study of all health issues in the Southwest corridor, but rather an indicator of health needs which have the potential be addressed through improvements to the built environment. Metro staff has collected health outcome data on three areas of health where evidence supports it is impacted by the built environment:

1. Physical activity related illnesses (e.g., obesity, cardiovascular disease, diabetes)
2. Air Quality related diseases (e.g., asthma), and
3. Mental health diseases (e.g., depression, anxiety).

Data is reported according to the geographic extent available for that data set. Data sets are reported by state, metropolitan area, county or census tracts. The Southwest corridor lies within Multnomah and Washington counties; therefore, county-level data is reported for those counties only.

Oregon Health Study, Providence CORE

Providence CORE collected clinical biomarkers of health (obesity, blood pressure, cholesterol, blood sugar control) on 13,000 lower income residents in and around Portland for the Oregon Health Study (www.oregonhealthstudy.org). People with low incomes are considered a vulnerable population and are at greater risk for poor health outcomes generally. Of the 10,184 study participants that Providence CORE associated with census tracts for that study, 716 were in the census tracts within the Southwest corridor study area. Of the 51 tracts in the Southwest corridor, Providence CORE lacked data on 12 tracts that were not associated with zip codes in the study. Sample sizes for the tracts range from 1 to 58, and weighted sample sizes range from 1 to 233. Therefore, a wide range of standard errors are associated with these estimates.

Kaiser Permanente

In fall 2011, Kaiser Permanente provided Metro with 2010 data on the number of members (MBRS) and the number, rates (PROP) and margin of error (MOE) for members with the following health outcomes in the Kaiser Permanente member population. Data was aggregated to the boundaries of year 2000 census tracts within the Portland Metro region: ASM (asthma), BMI (body mass index over 30), CVD (cardiovascular disease), CKD (chronic kidney disease), DM (diabetes mellitus), HF (congestive heart failure), HTN (hypertension), SMK (smoker). Kaiser Permanente members are a sample of the general population, but do not represent the population as a whole.

Department of Motor Vehicle Study, Multnomah County

Multnomah County Health Department obtained its data set from the Oregon Department of Motor Vehicles in 2009. The data include information on people issued new or renewal driver's license or identification cards in 2008. The geocoded residential address was used to assign records to the year 2000 census tracts. A total of 73,658 de-indentified records were geocoded that included people ages 15-97 years, with the mean age of 38.7. The Body Mass Index (BMI) was then calculated based on the following calculation: BMI = mass (lb) x 703 / (height(in))^2. This data is a sample of the general Multnomah County population 15 years and older. Weight and height are self-reported.

Behavioral Risk Factor Surveillance System (BRFSS)

The Behavioral Risk Factor Surveillance System (BRFSS), managed by the Centers for Disease Control and Prevention, collects on-going telephone health survey information on health risk behaviors, preventive health practices and health care access primarily related to chronic disease and injury. More than 350,000 adults are interviewed each year in all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands and Guam. BRFSS data is often used to identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs. The Southwest corridor is a portion of Multnomah and Washington counties. BRFSS data is reported at the county-level.

Health outcomes in the Southwest Corridor

According to the BFRSS survey, most residents in Multnomah and Washington counties believe they have good, very good or excellent health (85 percent and 90 percent, respectively). The perception of good health differs from the data collected on physical activity related diseases, air quality-related diseases and mental health in the paragraphs below.

Table 1: Prevalence of general health in the Portland metro region[54]

Health status: How is your general health?	Multnomah County (percent)	Washington County (percent)
Excellent	22.1	20.5
Very good	35.7	37.9
Good	27.6	30.6
Fair	9	8.2
Poor	5.5	2.8

Obesity

Overweight and obesity are defined by ranges of weight for a given height and are measured using the "body mass index" (BMI). The World Health Organization set the following standards: individuals with a BMI of 18.5-25 are considered to be within a healthy weight, a BMI greater than 25 but less than 30 are considered overweight, and a BMI over 30 are considered to be obese. Refer tothe following table for an example.

Table 2. Body mass index to weight classifications example

Height	Weight range	BMI	Considered
5' 9"	124 lbs or less	Below 18.5	Underweight
	125 lbs to 168 lbs	18.5 to 24.9	Healthy weight
	169 lbs to 202 lbs	25.0 to 29.9	Overweight
	203 lbs or more	30 or higher	Obese

BMI generally correlates with the amount of body fat which increases the likelihood of certain diseases and other health problems. Other common predictors of obesity related diseases include abdominal fat, high blood pressure or physical inactivity.

Within the Portland-Vancouver Metropolitan Area, one in four residents (24 percent) are obese and an additional one in three residents (37 percent) are overweight. In other words, one in two Portland metro residents are considered either obese or overweight. [55]

In Multnomah and Washington County, almost one in two adult residents is considered overweight or obese. Approximately one in four residents is obese. As illustrated in the table below, one-quarter of 11th grade students and 8th grade students are considered overweight or at risk of being overweight.

[54] Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

55 Multnomah County Health (June 9, 2008). *Letter to Columbia River Crossing*.

Table 3: Prevalence of obesity, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
percent of 11th graders at risk of overweight, 2005-2006[56]	13	11
percent of 11th graders overweight, 2005-2006[57]	10	10
percent of 8th graders at risk of overweight, 2005-2006[58]	15	16
percent of 8th graders overweight, 2005-2006[59]	11	7.8**
Overweight and Obesity (BMI): Weight classification by Body Mass Index (BMI): percent neither overweight nor obese (BMI less than 24.9)[60]	43.5	36.8
Overweight and Obesity (BMI): Weight classification by Body Mass Index (BMI): percent overweight (BMI 25.0 - 29.9) [61]	30.2	39.2
Overweight and Obesity (BMI): Weight classification by Body Mass Index (BMI): percent obese (BMI 30.0 - 99.8) [62]	26.3	23.9

** OHS 2005-2007: Statistically significant difference compared to Oregon.

Table 4: Prevalence of obesity, Multnomah and Washington counties, age-adjusted

	Multnomah County (percent)	Washington County (percent)
percent of adults classified as overweight, 2006-2009 (age-adjusted) [63]	33.8	36.9
percent of adults classified as obese, 2006-2009 (age-adjusted) [64]	21.8	23.2

The Providence CORE Medicaid participant study in the Southwest corridor study area census tracts, indicated almost three in four (71 percent) of participants are overweight (BMI over 25), of which over one-third (41 percent) are obese (BMI over 30). This sample study reports higher average percentages of overweight and obesity.[65]

56 Oregon Department of Human Services (January 2007). *Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007)*.

57 Oregon Department of Human Services (January 2007). *Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007)*.

58 Oregon Department of Human Services (January 2007). *Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007)*.

59 Oregon Department of Human Services (January 2007). *Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007)*.

60 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

61 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

62 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

63 State of Oregon (2010). *Heart Disease and Stroke in Oregon: Update 2010*.

64 State of Oregon (2010). *Heart Disease and Stroke in Oregon: Update 2010*.

65 Providence CORE (2011). *Oregon Health Study*, www.oregonhealthstudy.org,.

By comparison, the BRFSS data indicates one-third of residents in Multnomah County (30.2 percent) and Washington County (39.2 percent) are overweight and one-quarter of residents in Multnomah County (26.3 percent) and Washington County (23.9 percent) are obese.[66] The BRFSS obesity statistic is over 10 percent lower than the percentage of individuals in the Providence CORE Medicaid study.

Multnomah County obtained the following data set from the Oregon Department of Motor Vehicles in 2009. Multnomah County includes in its borders approximately six miles of the Southwest corridor, including the neighborhoods of Hillsdale, Lair Hill, Multnomah Village, Terwilliger-Corbett and South Waterfront. Within the Multnomah County portion of the Southwest corridor study area the average BMI is 24.36, or just below the overweight threshold of 25 BMI. Over one in three (38 percent) residents is considered overweight and one in ten (9 percent) are considered obese. This is a lower BMI and lower percentages of overweight and obesity than the rest of the county. Almost one in two Multnomah County residents are overweight (45 percent) and one in five (14 percent) is obese.[67]

The prevalence of obesity (BMI over 30) of Kaiser Permanente member population region-wide is 1.36 people per acre or 20 percent of population. The prevalence of obesity is 16.4 percent of Kaiser Permanente members in the Southwest Corridor.[68]

Table 5: Prevalence of obesity within Multnomah County in the Southwest Corridor

	Southwest corridor census tracts[69]	Multnomah County census tracts[70]
Mean BMI	24.36	25.1
Overweight (percent)	38	45
Obese (percent)	9	14
Normal weight (percent)	62	55

66 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

67 Oregon Department of Motor Vehicles (2009). Multnomah Health Department data set.

68 Kaiser Permanente (2010).

69 Oregon Department of Motor Vehicles (2009). Multnomah Health Department data set.

70 Oregon Department of Motor Vehicles (2009). Multnomah Health Department data set.

Figure 2: Prevalence of obesity in Kaiser Permanente adult members, Southwest corridor data collection area

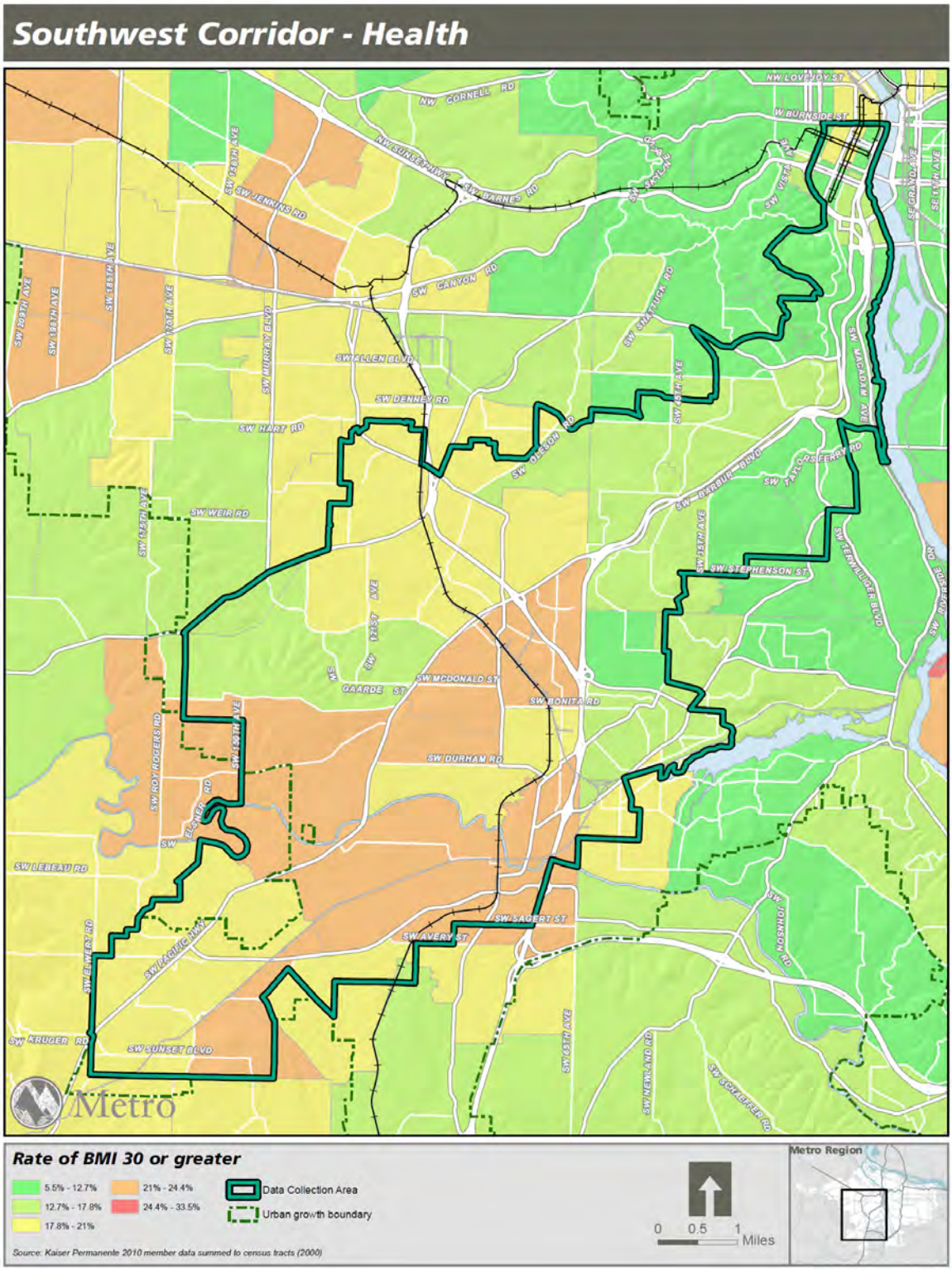


Figure 3: Obesity density, Kaiser Permanente adult members, Southwest corridor data collection area

