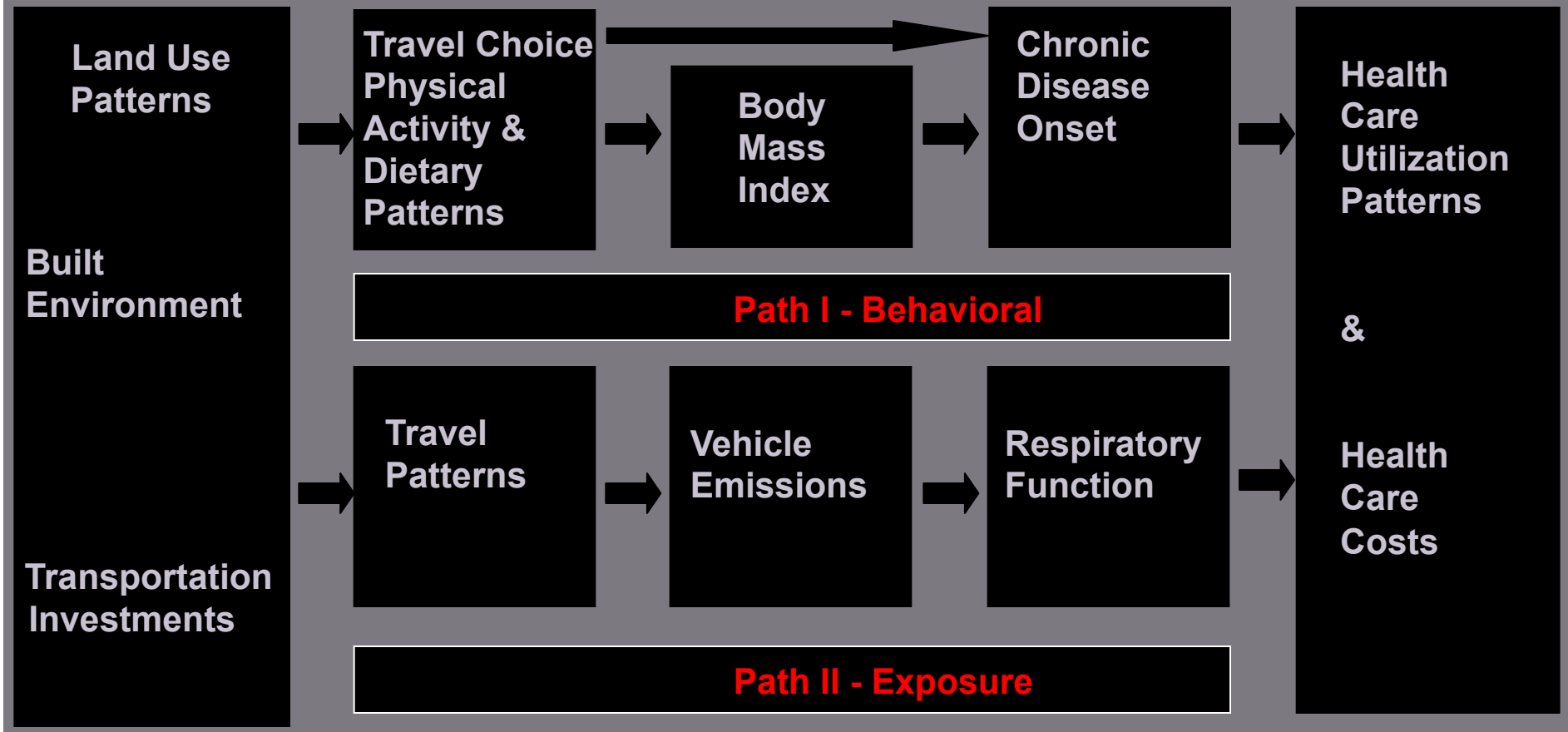
# APPLYING EVIDENCE ON HEALTH AND BUILT ENVIRONMENT RELATIONSHIPS: HEALTH IMPACT ASSESSMENT TOOLS

**Dr. Lawrence Frank, President, Urban Design *4* Health, Inc.**
**Professor, University of British Columbia**

# Health and Built Environment Evidence to Date

1) built environments play a role in shaping health outcomes and disparities
   a) behaviors and b) exposures
2) Environments relate with health outcomes independent of preferences or self selection
   - relationship is at likely least partially causal
3) Built environment X Health relationships vary considerably across age, income, and gender
4) Meeting physical activity guidelines and reduced risk of obesity are associated with transit use and more bikable and walkable environments
   a) reduces odds of chronic disease onset for several morbidities
   b) logically reduces demands on health care system and associated costs
4) It is both *possible* and *timely* to monetize these costs

# CONCEPTUAL MODEL




**Note:** **Diet and nutrition**, age, gender, income, genetics, and other factors also impact weight and chronic disease and to the extent possible are controlled in analyses. Vehicle age and climate impacts emissions and air quality, and respiratory function is also impacted by a variety of factors

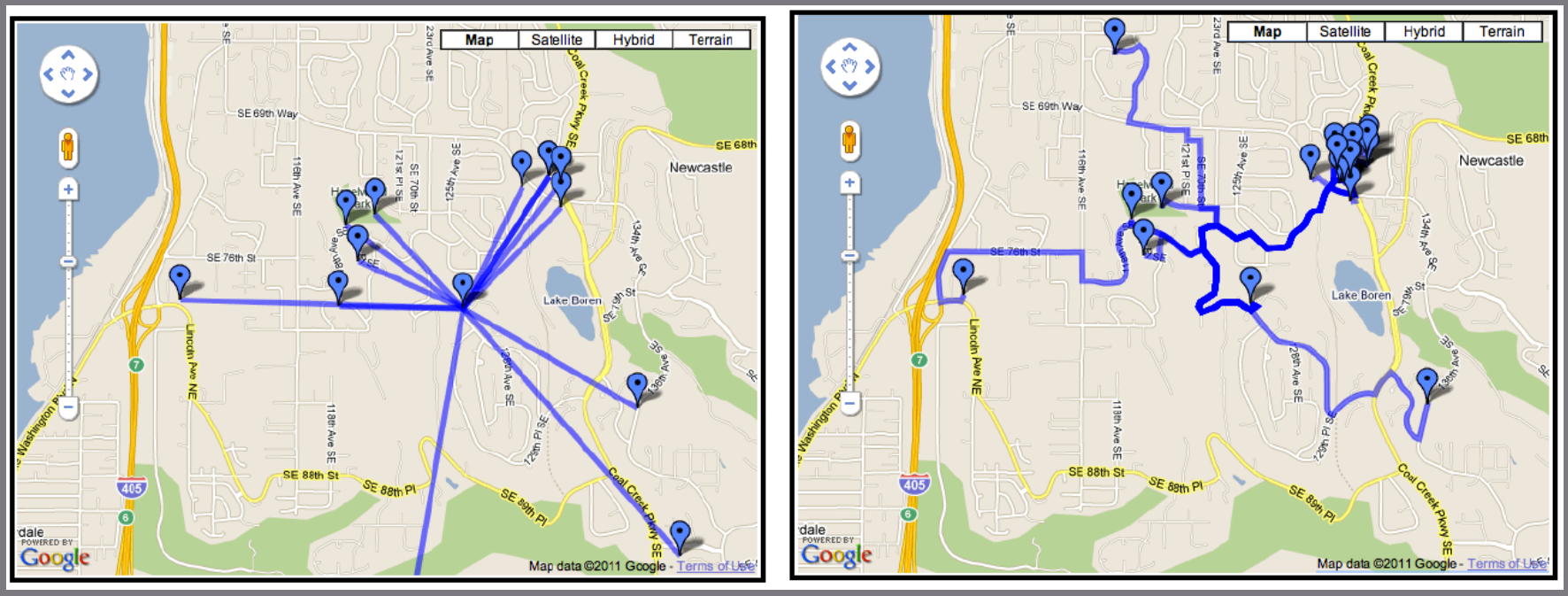
*Dr. Lawrence Frank*

# Why Should we care?

- Health Care Costs
  - Changes in health care system service delivery
    - Affordable care act & Health District Planning
- GHG Impacts and Co-Benefits
  - Energy Security
- Aging population need easy access to facilities
  - Reduced response time
  - increased efficiency of case management
- Meeting the growing unmet demand for walkable environments