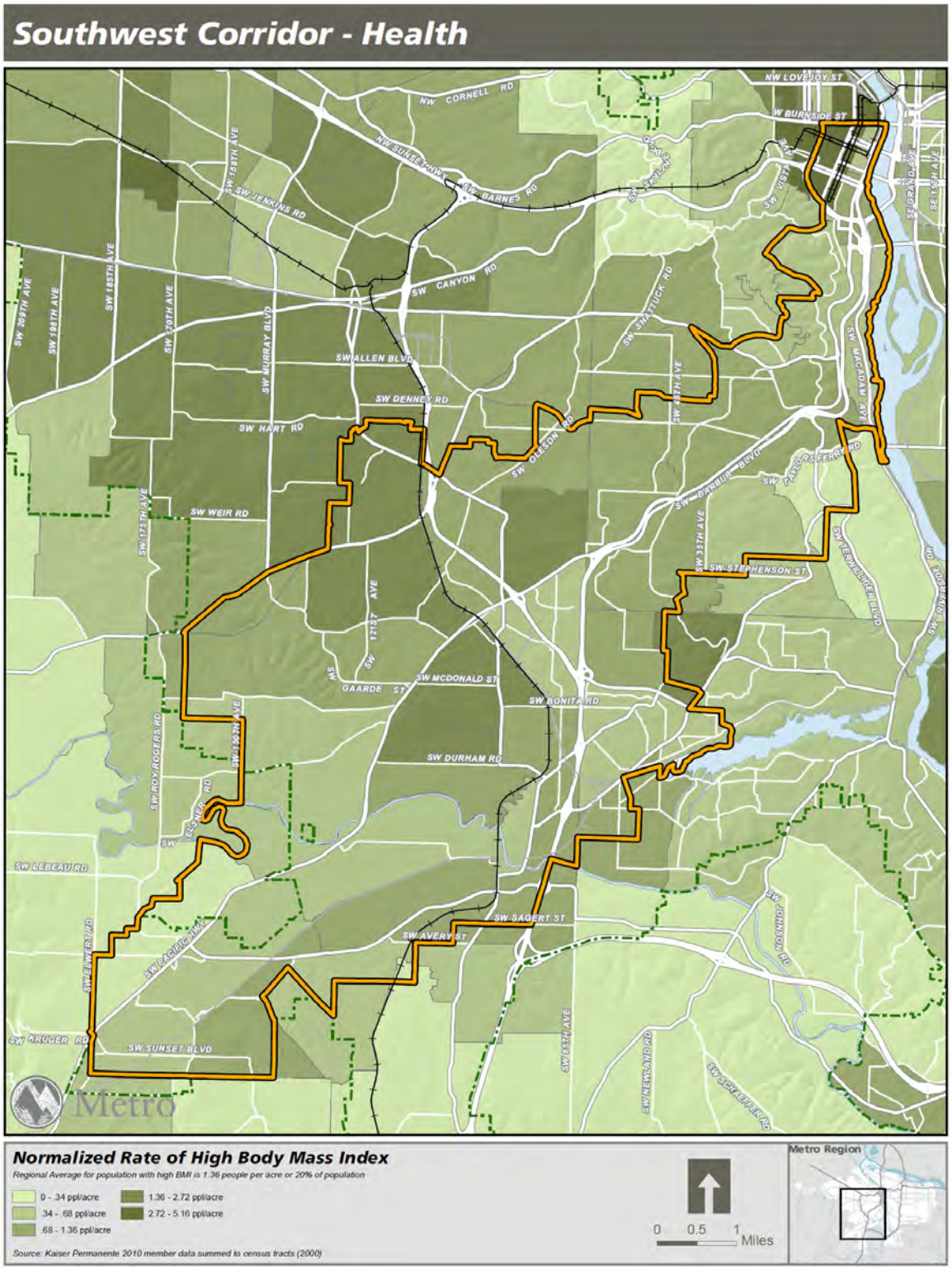
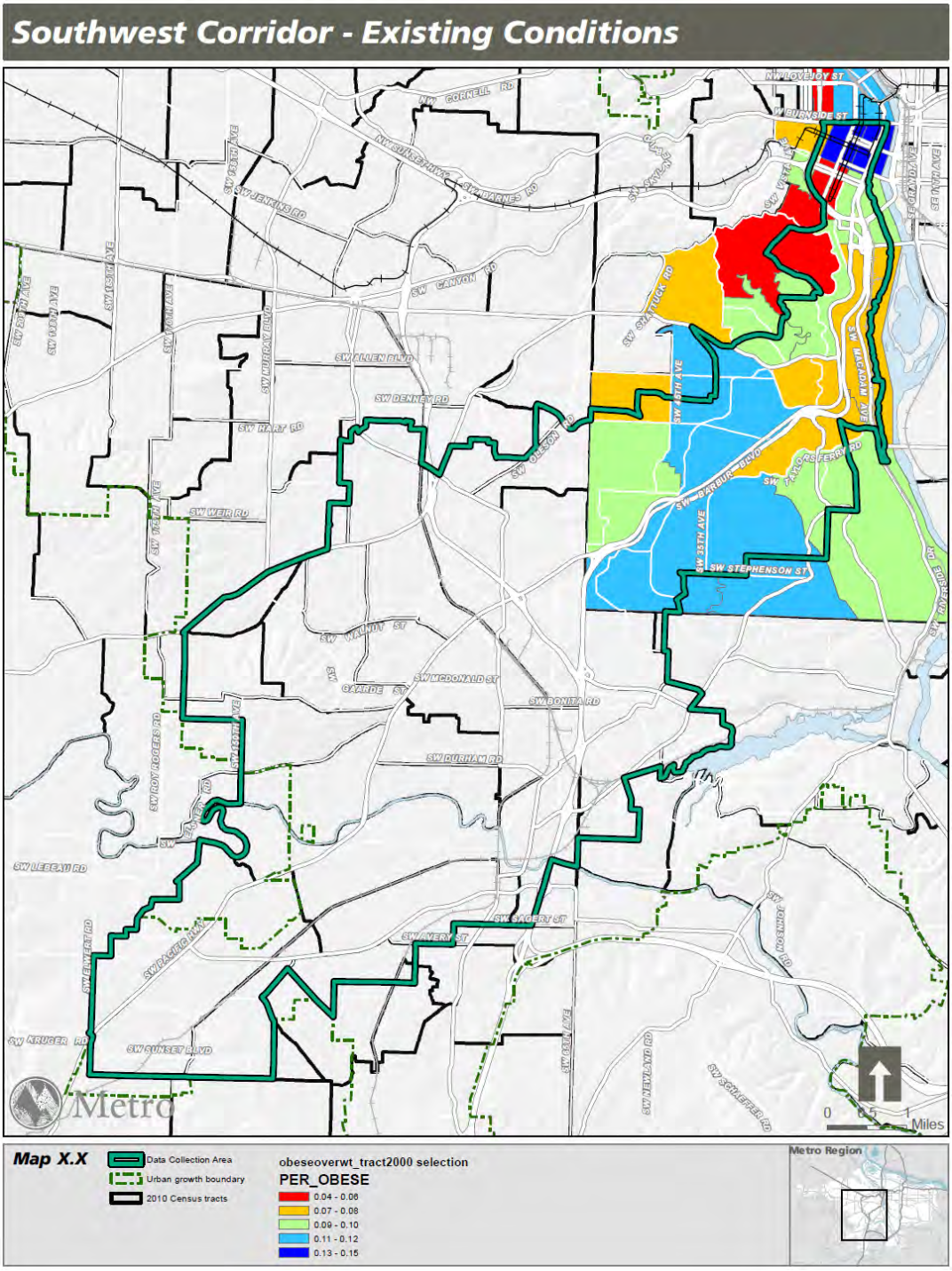
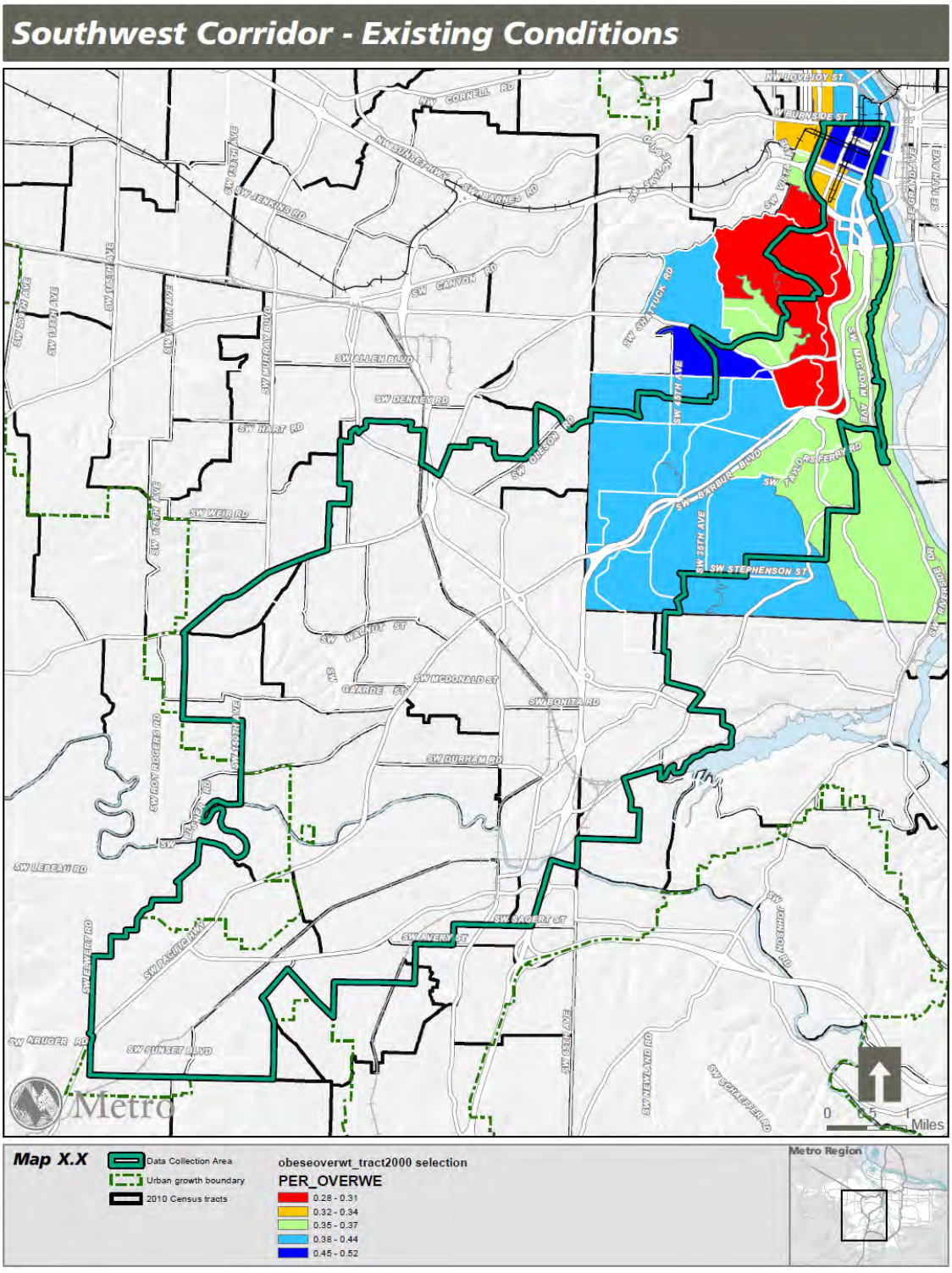


Figure 4: Obesity within Multnomah County in the Southwest corridor[71]



71 Oregon Department of Motor Vehicles (2009). Multnomah Health Department data set.

Figure 5: Overweight within Multnomah County in the Southwest corridor[72]



72 Oregon Department of Motor Vehicles (2009). Multnomah Health Department data set..

Cardiovascular disease

Cardiovascular disease is linked to levels of physical activity, diet and weight. In 2006, cancer, stroke and heart disease caused the premature loss of over 7,000 years of life in Multnomah County.[84] In Multnomah and Washington counties, approximately one in twenty (5.8 percent and 5.4 percent) residents has had a heart attack, angina or a stroke.

Table 6: Prevalence of cardiovascular disease, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
Cardiovascular Disease: Ever told you had angina or coronary heart disease? percent Yes[74]	5	3
Cardiovascular Disease: Ever told you had a stroke? percent Yes[75]	2.9	1.6
Cardiovascular Disease: Ever told you had a heart attack (myocardial infarction)? percent Yes[76]	3	2.4
Heart Attack Hospitalizations: Age-adjusted rate among persons 35 and over per 10,000 population, both sexes, 3 counties, 2003-2007[77]	31.9	32.4

Table 7: Prevalence of cardiovascular disease, Multnomah and Washington counties, age-adjusted

	Multnomah County (percent)	Washington County (percent)
Angina, 2006-2009 (age-adjusted) [78]	3	3.1
Stroke, 2006-2009 (age-adjusted) [79]	1.8	1.9
Heart attack, 2006-2009 (age-adjusted) 80	2.9	2.5
Heart attack or angina, 2006-2009 (age-adjusted) 81	4.6	4.2
Heart attack, angina or stroke, 2006-2009 (age-adjusted) 82	5.8	5.4

The prevalence of heart failure of Kaiser Permanente member population region-wide is 0.14 people per acre or 2 percent of population. The prevalence of heart failure in the Southwest Corridor is 1.84 percent of the population.The prevalence of cardiovascular disease of Kaiser Permanente member

73 Clapp, Elizabeth, & McSharry, Moriah (June 2011). *Built Environment Atlas: Active Living, Healthy Eating*. Multnomah Country Health Department.

74 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

75 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

76 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

77 Oregon Environmental Public Health Tracking (2011).

78 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

79 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

80 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

81 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

82 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

population region-wide is 0.3 people per acre or 4 percent of population. The prevalence of cardiovascular disease in the Southwest Corridor is 4.03 percent of the population.[83]

83 Kaiser Permanente (2010).

Figure 6: Prevalence of heart failure in the Southwest corridor in Kaiser Permanente adult members

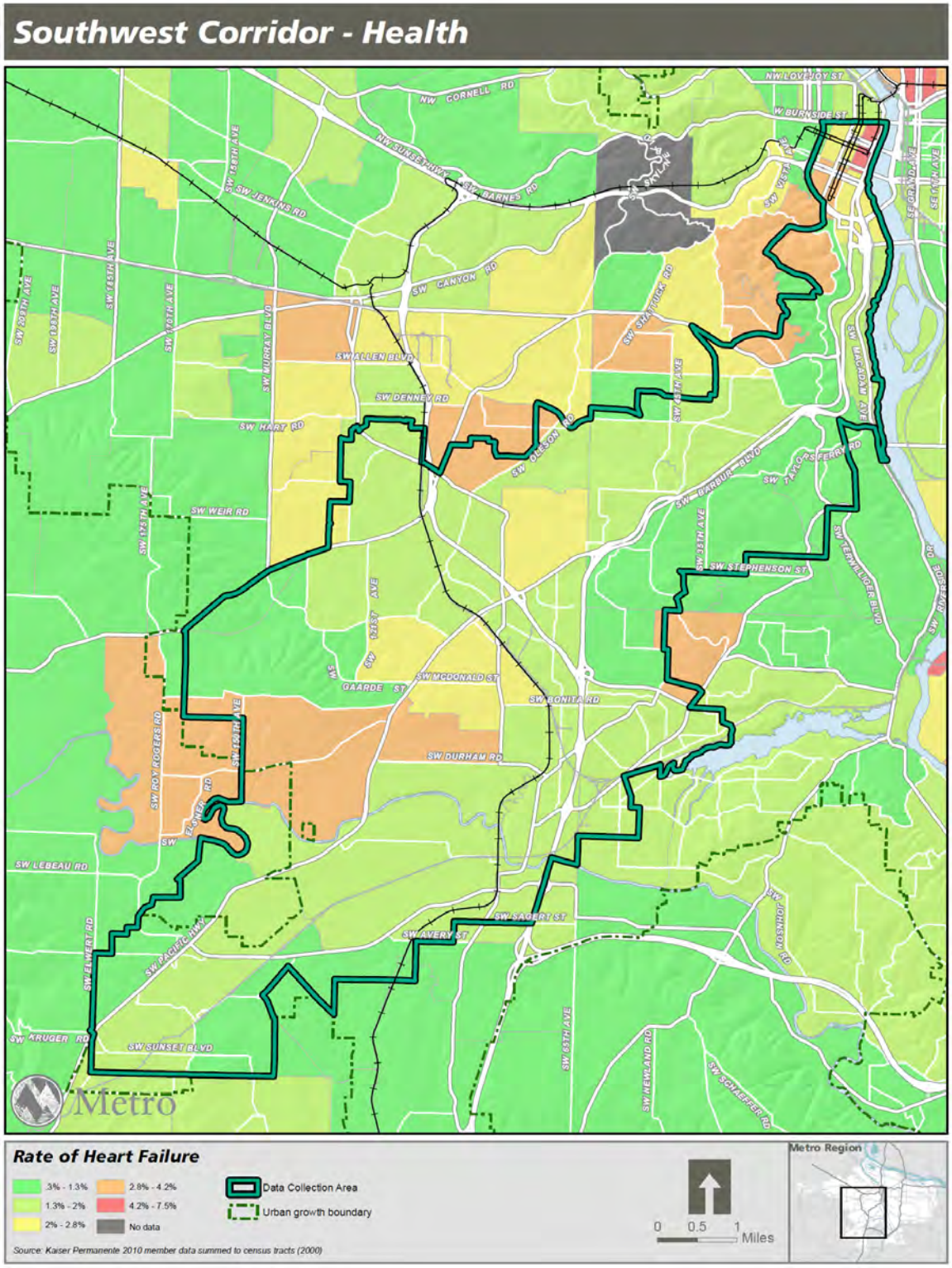


Figure 7: Heart failure density, Kaiser Permanente adult members, Southwest corridor data collection area

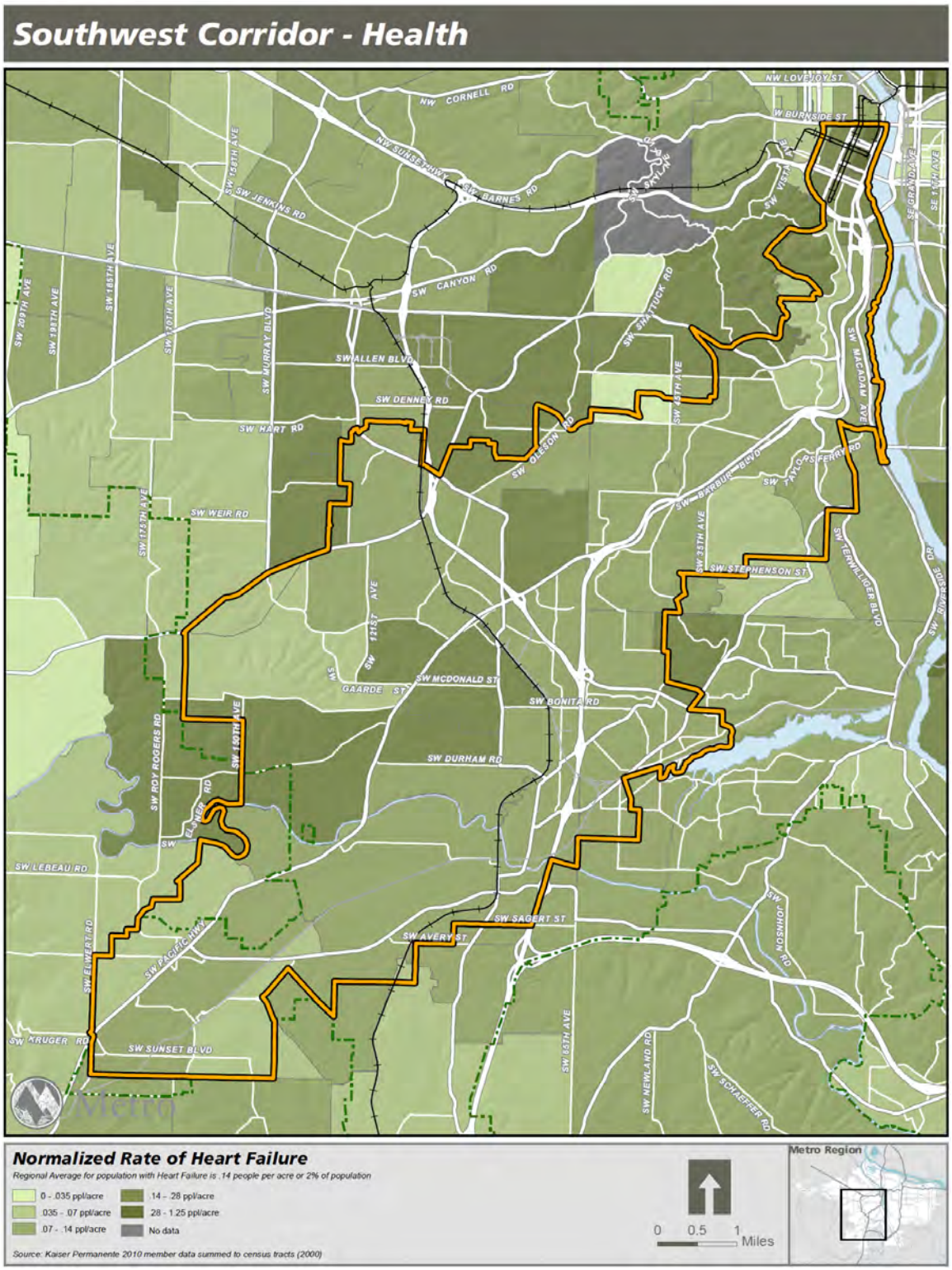


Figure 8: Prevalence of cardiovascular disease in Kaiser Permanente adult members, Southwest corridor data collection area