# Network Based WalkScore

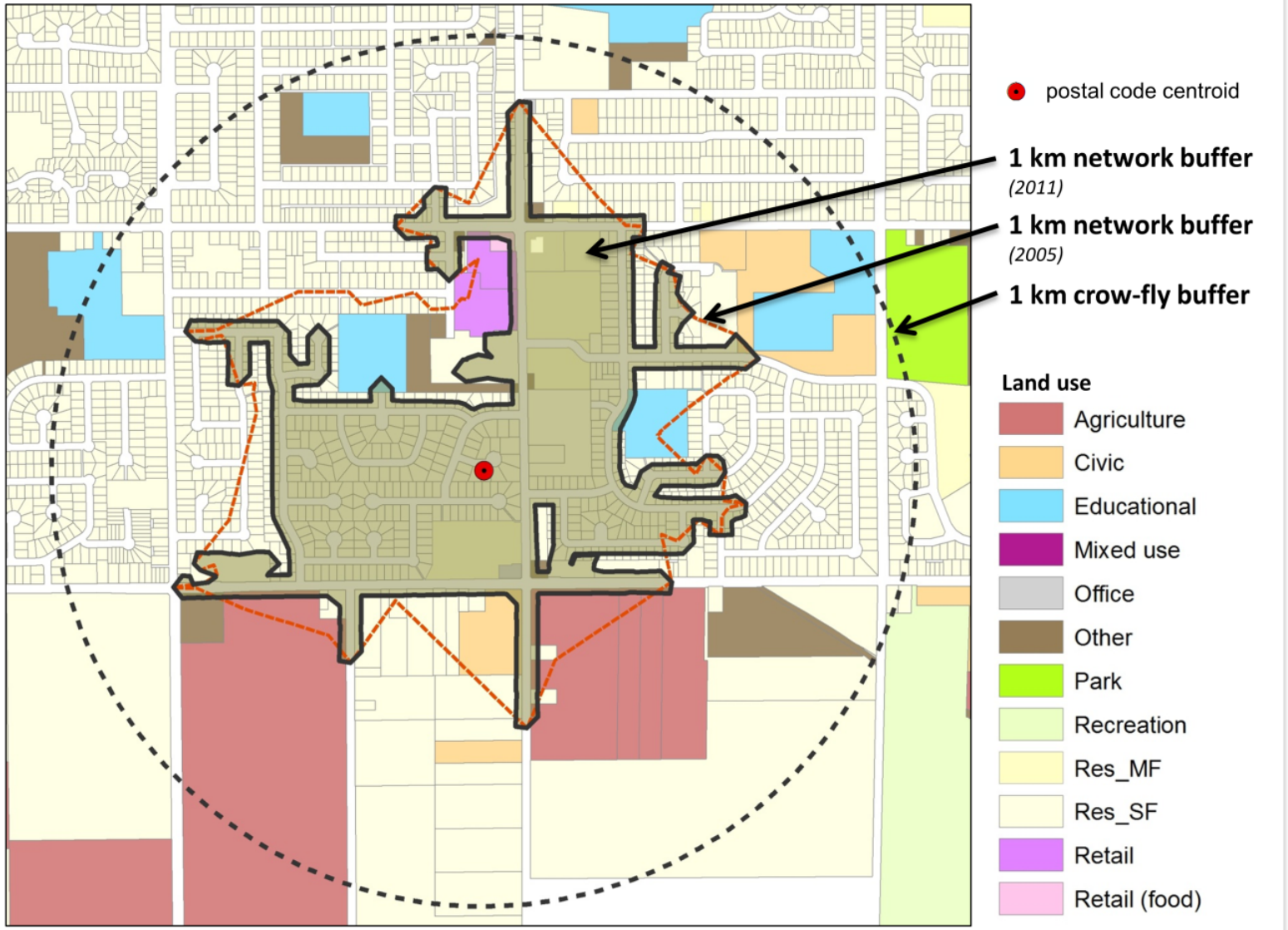
- Implemented and tested airline versus network distance measurement for Walk Score:



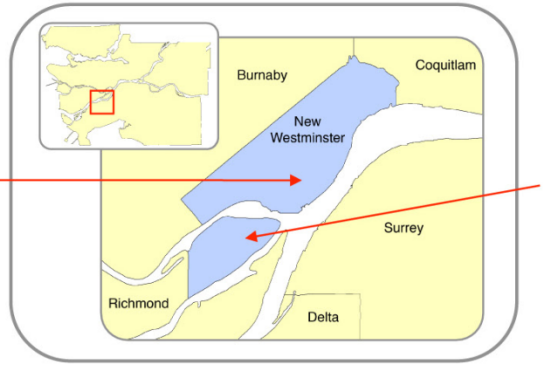

- Network method resulted in stronger bivariate association (as compared to airline method) with daily minutes of moderate or vigorous physical activity**, body mass index*, obesity, overweight**, and daily time spent in an automobile**