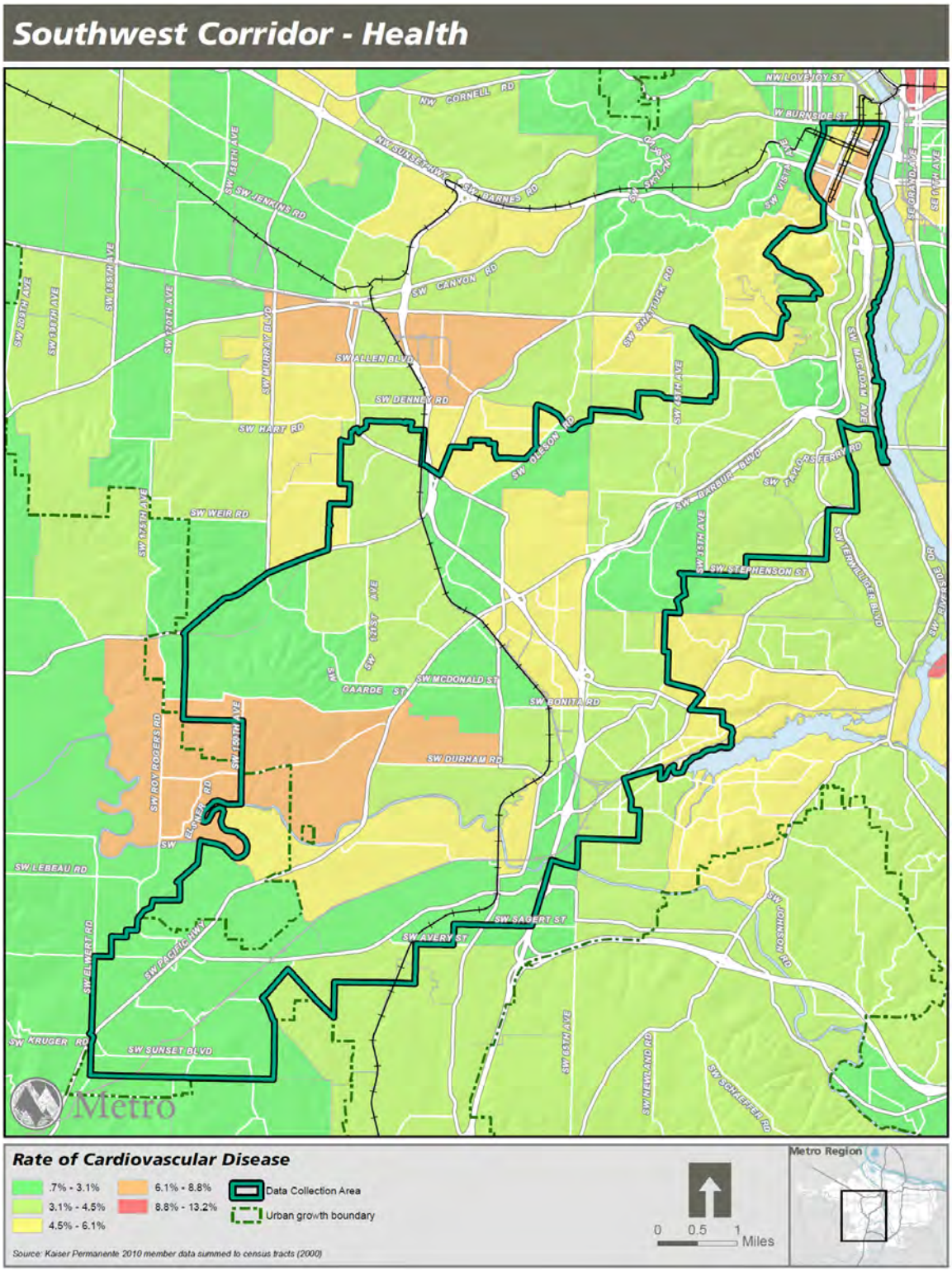
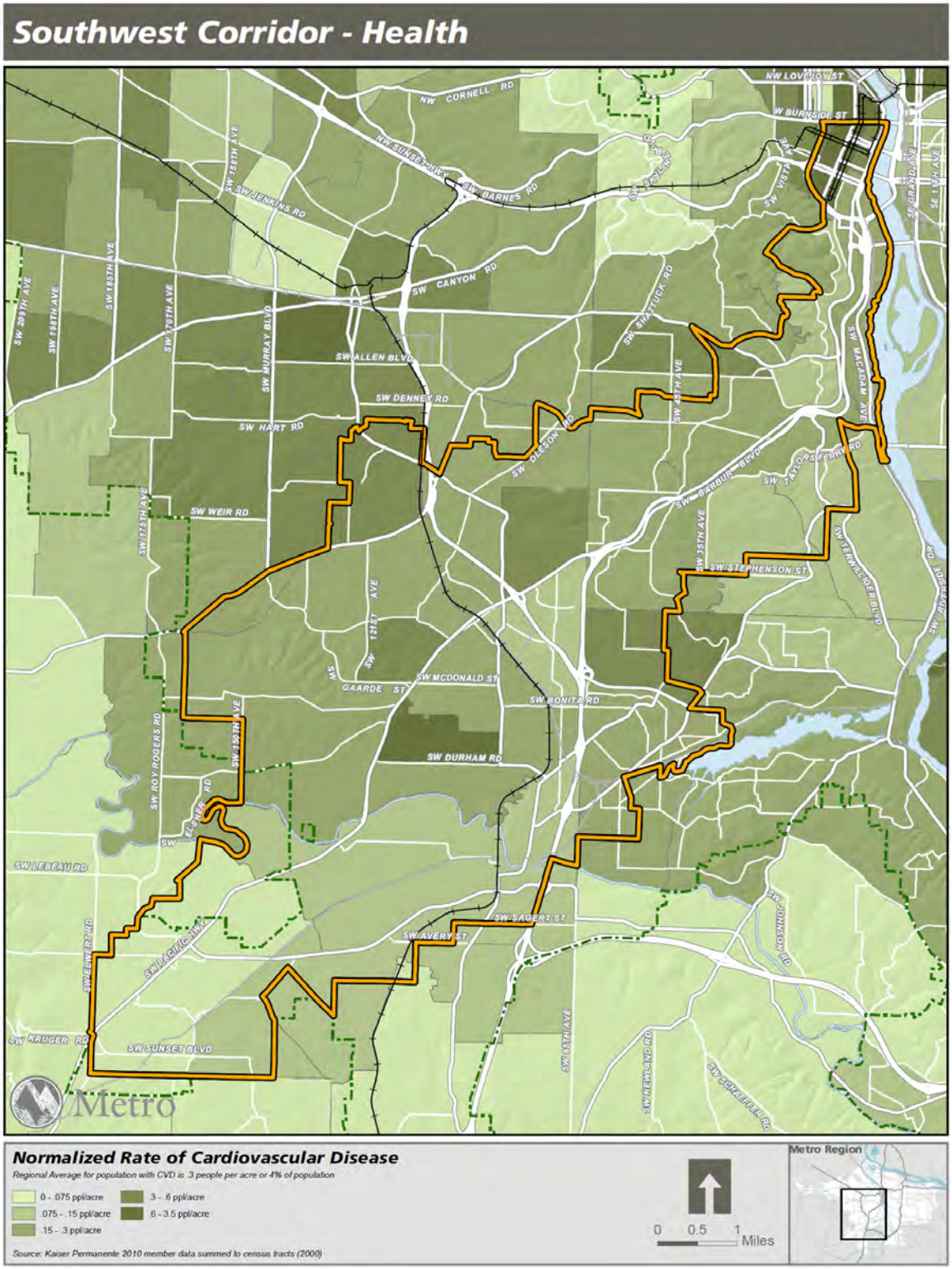


Figure 9: Cardiovascular disease density, Kaiser Permanente adult members, Southwest corridor data collection area



High blood pressure, high cholesterol

Of the Oregon Health Study participants in the Southwest corridor study area census tracts, one in six (16 percent) have high blood pressure and one in five (21 percent) have high cholesterol.[84] This sample study reports lower average percentages of high blood pressure and cholesterol than Multnomah and Washington counties.

One in five in Multnomah County (23 percent) and Washington County(22.9 percent) report high blood pressure and one in three (33.7 percent and 30.2 percent) report high cholesterol.[85]

Table 8: Prevalence of high blood pressure and cholesterol, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
High blood pressure, 2006-2009 (age-adjusted) [86]	23	22.9
High blood cholesterol, 2006-2009 (age-adjusted) [87]	33.7	30.2

The regional average prevalence of hypertension of Kaiser Permanente member population region-wide is 1.17 people per acre, or 17 percent of population. The prevalence of hypertension in the Southwest Corridor is 16.06 percent of the population. [88]

[84] Oregon Health Study (2011). Providence CORE. www.oregonhealthstudy.org.
[85] Oregon Health Study, www.oregonhealthstudy.org, Providence CORE, 2011.
[86] State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.
[87] State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.
[88] Kaiser Permanente (2010).

Figure 10: Prevalence of hypertension in the Southwest corridor in Kaiser Permanente adult members

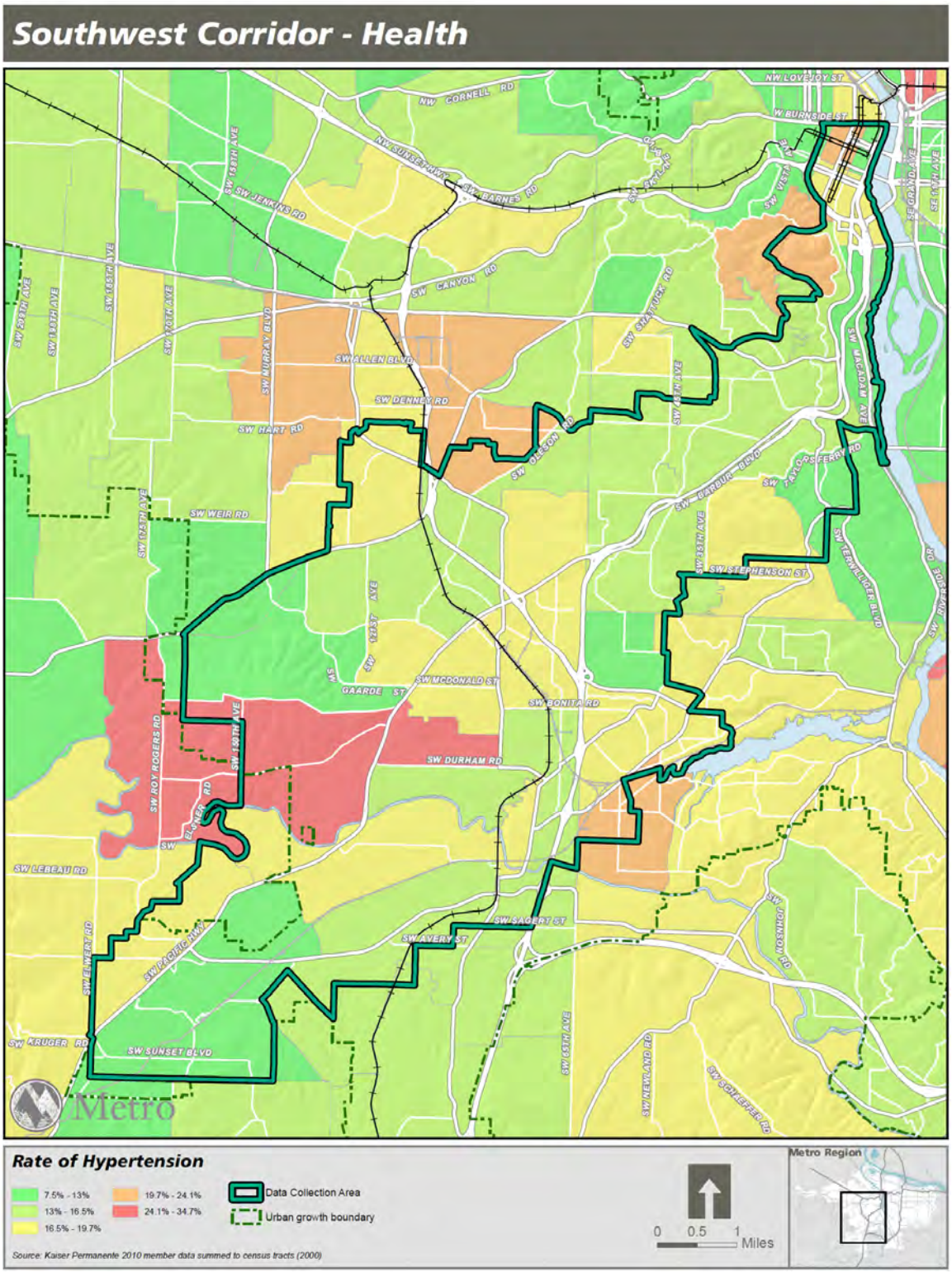
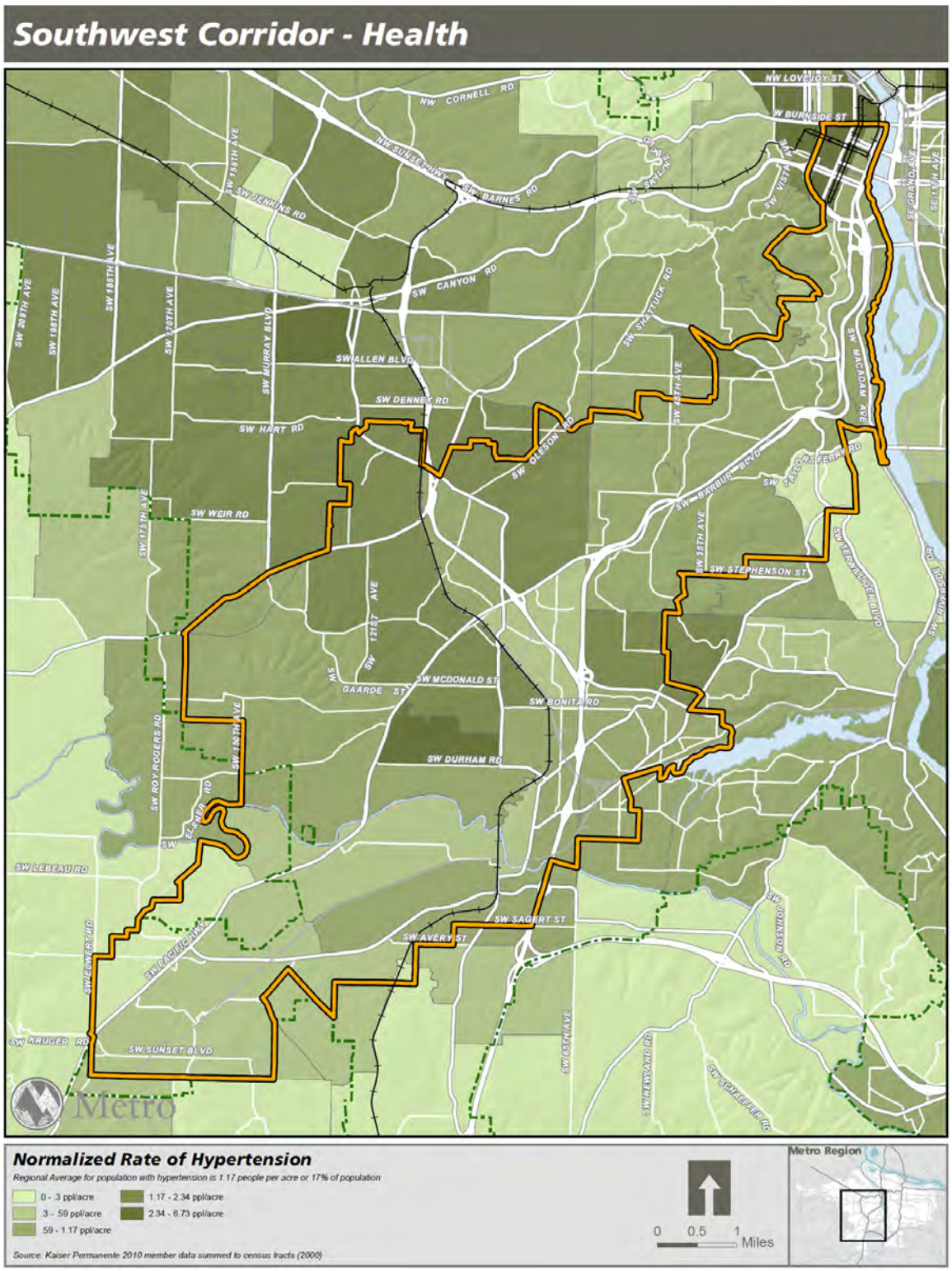


Figure 11: Hypertension density, Kaiser Permanente adult members, Southwest corridor data collection area



Diabetes

Physical activity level, diet and weight are contributing factors to Type 2 diabetes, once referred to as adult-onset or noninsulin-dependent diabetes. Type 2 diabetes develops when the body becomes resistant to insulin or when the pancreas stops producing enough insulin.

Table 9: Prevalence of diabetes, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
Diabetes: Have you ever been told by a doctor that you have diabetes? percent Yes[89]	6.7	5
Diabetes: Have you ever been told by a doctor that you have diabetes? percent Yes, pregnancy-related[90]	0.1	1.3
Diabetes: Have you ever been told by a doctor that you have diabetes? percent No[91]	91.9	92.9
Diabetes: Have you ever been told by a doctor that you have diabetes? percent No, pre-diabetes or borderline diabetes[92]	1.3	0.9

Table 10: Prevalence of diabetes, Multnomah and Washington counties, age-adjusted

	Multnomah County (percent)	Washington County (percent)
Diabetes, 2006-2009 (age-adjusted) [93]	6.2	5.9

Diabetes-related deaths almost doubled in Multnomah County between 1990 and 2006.[94] In Multnomah and Washington counties, approximately one in twenty residents (6.2 percent and 5.9 percent, respectively) have diabetes. Almost one in ten (9 percent) participants of the Oregon Health Study report suffering from diabetes.[95] The prevalence of diabetes mellitus of Kaiser Permanente member population region-wide is .45 people per acre or 6.5 percent of population. [96]

89 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

90 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

91 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

92 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

93 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

94 Clapp, Elizabeth, & McSharry, Moriah (June 2011). *Built Environment Atlas: Active Living, Healthy Eating*. Multnomah County Health Department.

95 Oregon Health Study (2011). Providence CORE. www.oregonhealthstudy.org.

96 Kaiser Permanente (2010).

Figure 12: Prevalence of diabetes in the Southwest corridor in Kaiser Permanente adult members

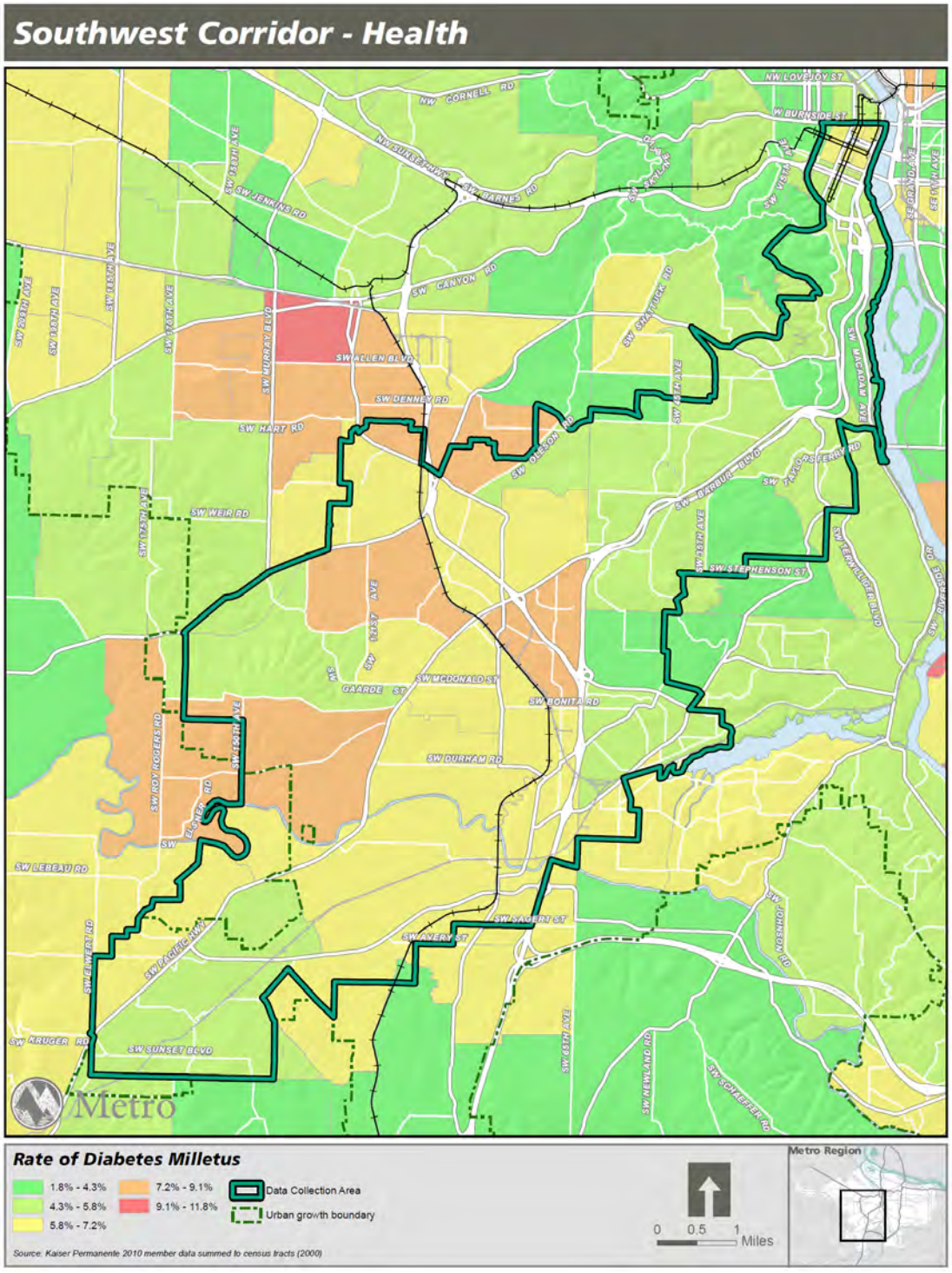
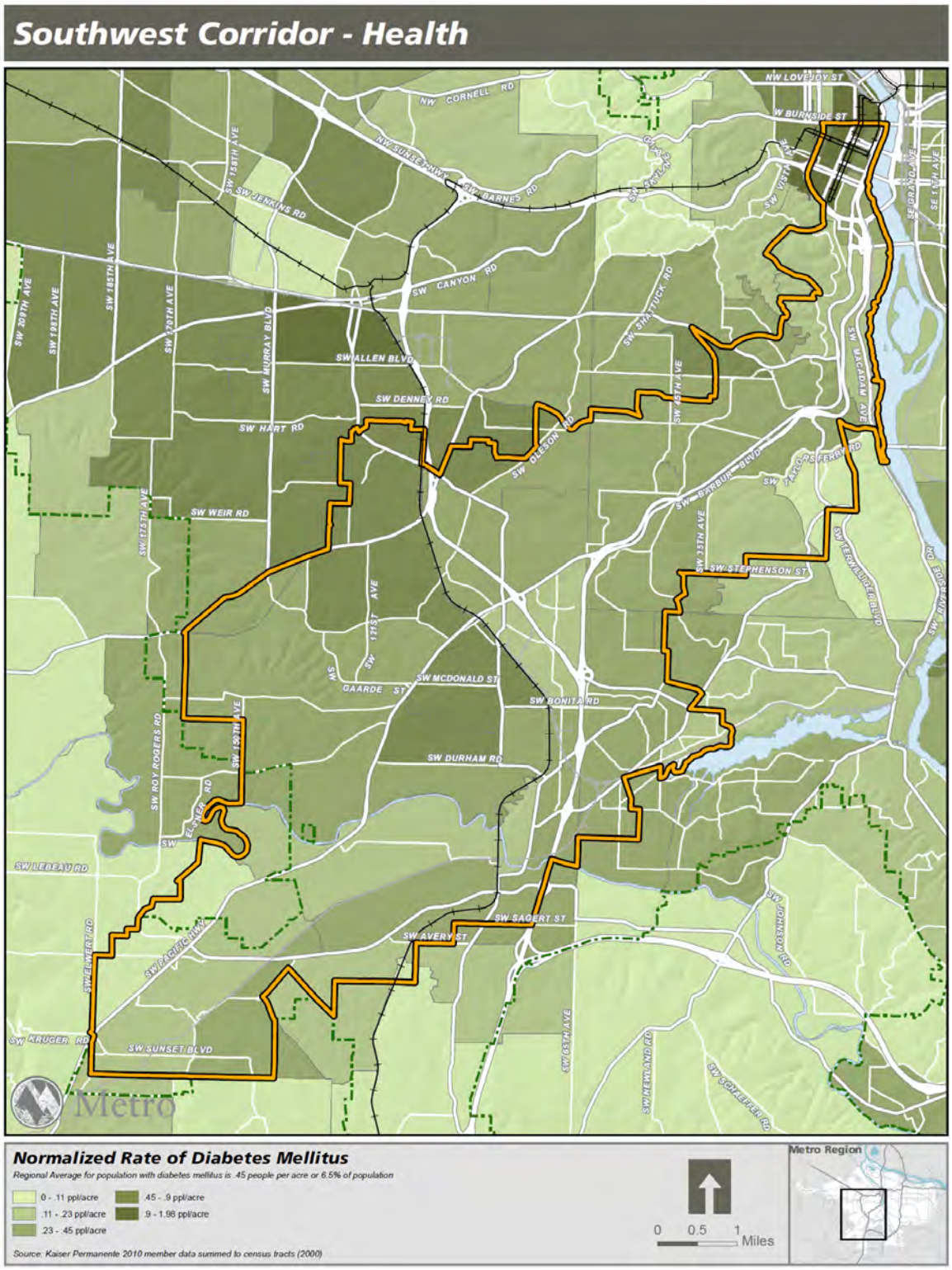


Figure 13: Diabetes density, Kaiser Permanente adult members, Southwest corridor data collection area



Asthma and lung disease in the Southwest corridor

Table 11: Prevalence of asthma, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
Adults with current asthma, 2004-2007[97]	9.9	9.2
Asthma: Adults who have been told they currently have asthma[98]	8.3	10.5

Table 12: Prevalence of asthma, Multnomah and Washington counties, age-adjusted

	Multnomah County (percent)	Washington County (percent)
Asthma Hospitalizations: Age-adjusted rate per 10,000 population, both sexes, 3 counties, 2003-2007[99]	7.7	4.9

Approximately one in ten (9.9 percent, 9.2 percent) residents in Multnomah and Washington counties have current asthma during 2004-2007. [100] Between five to eight people per 10,000 in the three counties were hospitalized for asthma during 2003-2007. [101]

The participants in the Oregon Health Study report three percent higher percentages of asthma than the regional trend. Approximately one in eight (13 percent)of those sample participants in the Southwest Corridor have asthma. [102] For comparison, one in ten residents of Multnomah County (9.9 percent) and Washington County (9.2 percent) have current asthma.

The regional average for population with asthma is 0.64 people per acre or 9 percent of population of Kaiser Permanente members. One in ten (8.7 percent) of Southwest Corridor Kaiser Permanente members has asthma. [103]

97 State of Oregon (2008). The burden of asthma in Oregon.

98 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

99 Oregon Environmental Public Health Tracking.

100 State of Oregon (2008). The burden of asthma in Oregon.

101 Oregon Environmental Public Health Tracking.

[102] Oregon Health Study (2011). Providence CORE. www.oregonhealthstudy.org.

[103] Kaiser Permanente (2010).