** = $p < 0.01$, * = $p < 0.05$

# *Measures Calculated Using 1 km Network Buffers*

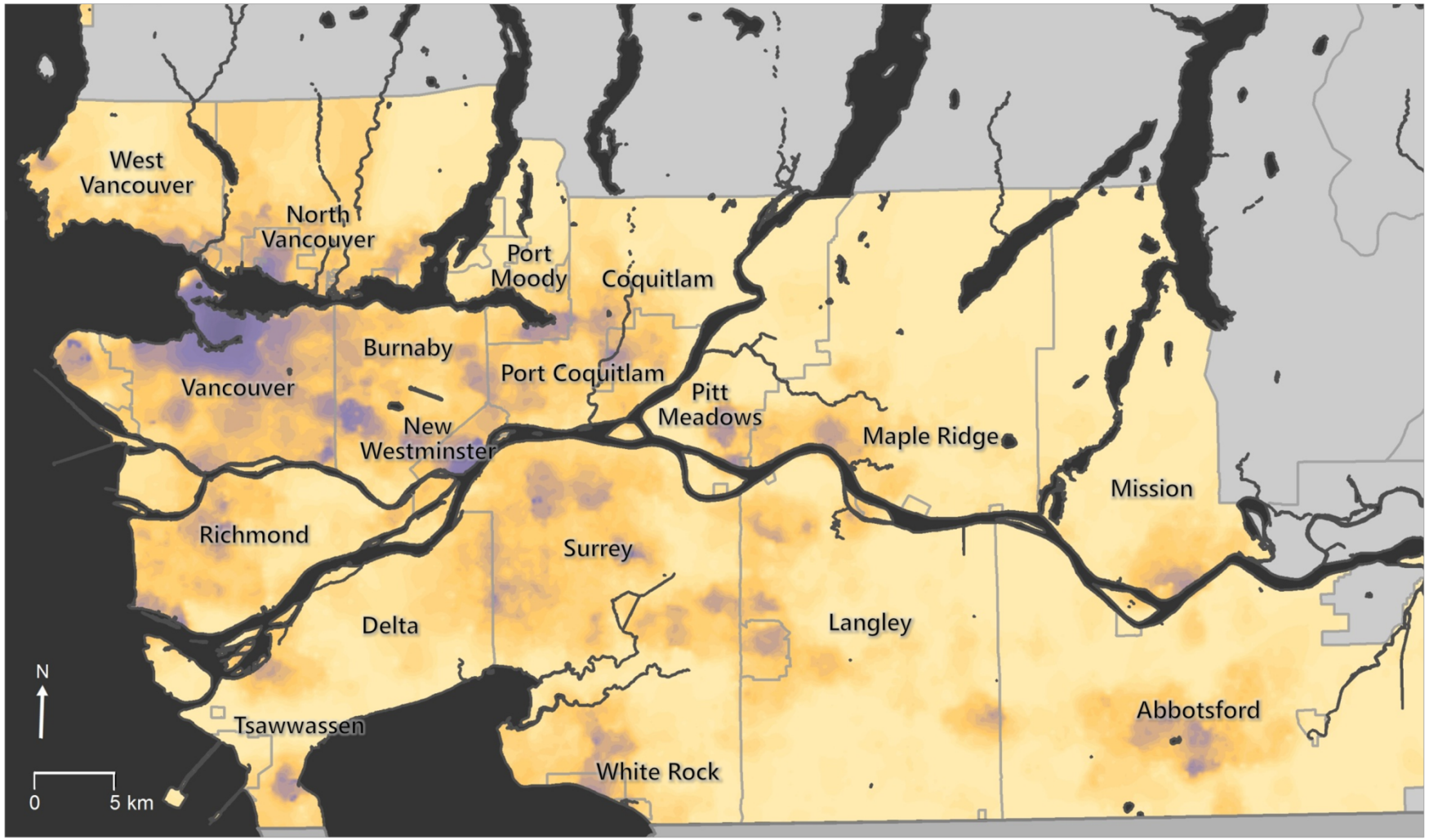


# Comparing Two Communities



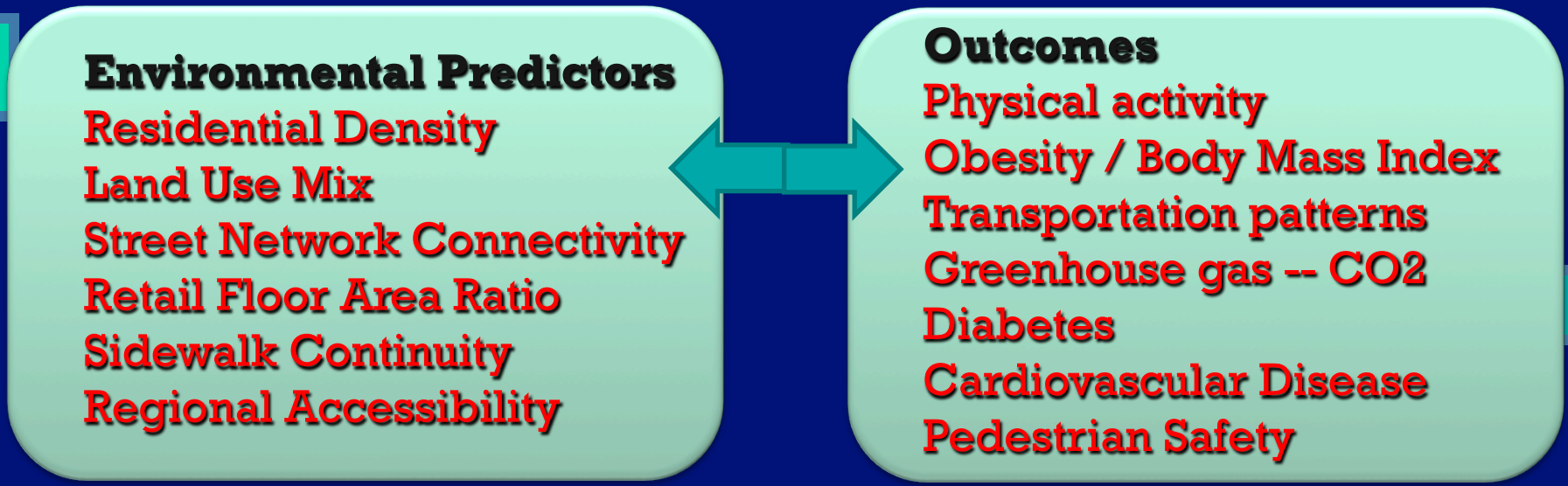

| | Uptown Moody Park | Queensborough |
|---|---|---|
| Net Residential Density (dwelling units/acre) | 40.29 | 7.73 |
| Mixed Use Index (range 0 – 1) | 0.58 | 0.09 |
| Intersection Density (per square km) | 70.12 | 27.91 |
| Retail Floor Area Ratio | 0.64 | 0.30 |
| Overall Walkability | 4.26 | -3.74 |

# 2011 Vancouver Walkability Surface



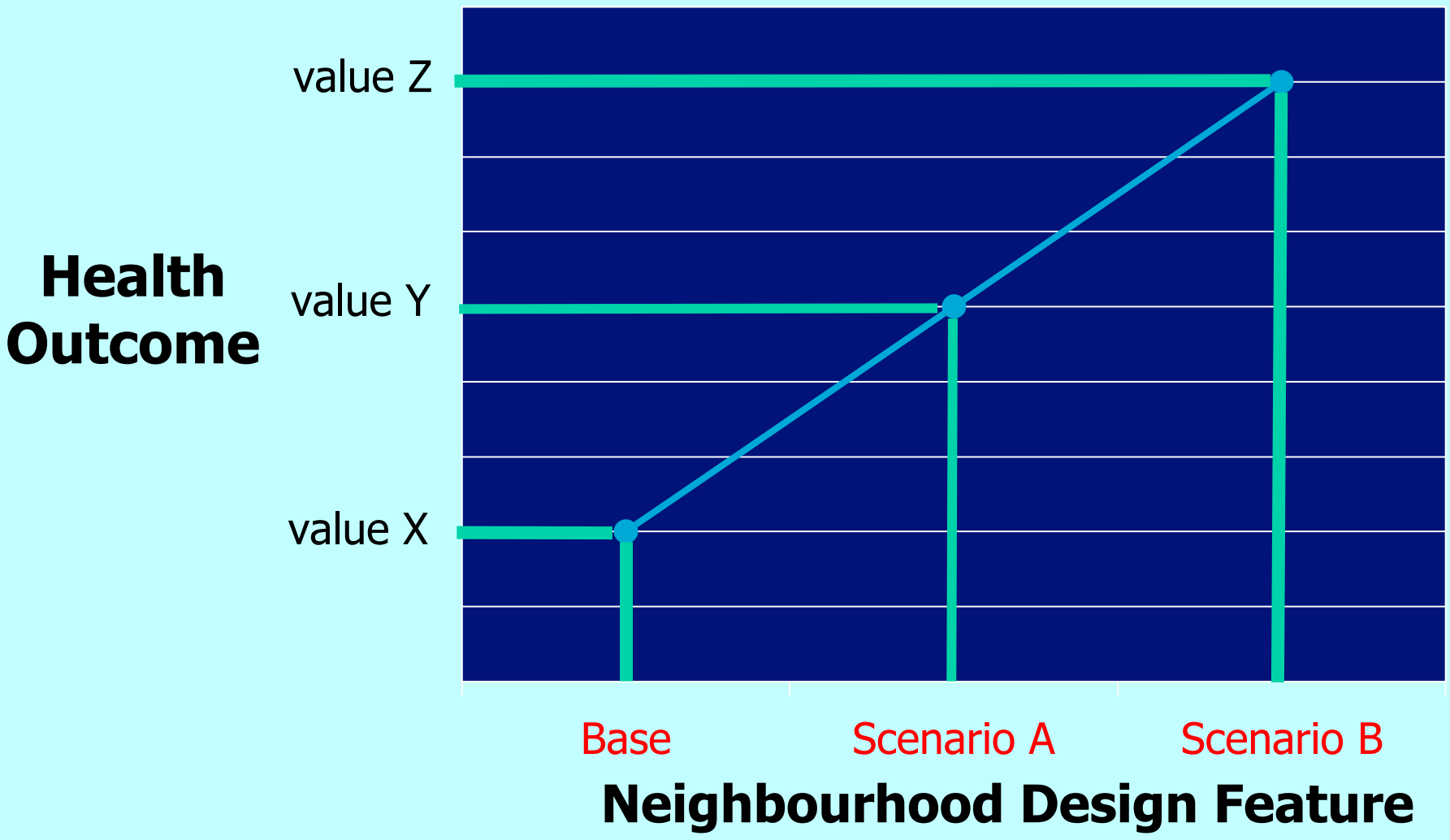

Data sources: UBC Health & Community Design Lab
Projection: NAD 1983 Albers | 

# Researching the Relationships




"Wiring" findings into existing software platforms including CommunityViz, Index, Urban Footprint