Figure 14: Prevalence of asthma in the Southwest corridor in Kaiser Permanente adult members

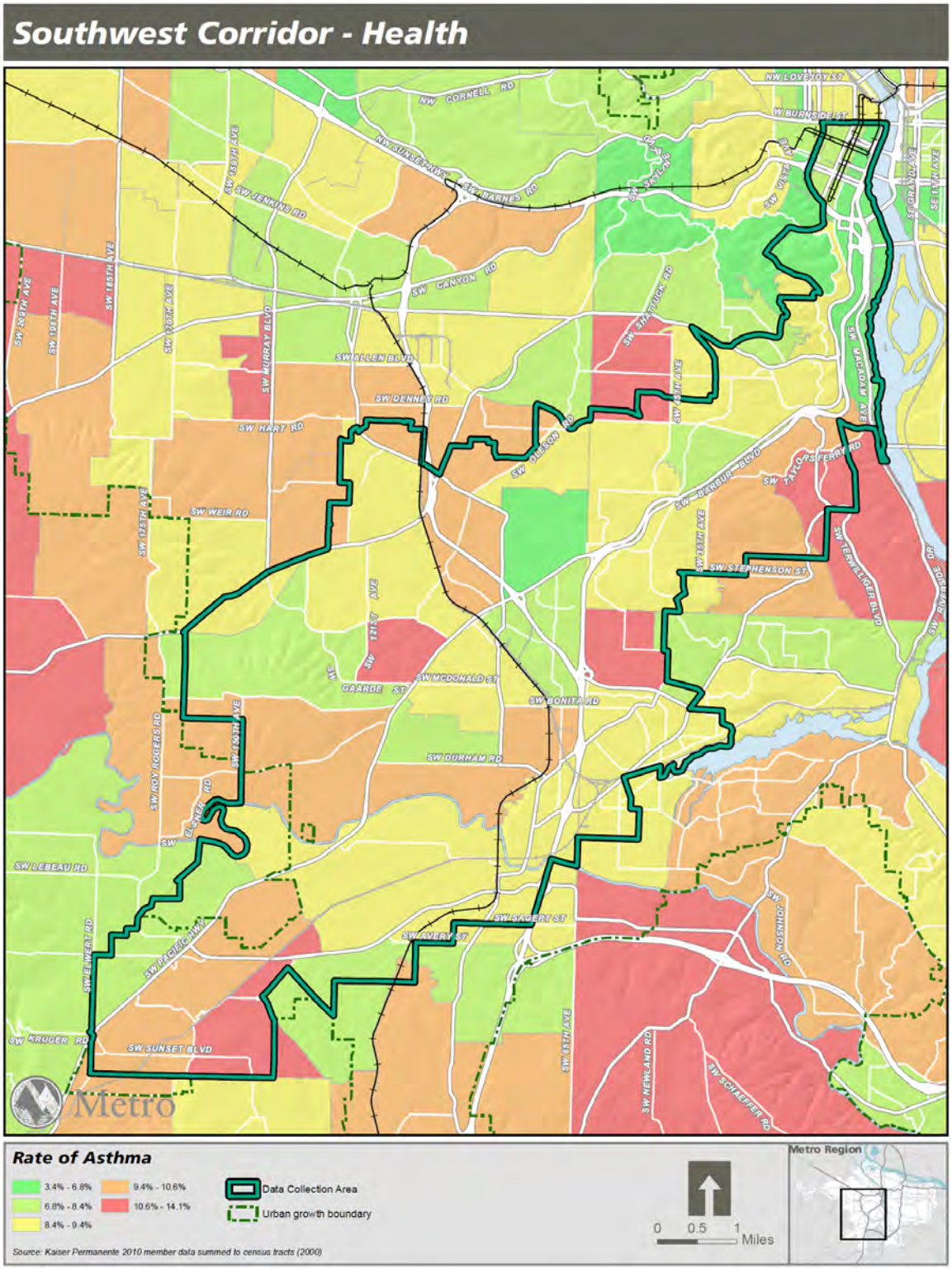
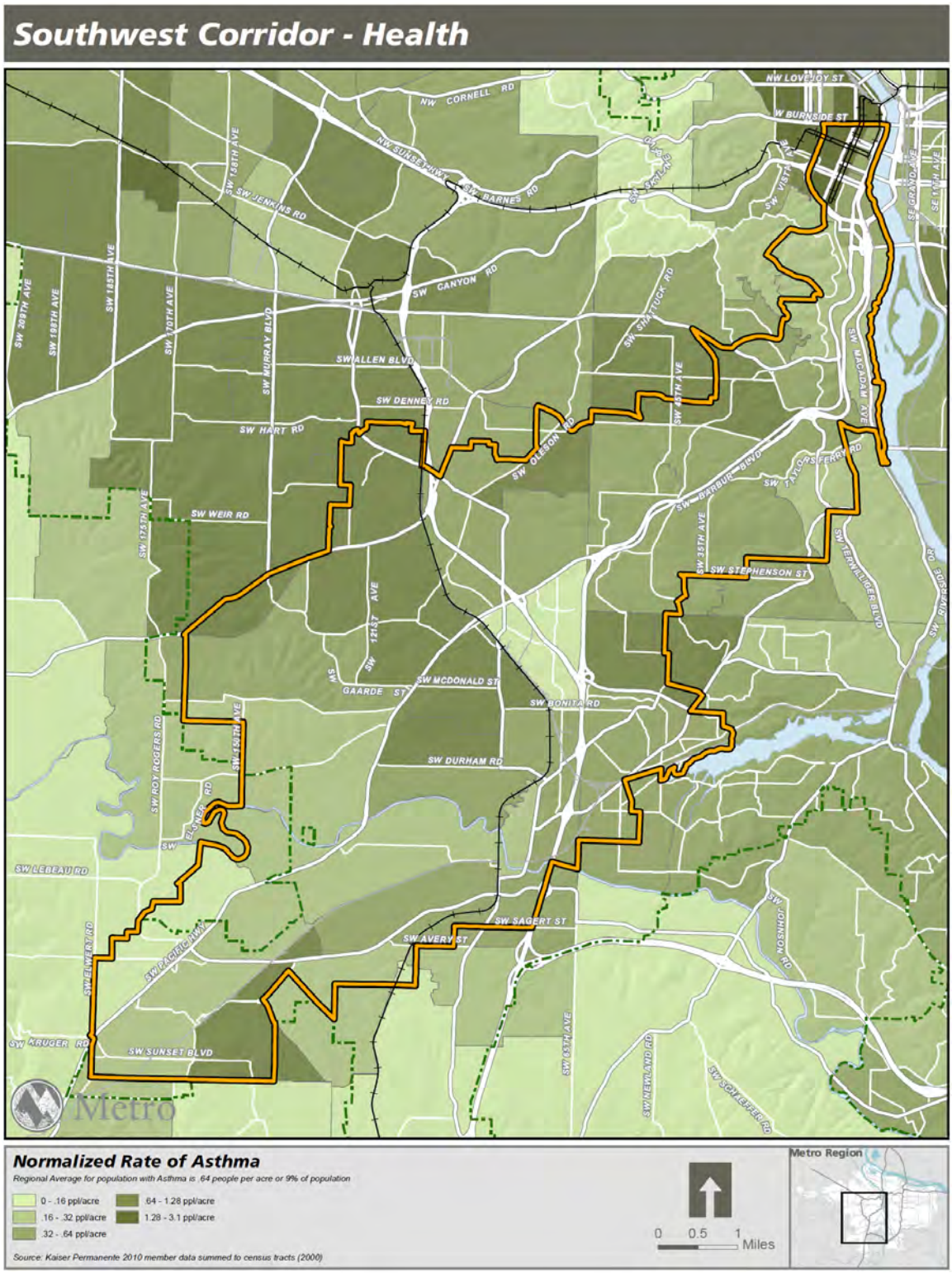


Figure 15: Asthma density, Kaiser Permanente adult members, Southwest corridor data collection area



Mental health in the Southwest corridor

More than one in four (28 percent) participants in the Oregon Health Study report having depression. Depression is measures by a score of 10 or greater on the Patient Health Questionnaire (PHQ-8), an eight-item diagnostic and severity measure for depressive disorders.

HEALTH BEHAVIORS AND ENVIRONMENTAL DETERMINANTS

Physical activity

Physical activity level lowers the risk of early death, heart disease, stroke, Type 2 diabetes, high blood pressure, adverse blood lipid profile, metabolic syndrome and some kinds of cancers. The Center for Disease Control and Prevention (CDC) offers recommendations for physical activity in the 2008 Physical Activity Guidelines for Americans. Adults are recommended a combination of 150-minutes of moderate-intensity aerobic physical activity (e.g., walking, pushing a lawn mower, dancing, biking to the store) or 75-minutes of vigorous-intensity (e.g., running, jogging) aerobic physical activity and twice per week muscle-strengthening. Examples of aerobic activities that meet these recommendations include: a 30-minute brisk walk 5 days a week or 25 minutes of jogging or running 3 days a week. Children and adolescents are recommended to complete a minimum of 60 minutes of physical activity each day.

In Multnomah and Washington counties, a little more than half of adult residents meet CDC recommendations for physical activity level. Less than half of 11th grade students and a little more than half of 8th grade students meet the CDC recommendations for physical activity level.

The BFRSS surveys indicate that most adult residents in Multnomah and Washington counties participate in physical activity during a one month period.

Table 13: Prevalence of physical activity level, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
percent of adults who met CDC recommendations for physical activity, 2006-2009 (age-adjusted) [104]	55.1	53.8
percent of 11th graders who met current physical activity recommendations, 2005-2006[105]	40.4**	46.4
percent of 8th graders who met current physical activity recommendations, 2005-2006[106]	55.1**	55.4**
Exercise: During the past month, did you participate in any physical activities? percent Yes[107]	86	84.2
Exercise: During the past month, did you participate in any physical activities? percent No[108]	14	15.8

104 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

105 DHS Oregon Department of Human Services (January 2007). Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007).

106 DHS Oregon Department of Human Services (January 2007). Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007).

107 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

** OHS 2005-2007: Statistically significant difference compared to Oregon.

Diet

Dietary Guidelines for Americans, published jointly by the Department of Health and Human Services and the Department of Agriculture, provides dietary recommendations to promote health and reduce risk for major chronic diseases. The 2005 *Dietary Guidelines for Americans* recommended eating five servings of fruits and vegetables per day. The 2010 *Dietary Guidelines for Americans* recommends 2 to 3 cups of vegetables and 1.5 to 2 cups of fruit per day, depending on age and gender.

In Multnomah and Washington counties, less than a third of adult residents eat the recommended five servings of fruits and vegetables per day. Less than one-fifth of 11th grade students and one-quarter of 8th grade students consume the recommended daily five servings of fruit and vegetables.

Table 14: Prevalence of healthy eating, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
percent of adults who consumed at least 5 servings of fruits and vegetables per day, 2006-2009 (age-adjusted)[109]	30	24.9
percent of 11th graders who consumed > servings of fruits and vegetables per day, 2005-2006[110]	18	18
percent of 8th graders who consumed > servings of fruits and vegetables per day, 2005-2006[111]	26.6**	24

** OHS 2005-2007: Statistically significant difference compared to Oregon.

Food access

According to research, people choose healthier food options when they have access to the locations that provide it.[112] Eating more fruits and vegetables and maintaining a healthy weight is associated with residing near full-service grocery stores that provide a variety of produce. For the Southwest corridor, the following maps detail the availability of full-service grocery stores that provide the opportunity to obtain fresh fruits and vegetables.

USDA conducted an analysis of food deserts in the United States by census tract. According to that analysis, the Washington Square regional center is a food desert. See map below.

108 Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

109 State of Oregon (2010). Heart disease and stroke in Oregon: Update 2010.

110 DHS Oregon Department of Human Services (January 2007). Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007).

111 DHS Oregon Department of Human Services (January 2007). Oregon Overweight, Obesity, Physical Activity and Nutrition Facts (OHS 2005-2007).

112 Raimi & Associates (2008). How to Create and Implement Healthy General Plans.

Figure 16: Access to fruit, vegetable or meat markets and full-service grocery stores

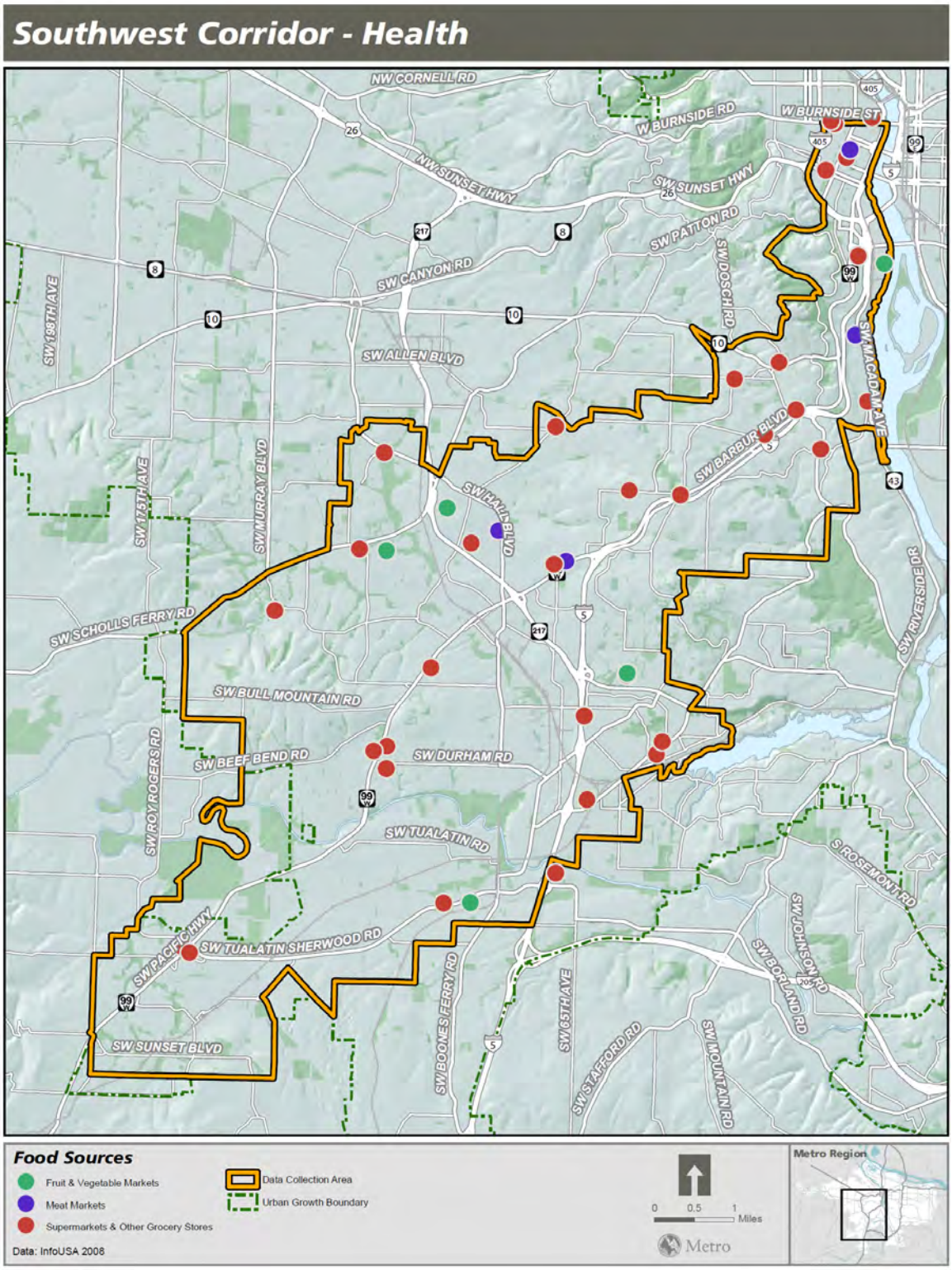
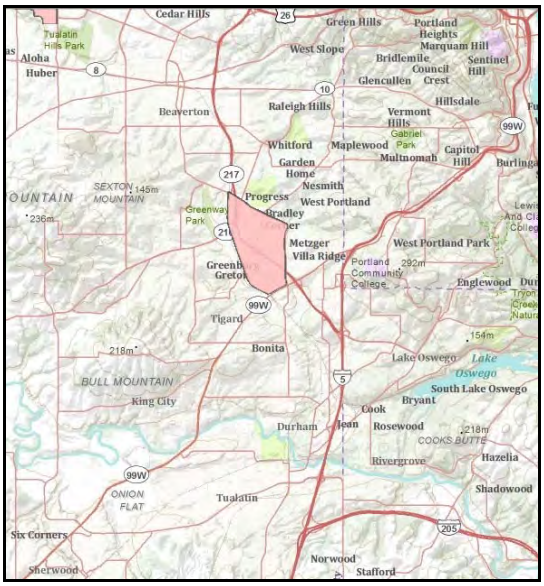


Figure 17: Food desert analysis[113]



Particulate matter in the Portland metro region

Approximately 77 percent of air pollution in Multnomah County comes from mobile sources.[114] Within the Portland metro area, 528.7 tons of diesel particulate matter are produced per year and most of the air quality receptors (86 percent; 2,049 receptors) show levels over the 0.1 µg/m3 benchmark for the region.[115] See map of diesel particulate matter below. A reduction in the NAAQS for particulate matter (PM 2.5) from 15 to14 µg/m3 is estimated to result in 1,900 fewer premature deaths, 3,700 fewer non-fatal heart attacks and 2,000 fewer emergency room visits for asthma per year.[116]

Methodology, PATS 2017, Department of Environmental Quality

Within the State of Oregon, the Department of Environmental Quality, collects and maintains the air quality data. The U.S. Environmental Protection Agency (EPA) maintains the nation's chief repository of ambient air quality data, which is obtained from more than 10,000 monitors operated by state, tribal and local agencies. The 1970 Clean Air Act provides the legislative basis for the EPA's program of air pollution monitoring and regulation by establishing the EPA's enforcement authority, setting national standards and state performance standards for ambient air quality and establishing regulations for stationary sources (e.g., factories, power plants and the like) and motor vehicle emissions. Major amendments were made in 1977 and 1990, expanding the Clean Air Act's scope. For more information about air quality, see the *Southwest Corridor Air Quality Technical Report*.

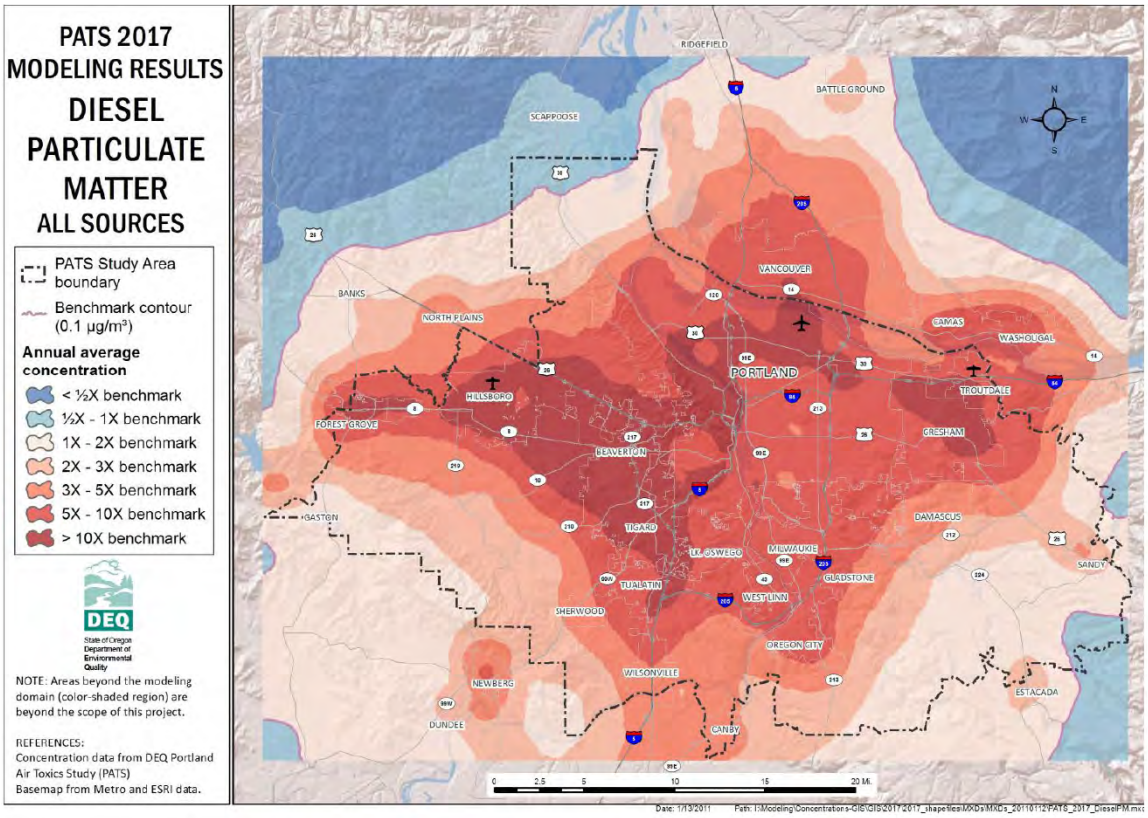
113 USDA (2011). Food Desert Locator by Census Tract. http://www.ers.usda.gov/data/fooddesert/fooddesert.html.

114 Multnomah County Health (June 9, 2008). Letter to Columbia River Crossing.

115 Portland Air Toxics Solutions Advisory Committee (January 25, 2011). PATS 2017 Pollutant Modeling Summary.

116 Multnomah County Health (June 9, 2008). Letter to Columbia River Crossing.

Figure 18: Diesel particulate matter in the Portland metro region



117

Table 15: Prevalence of particulate matter, Multnomah and Washington counties

	Multnomah County (percent)	Washington County (percent)
Particulate Matter 2.5 (PM 2.5): Mean ambient concentration in µg/mg3, 2 counties, 2003-2007[118]	8.5	8.3

The mean ambient concentration of particulate matter is approximately 8.4 µg/mg3 for PM 2.5 particles in Multnomah and Washington counties.[119]

The DEQ Portland Air Toxics Solution (PATS) conducts studies on air quality within the Portland metro region. According to concentration data from the PATS study, the highest concentration of air quality risk with in the Southwest Corridor is in the general proximity of Highway 217 (26-35), South Waterfront (26-35) and downtown Portland (36-50). The rest of the Southwest Corridor study area has a medium air quality risk (16-25). Sherwood demonstrates the lowest concentration of air

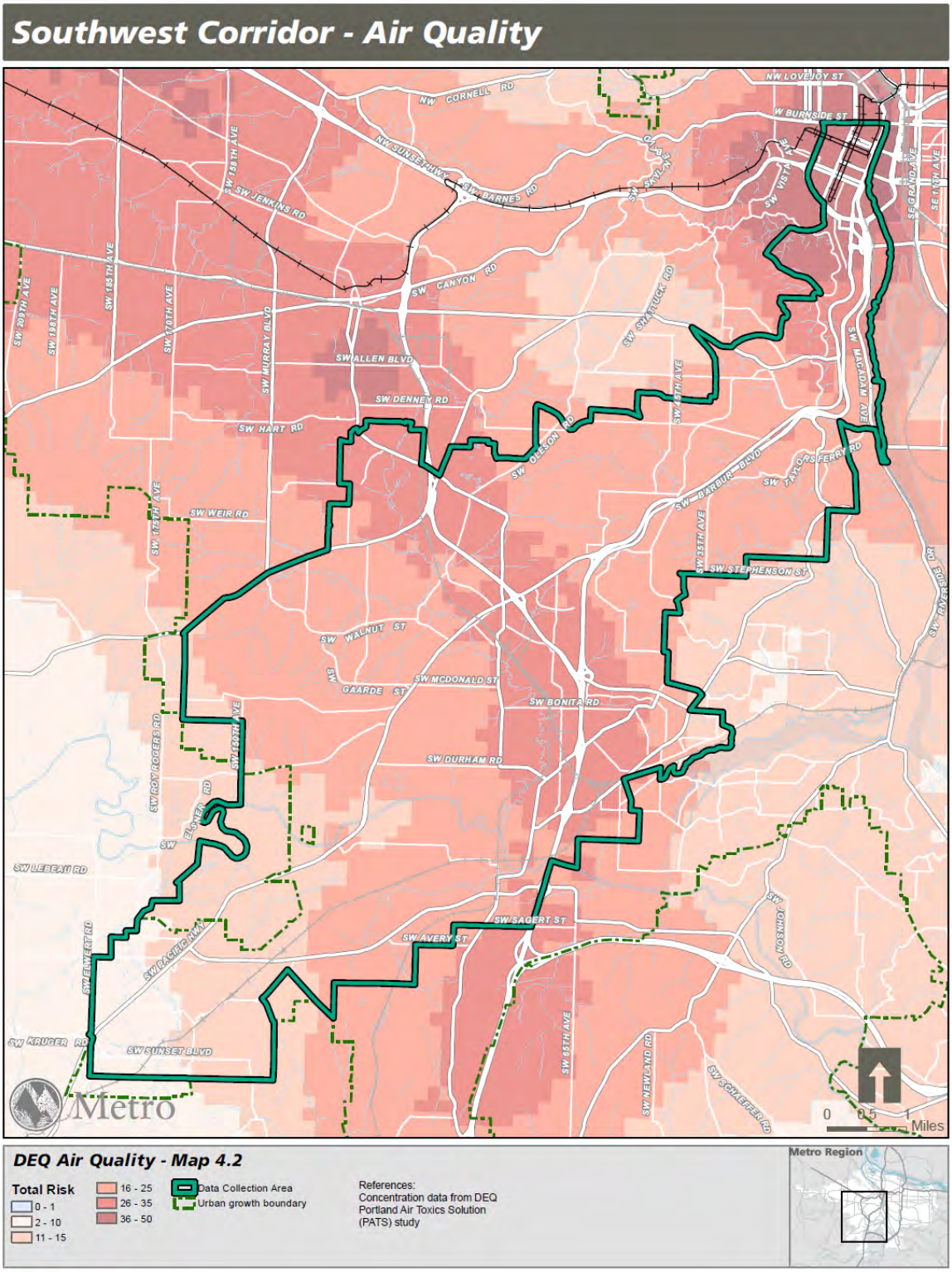
117 Portland Air Toxics Solutions Advisory Committee (January 25, 2011). PATS 2017 Pollutant Modeling Summary.

118 Oregon Environmental Public Health Tracking.

119 Oregon Environmental Public Health Tracking.

quality risk (2-15). For more information, please see the *Southwest Corridor Air Quality Existing Conditions Technical Report*.