# Calculated Outcome Changes

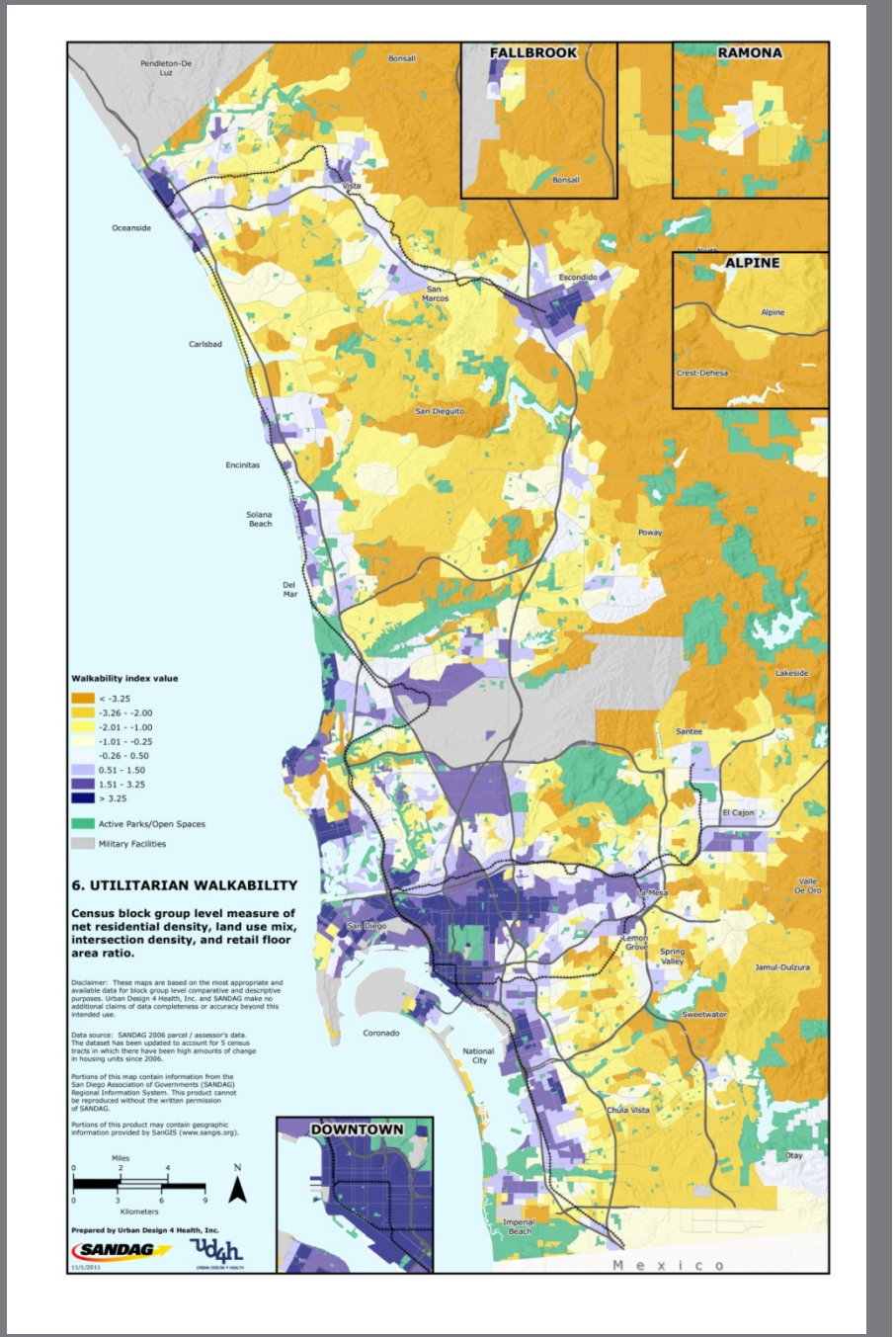



SANDAG
Healthy Works
CPPW / ARRA
Grant

# Utilitarian Walkability

Made up of: Residential density, retail Floor Area Ratio, intersection density, land use mix

Regional walkability distribution, by block group

# Innovations

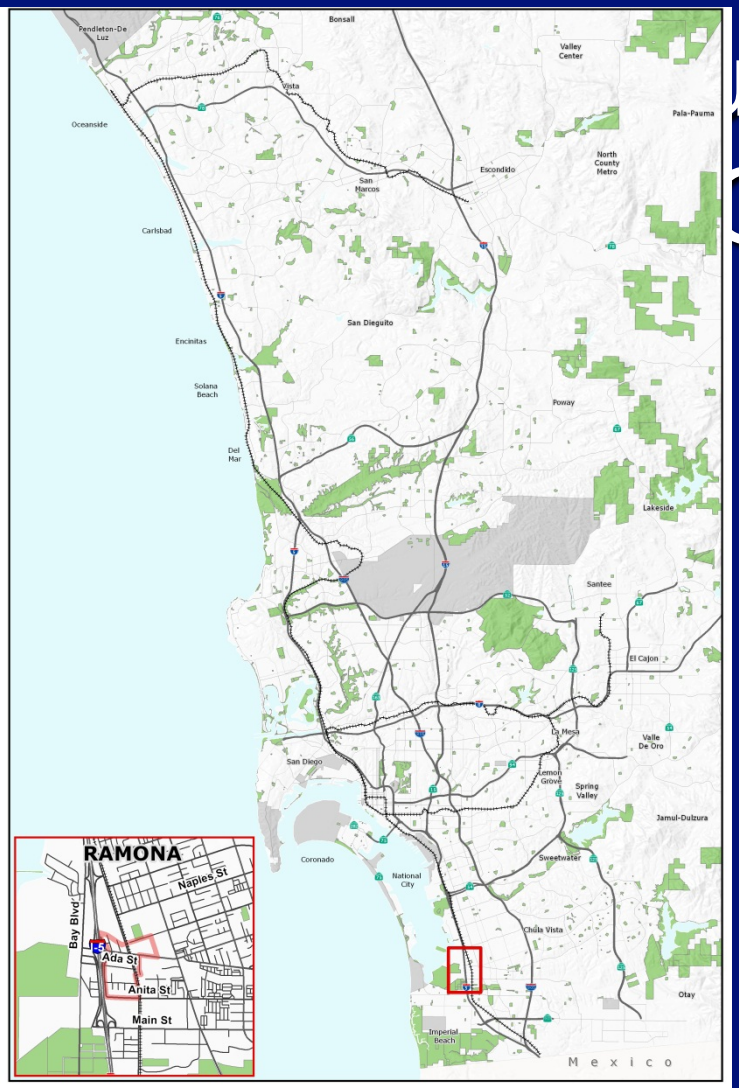
- First large scale study to spatially match a prevalence (health outcome dataset - Calif. Health Interview Survey) with detailed parcel level built environment measures
  - Piloted in San Diego County N= appx 18000
- One of 3 efforts to date that have imported elasticities linking local (walkability) and regional accessibility (transit LOS) with chronic disease outcomes directly into a decision support tool
  - Type II Diabetes, Cardiovascular disease, respiratory ailments along with obesity, physical activity levels
- Results forthcoming in several publications
- Tool operational, validated, and ready for use

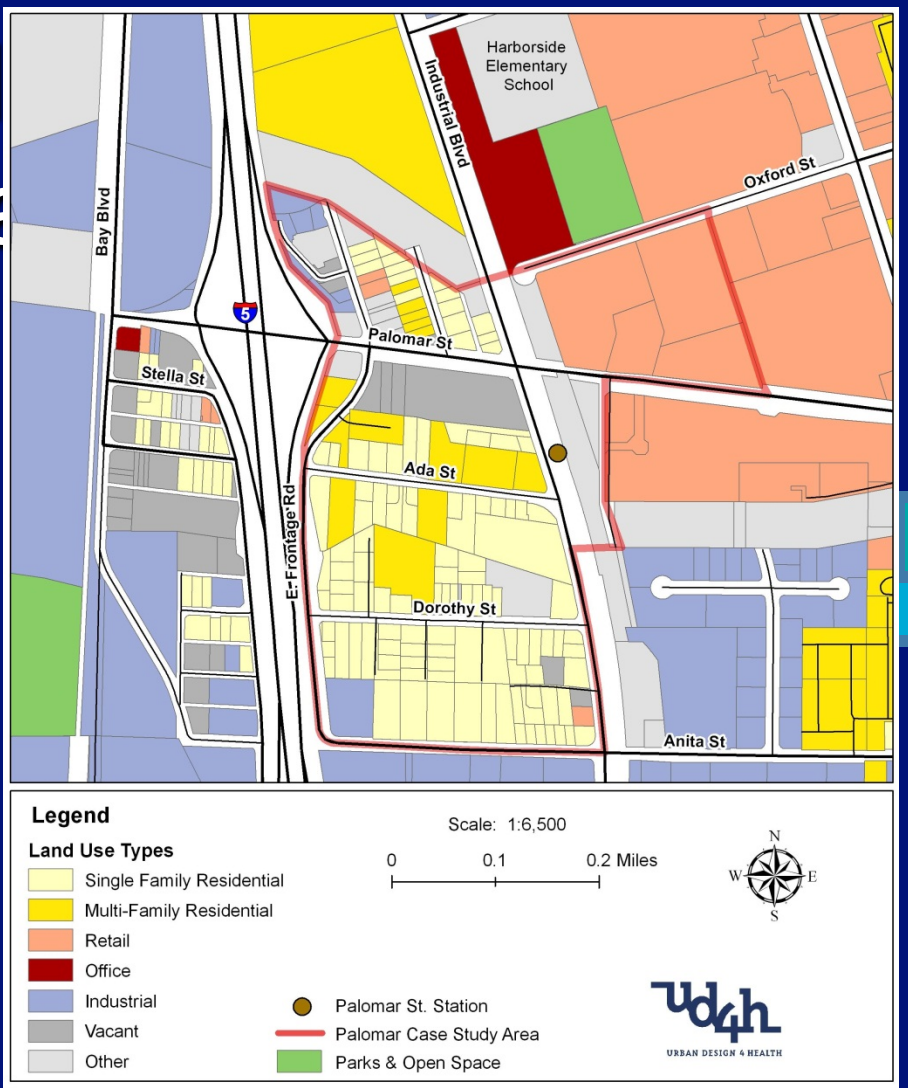
# Case study – Palomar Gateway

- Neighborhood-scale, using a parcel-level tool
- Located just east of I-5 in southern Chula Vista
- 100 acres of vacant, retail, and industrial land near Palomar St, with residential to the north and south
- Identified in the City's 2005 General Plan as one of the top locations for infill and redevelopment
- Case study will test health impacts of potential Specific Plan alternatives

URBAN DESIGN 4 HEALTH

ud
Ga



# Built environment changes

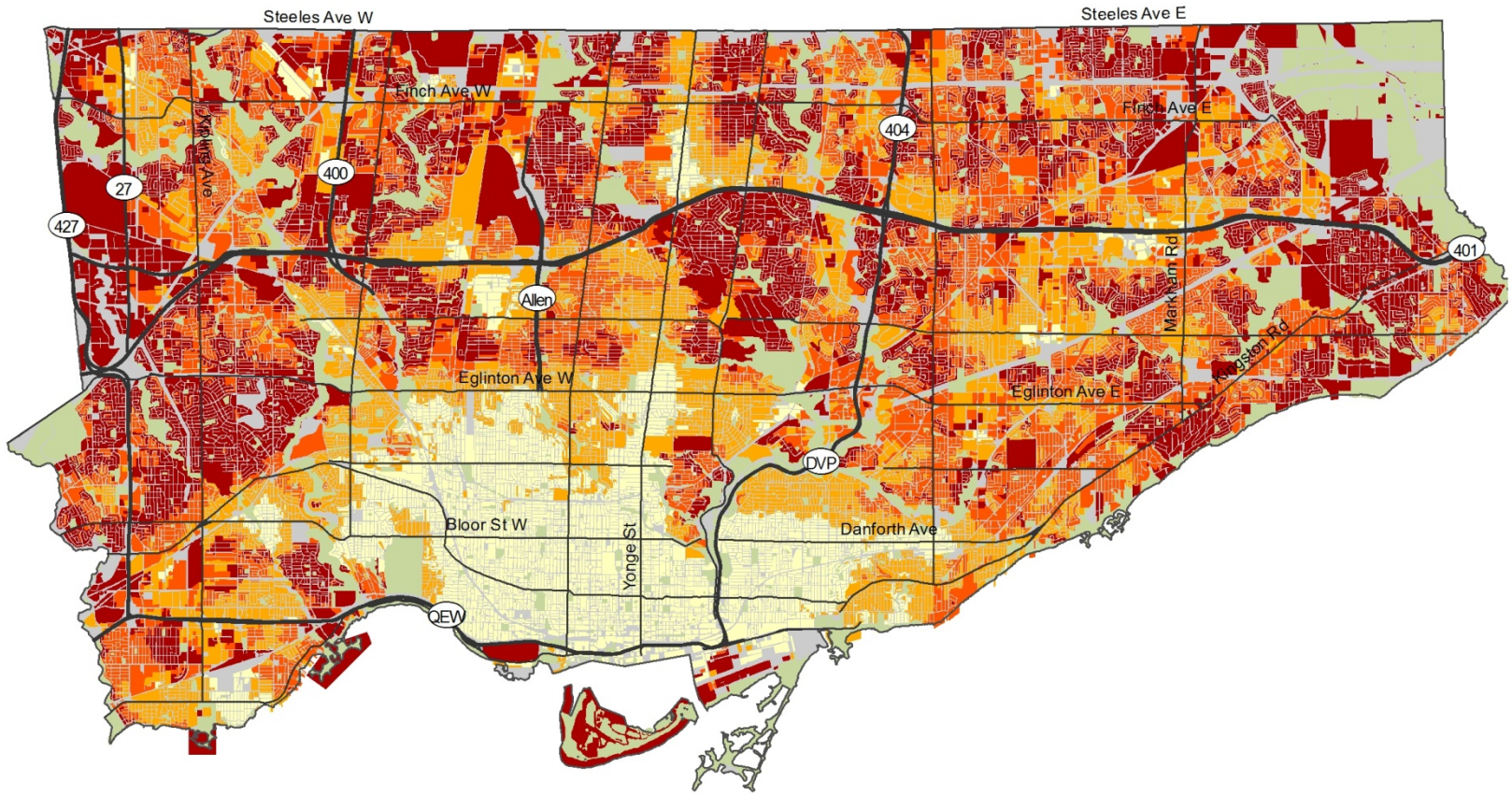
RESULTS ARE PRELIMINARY AND FOR ILLUSTRATIVE PURPOSES ONLY

| Name | Base Scenario | Change Scenario | Units |
|---|---|---|---|
| Single Family DU | 192 | 80 | housing units |
| Multi-Family DU | 155 | 1626 | housing units |
| Total Population | 884 | 3841 | people |
| Residential Area | 44.3 | 68.5 | acres |
| Net Residential Density | 7.8 | 24.9 | units/acre |
| Retail Floorspace | 370073 | 395221 | square feet |
| Retail Land Area | 15.7 | 7.3 | acres |
| Retail FAR | 0.5 | 1.3 | |
| Office Floorspace | 0 | 41238 | square feet |
| Office Area | 0 | 1.2 | acres |
| Office FAR | 0 | 0.8 | |
| Civic and Education Floorspace | 0 | 20035 | square feet |
| Recreation and Entertainment Floorspace | 0 | 58393 | square feet |
| Park Area | 1.2 | 1.2 | acres |
| Number of Schools | 0 | 0 | |
| Number of Transit Stops | 3 | 3 | |
| Number of Grocery Stores | 1 | 2 | |
| Total Road Centerline Miles | 4.2 | 4.2 | miles |
| Total Sidewalk Miles | 4.5 | 5.5 | miles |
| Sidewalk Coverage | 53% | 66% | |
| Total Bike Miles | 0.5 | 1.2 | miles |

# Change in health outcomes

| Name | Base Scenario | Change Scenario | Units |
|---|---|---|---|
| Adult Transportation Walking | 6.1 | 10.2 | minutes per adult per day |
| Adult Leisure Walking | 8.4 | 8.9 | minutes per adult per day |
| Adult Leisure Moderate Physical Activity | 17.3 | 18.4 | minutes per adult per day |
| Adult Time in Private Automobiles | 49.0 | 44.9 | minutes per adult per day |
| Adult Body Mass Index | 28.0 | 27.6 | |
| Adults Overweight or Obese | 69% | 67% | |
| Adults Obese | 33% | 32% | |
| Adults with Type 2 Diabetes | 8.6% | 7.8% | |
| Adults with High Blood Pressure | 31% | 26% | |
| Adult Self-Rated General Health | 3.2 | 3.3 | scale of 1-5 (poor-excellent) |
| Adults Visiting a Park in the Last 30 Days | 57% | 59% | in past month |
| Teen/child transportation walking | 4.4 | 5.2 | minutes per child/teen per day |
| Teens walking to/from school | 44% | 47% | |
| Teen moderate/vigorous physical activity | 3.87 | 3.92 | days with at least 60 minutes per teen per week |
| Teen body mass index | 23.2 | 23.0 | |
| Teen park visitation | 31% | 36% | in past month |
| Children walking to/from school | 19% | 24% | |
| Child body mass index | 20.9 | 20.7 | |
| Child park visitation | 5.7 | 6.7 | days per child per month |
| Pedestrian/bicycling risk factor | 46.7 | 47.0 | scale of 1-100 (low-high) |

# Toronto Walkability Index - 2011




**Utilitarian walkability by 1km buffered postal code**

- Low
- Medium-low
- Medium-high
- High
- No data
- Public green area
- Highway
- Major road

N W E S

0 1 2 4 Km

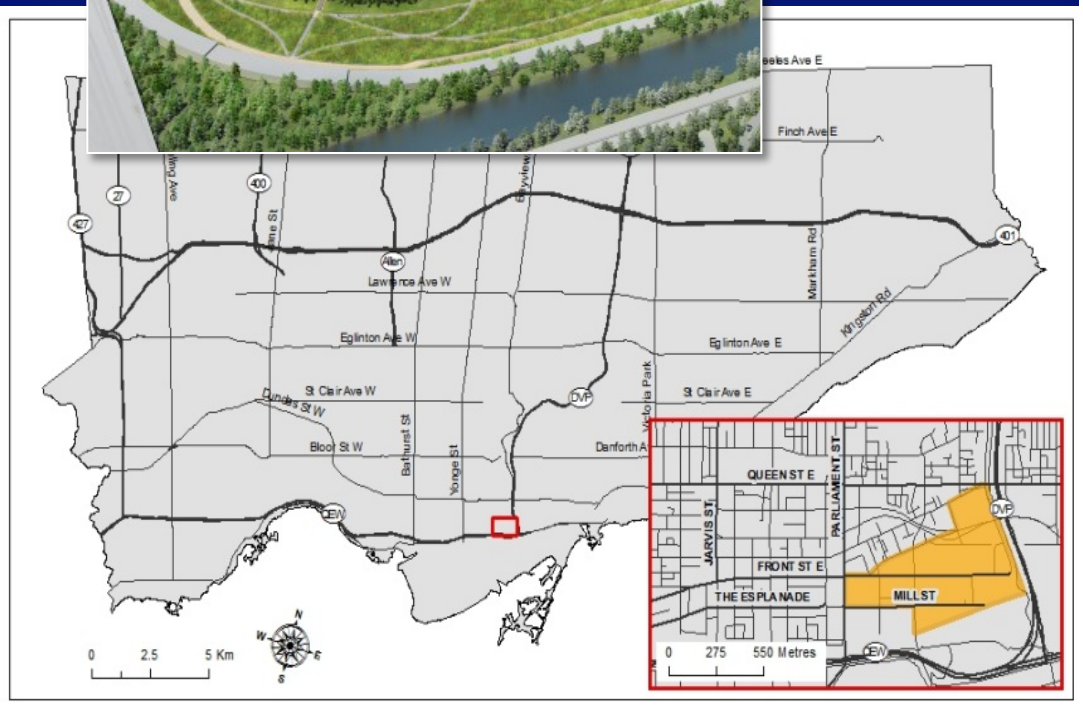


Data sources: City of Toronto Geospatial Competency Centre; MPAC (see full report for source files, licenses, and restrictions)