Figure 19: Air quality risk



CONCLUSION

Key findings

The planning of communities, especially the availability of community infrastructure and the design of the built environment, significantly affects health behaviors and environmental exposure. The design of the built environment can offer opportunities for residents to engage in health behaviors, such as walking, biking and making healthy diet choices, that reduce illness. In addition, the built environment can help to limit exposure to air toxins and noise pollution, which could cause stress-related or air quality-related illnesses. The natural built environment, such as trails, parks, tree canopy and open spaces, also enhances environmental exposure which has been shown to reduce stress. Preliminary research indicates the following health outcomes exist in the Southwest corridor.

Obesity

The prevalence of obesity of Kaiser Permanente members in the Southwest Corridor is 16.4 percent compared to 20 percent of Kaiser Permanente members region-wide.[120] Over one-third (41 percent) of participants in a Medicaid sample are obese in the Southwest Corridor study area.[121] In comparison, one-quarter of residents in Multnomah County (26.3 percent) and Washington County (23.9 percent) are obese.[122]

Almost three-fourths (71 percent) of participants of a Medicaid sample are overweight or obese in the Southwest Corridor. [123] In comparison, one-third of residents in Multnomah County (30.2 percent) and Washington County (39.2 percent) are overweight. [124]

Asthma

Nearly one in ten (8.7 percent) Kaiser Permanente members in the Southwest Corridor have asthma compared to 9 percent of population of Kaiser Permanente members region-wide.[125] Approximately one in eight (13 percent) participants of a Medicaid sample who reside in the Southwest corridor have asthma.[126] For comparison, one in ten residents of Multnomah County (9.9 percent) and Washington County (9.2 percent) have current asthma.[127]

Mental Health

Two in three Multnomah (61.9 percent) and Washington County (69.2 percent) residents believe they have had no poor mental health in the past 30 days (2006-2009). [128] More than one in four (28

[120] Kaiser Permanente(2010).
[121] Providence CORE (2011). *Oregon Health Study*, www.oregonhealthstudy.org.
[122] Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.
[123] Providence CORE (2011). *Oregon Health Study*, www.oregonhealthstudy.org.
[124] Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.
[125] Kaiser Permanente(2010).
[126] Oregon Health Study, www.oregonhealthstudy.org, Providence CORE, 2011.
[127] Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.
[128] Centers for Disease Control and Prevention (2010). Behavioral Risk Factor Surveillance System.

percent) participants of a Medicaid sample who reside in the Southwest corridor report having depression. [129]

Needs

Improvements to the built environment that could positively affect health outcomes within the Southwest corridor face geographic, cultural and financial challenges. Throughout the study area, there is a wide-range of topographic limitations such as steep hills and ravines. These topological forms restrict active transportation. The existing environment is not human scale; it is built for automobile movement instead of human movement. Additionally, the *Southwest Corridor Community Access Technical Report* notes sidewalk gaps, unsafe walking environments and lack of bicycle facilities. The scale of the environment and a lack of pedestrian and bicycle infrastructure affect health outcomes associated with obesity and stress-related mental health diseases. The Southwest Corridor Air Quality Technical Report notes high levels of air pollution associated with major roadways. This affects the percentages of air quality related health outcomes in the study area.

Opportunities

Sidewalks, trails, bicycle paths, high capacity transit or roadway improvements and zoning are planning elements that encourage residents to engage in recreation, be physical active and a eat healthy. Trails, parks, tree canopy and open spaces enhance the positive environmental exposure and have been shown to reduce stress, improve air quality, and increase opportunities for physical activity and recreation. Roadway, sewer and other infrastructure projects can be enhanced to include walking and biking routes, stream enhancement, and storm water improvements.

The *Southwest Corridor Community Access Technical Report* lists built environment projects, ongoing and planned, in the study area that might address some of the health outcomes discussed in this report. Additionally, these projects provide the occasion to address air quality and vehicle miles traveled standards as dictated by the state government. The application of funded projects and the development of new bicycle and pedestrian infrastructure, new trails and increased green space.

Constraints

Financial constraints affect the development of new built environment facilities that would change the opportunities for community members to mitigate or prevent negative health outcomes. Infrastructure is built in a manner that makes improved connectivity, walkability and bikeability financially and physically difficult to build. The topography of the area adds, often significant,costs to infrastructure projects because of the additional design and engineering required or potential impacts to the natural resources affected.

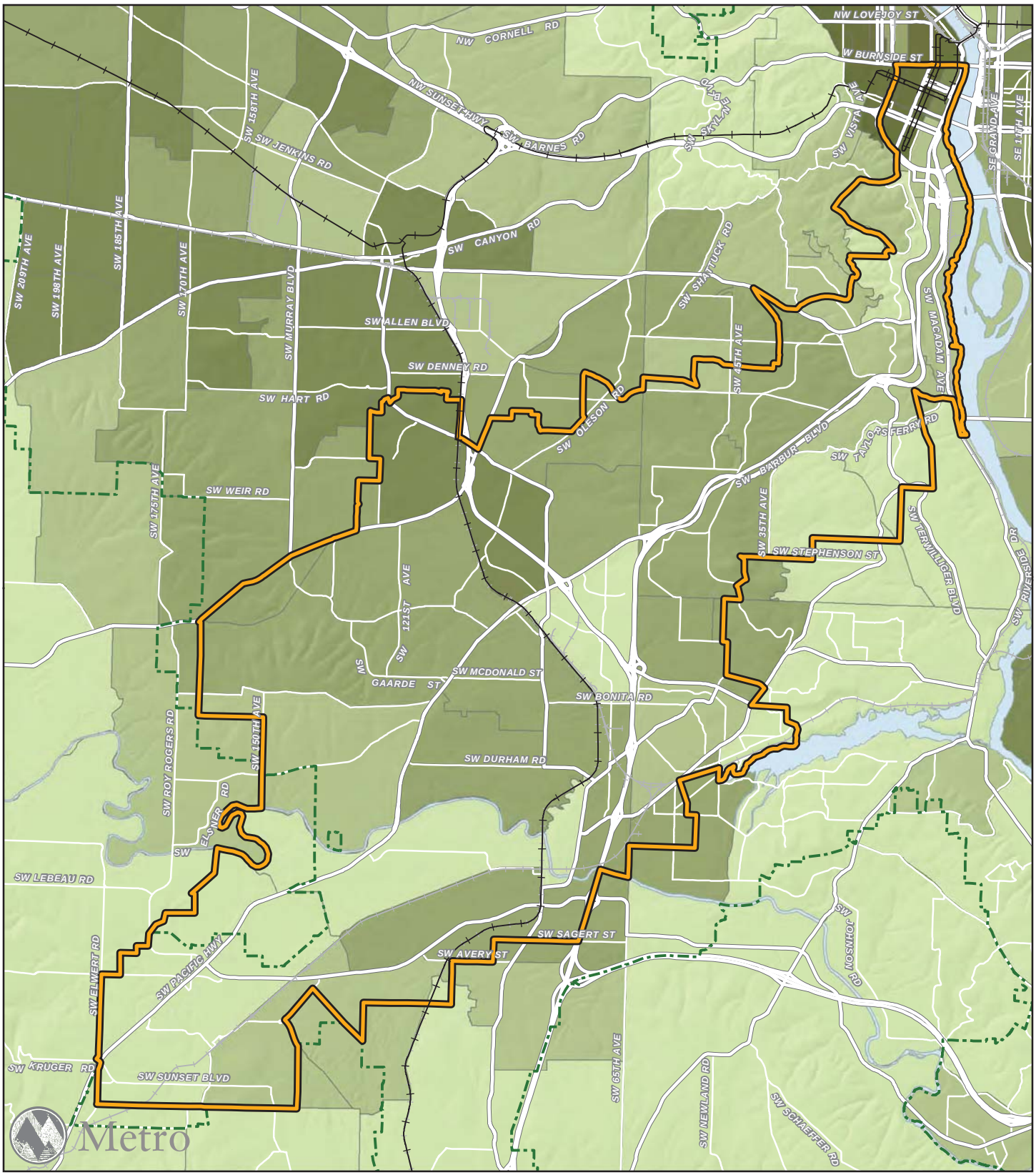
[129] Providence CORE (2011). *Oregon Health Study*, www.oregonhealthstudy.org.

APPENDIX

Figure 20: Prevalence of smokers in the Southwest corridor in Kaiser Permanente adult members

Figure 21: Prevalence of chronic kidney disease in the Southwest corridor in Kaiser Permanente adult members

Southwest Corridor - Health



Normalized Rate of Smoking

Regional Average for population that smoke is 1.04 people per acre or 14% of population

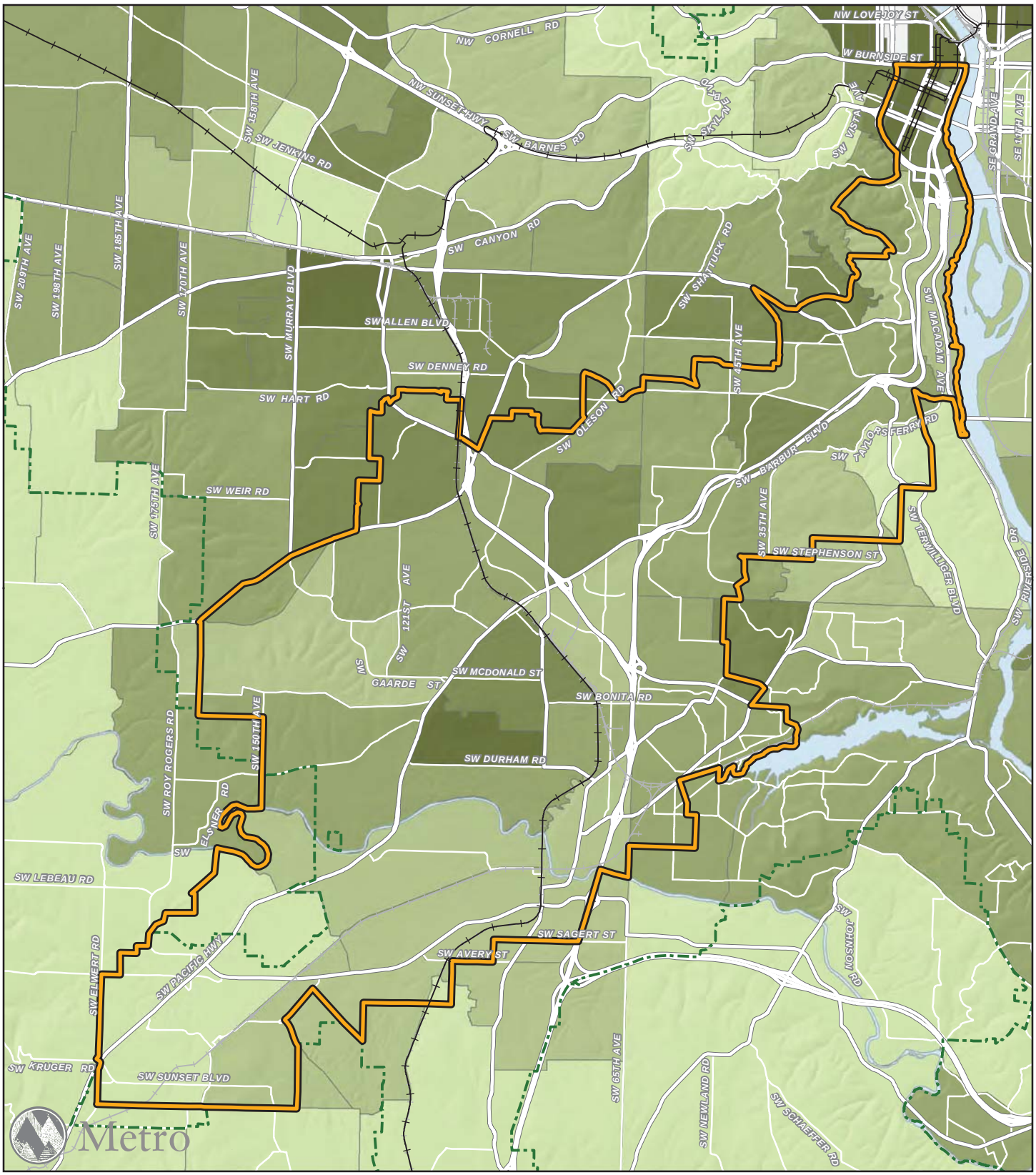
- 0 - .26 ppl/acre
- .26 - .52 ppl/acre
- .52 - 1.04 ppl/acre
- 1.04 - 2.08 ppl/acre
- 2.08 - 5.68 ppl/acre

0 0.5 1 Miles

Metro Region

Source: Kaiser Permanente 2010 member data summed to census tracts (2000)

Southwest Corridor - Health



Normalized Rate of Chronic Kidney Disease

Regional Average for population with CKD is .22 people per acre or 3.2% of population

- 0 - .05 ppl/acre
- .05 - .11 ppl/acre
- .11 - .22 ppl/acre
- .22 - .44 ppl/acre
- .44 - 1.7 ppl/acre

0 0.5 1 Miles

Metro Region

Source: Kaiser Permanente 2010 member data summed to census tracts (2000)