# West Don Lands (Toronto) Example

Pilot study site for software tool application:

- Substantial planning already done
- 80 acres
- significant changes in built environment
  - dense/mixed use development
  - 6000-6500 housing units
  - 1 million sq ft of office/retail
  - 2 new streetcar stops
  - new park space
- Redevelopment is part of revitalizing Toronto's waterfront
- Site of athlete's village for Pan American Games (2015)



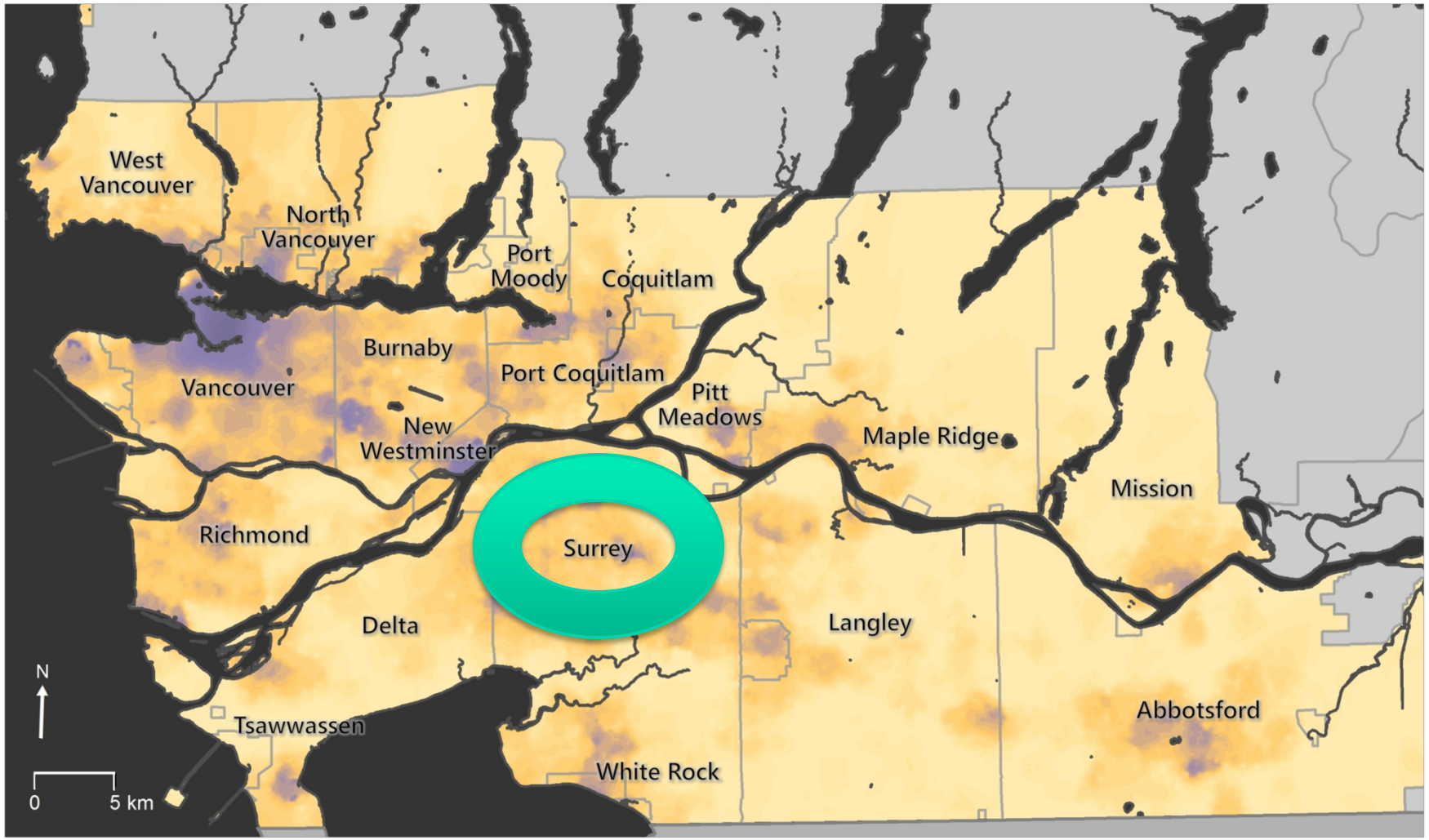
# Outcome Changes – West Don Lands

| Outcome | Study Area* | | City** |
|---|---|---|---|
| | Base | Future | Base |
| average **active trips**/person/day | 0.2 | **0.4** | 0.1 |
| average **transit trips**/person/day | 0.6 | **0.7** | 0.5 |
| average **automobile trips/**person/day | 1.0 | 0.6 | 1.3 |
| average **trip kilometers**/person/day | 18.2 | 15.9 | 22.6 |
| average **CO2** generated (kg/HH/day) | 3.4 | 2.5 | 4.2 |
| **walking for exercise** monthly freq. | 14.4 | **14.6** | 10.7 |
| **walk to work/school** monthly freq. | 7.8 | **9.8** | 5.6 |
| **bicycle for exercise** monthly freq. | 1.1 | **1.4** | 0.6 |
| **bicycle to work/school** monthly freq. | 0.8 | **1.1** | 0.3 |
| daily **energy expenditure** (kcal/kg/day) | 2.7 | **3.2** | 2.4 |
| body mass index | 24.3 | 24.2 | 24.6 |
| high blood pressure (likelihood) | 0.1 | 0.1 | 0.1 |

*Average of postal code values

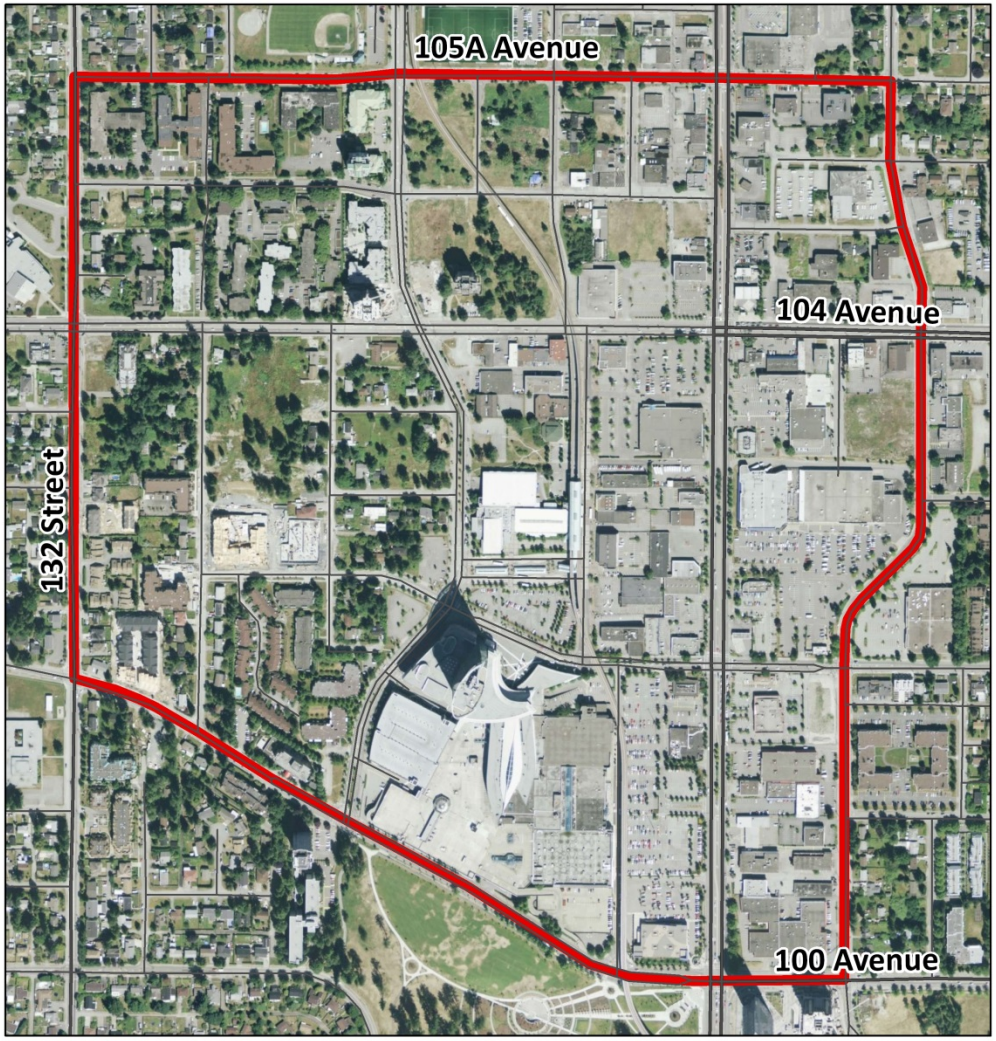
** Population weighted average of postal code values

# 2011 Vancouver Walkability Surface

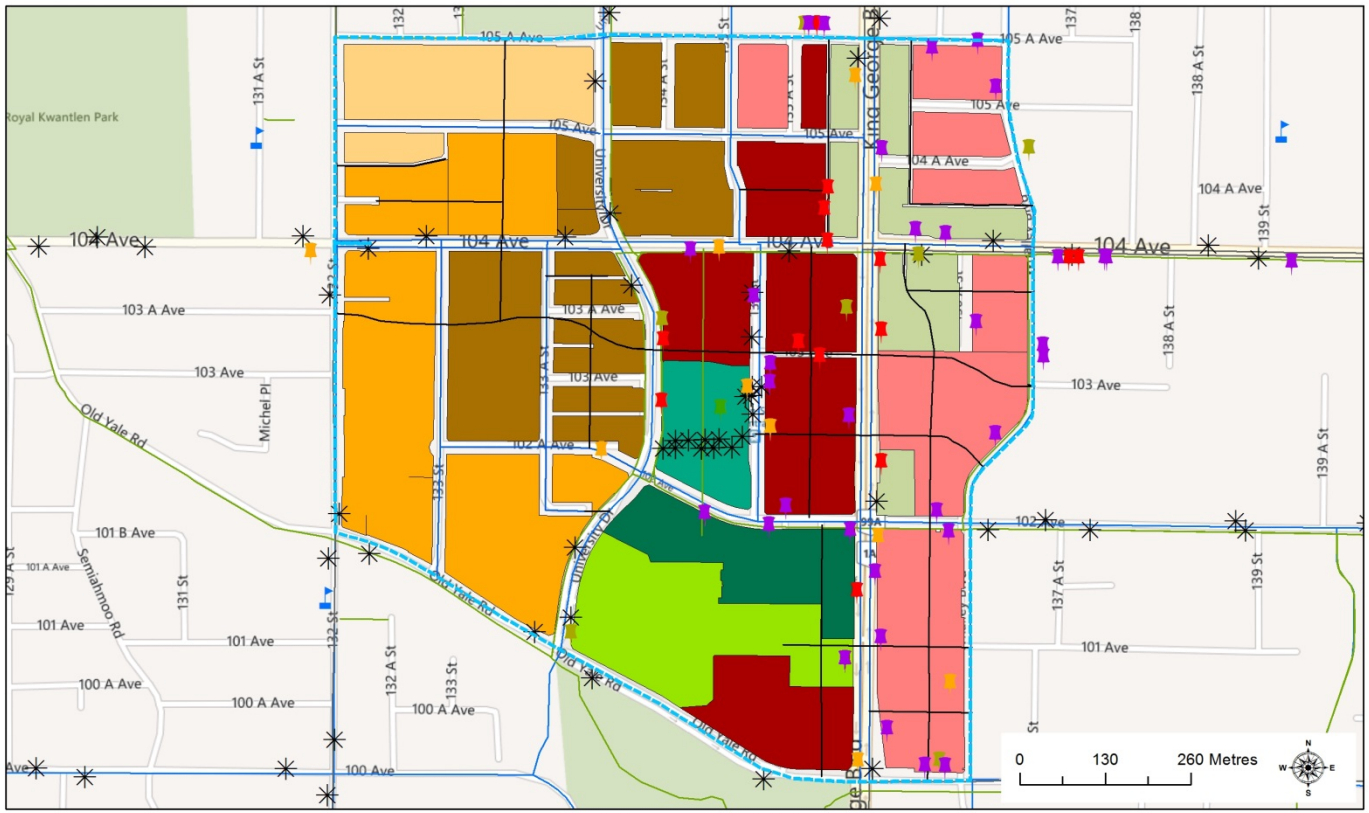



Data sources: UBC Health & Community Design Lab
Projection: NAD 1983 Albers | 

# Surrey Central Station



# Change Scenario Assumptions




**Transit.** Although service frequency is expected to increase along existing bus routes and the Skytrain station is expected to become a major transit hub for new rapid transit services in the Surrey region, no new stop locations were added to the study area.

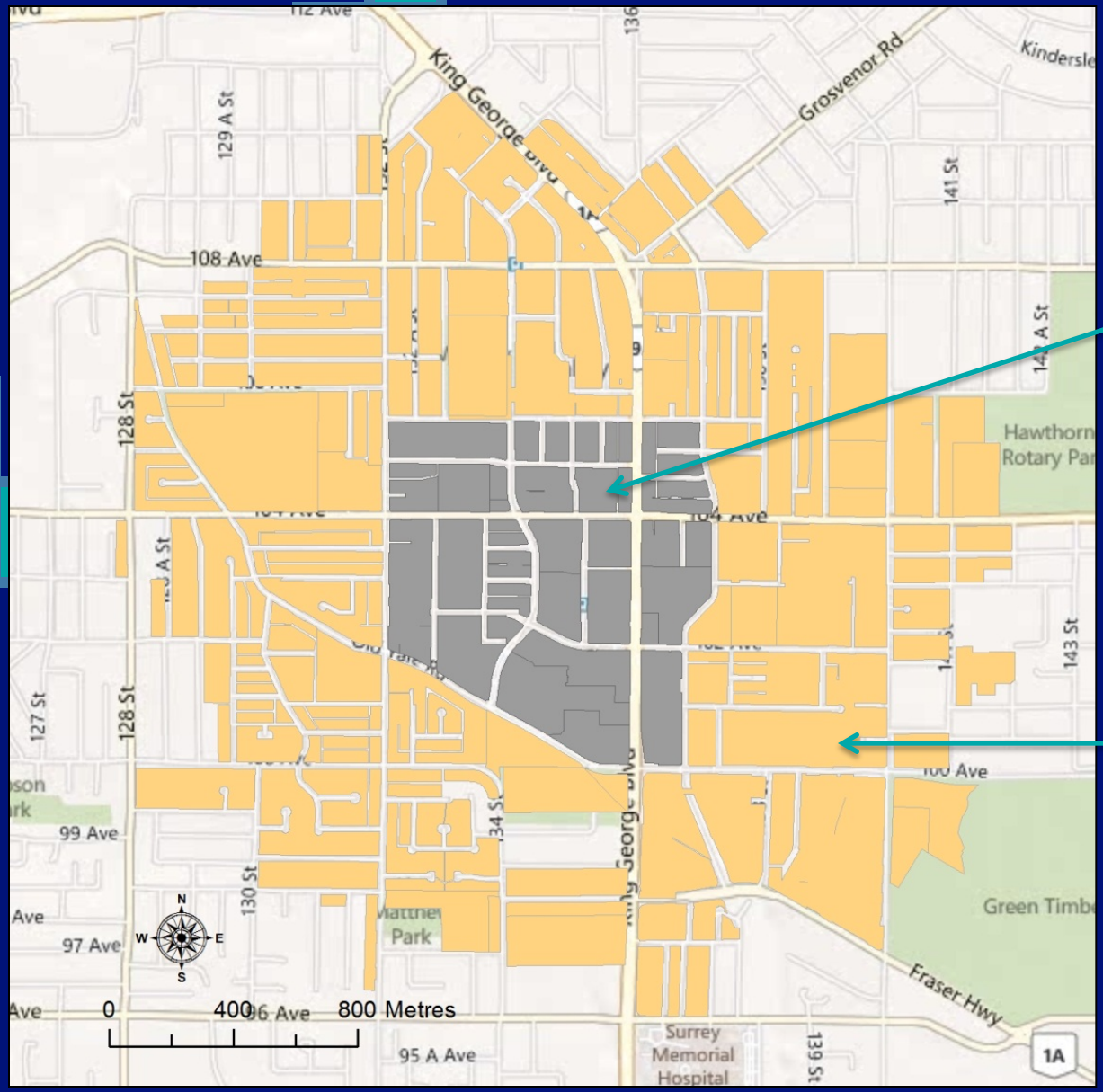
**Streets.** The street grid matches the planned street network as closely as possible.

**Parks.** The public plaza planned for Surrey Central Station was designated as park land.

**Food retail.** New food locations were added to support the planned increase in population; they were located in areas where commercial and mixed used development is planned to occur.

**Sidewalks.** All roads in the redevelopment scenario were assumed to have 100% sidewalk coverage.

**Trails.** A new north-south trail was placed through the polygon containing the planned public plaza.




**Study area** (grey polygons)

**Impacted area** (orange polygons)

# SCS Study Area Parcel-Based Polygons

# SCS Scenario Summary
## (unweighted average)

| Variables | Existing Conditions | | Change Scenario 1: SCS Plan | |
|---|---|---|---|---|
| | Study area postal codes (n=39)[70] | Buffered study area postal codes (n=39)[71] | Study area postal codes (n=39) | Buffered study area postal codes (n=39) |
| Net residential density (residential units per residential acres) | 17.9 | 10.5 | 101.0 | 33.6 |
| Land use mix (0-1)[72] | 0.11 | 0.71 | | 0.57 |
| Retail floor area ratio | 0.20 | 0.29 | | 0.56 |
| Intersection density (count/sq km) | 47.0 | 60.9 | 91.0 | 73.8 |
| Transit density (count/sq km) | 33.0 | 27.6 | 33.0 | 27.6 |
| Number of intersections | 47 | 207 | 91 | 251 |
| Number of transit stops | 33 | 94 | 33 | 94 |
| Pedestrian-accessible roads (km) | 14.2 | 57.8 | 20.0 | 63.6 |
| Bicycle Facilities (km) | 10.6 | 36.6 | 21.6 | 47.6 |
| Trails (km) | 6.7 | 21.8 | 7.2 | 22.3 |
| Schools | 0 | 4 | 0 | 4 |
| Food locations | 53 | 93 | 73 | 113 |

# Estimated Outcome v=Values for Study Area
## (SCS polygon count =39)

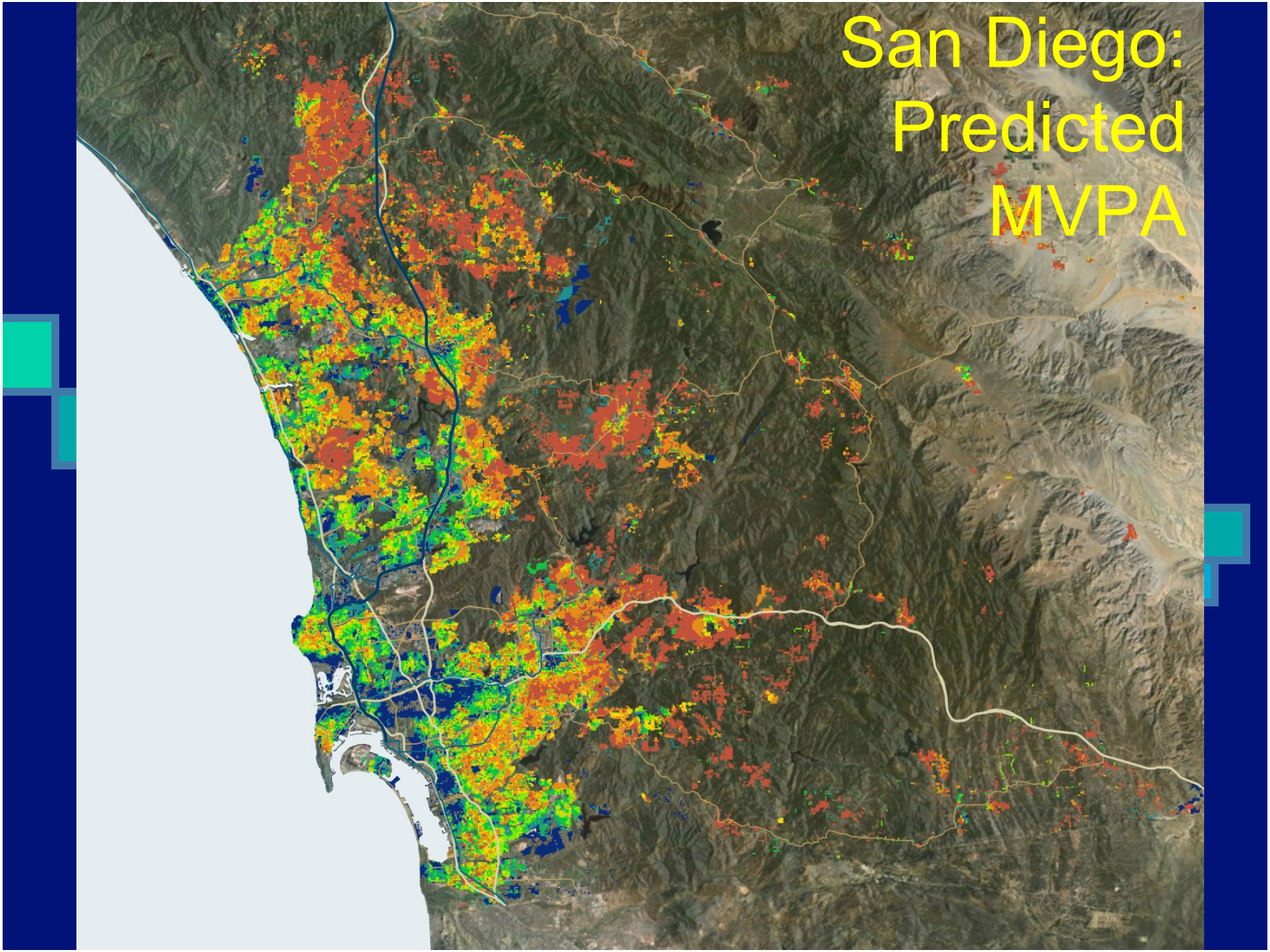
| Outcome | SCS Existing Conditions* | Change Scenario 1: SCS Plan* |
|---|---|---|
| average active trips/person/day | 0.24 | 0.46 |
| average transit trips/person/day | 0.61 | 0.74 |
| average automobile trips/person/day | 0.89 | 0.52 |
| average trip kilometers/person/day | 23.77 | 22.40 |
| average CO2 generated from vehicles (kg/household/day) | 4.74 | 3.73 |
| walking for exercise monthly freq. | 13.91 | 14.23 |
| walk to work/school monthly freq. | 7.97 | 8.44 |
| bicycle for exercise monthly freq. | 0.57 | 0.65 |
| bicycle to work/school monthly freq. | 1.26 | 2.54 |
| daily energy expenditure (kcal/kg/day)[73] | 1.40 | 1.55 |
| body mass index | 24.92 | 24.86 |
| high blood pressure (likelihood) | 7.82% | 7.68% |

**Unweighted average of postal code values*

# Vision California – Urban Footprint

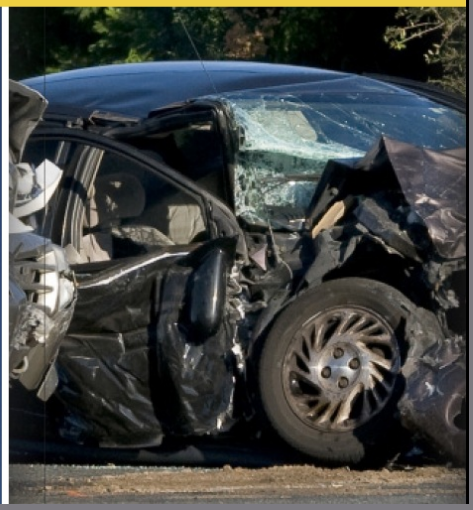
# CALIFORNIA'S URBAN FOOTPRINT MODEL

| Data source | Sample | Built environment inputs | Spatial unit for built environment analysis | Demographic/ socioeconomic inputs | Health outcomes |
|---|---|---|---|---|---|
| **King County Neighborhood Quality of Life Study (NQLS)** | 1,228 adults | Walkability (composed of land use mix, street connectivity, net residential density, and floor-to-area ratio) | 1-kilometer buffer of respondent's home | Gender, age, education, ethnicity, number of children under 18, household income, vehicle ownership | BMI, objectively measured levels of physical activity, depressive symptoms, social cohesion |
| **SMARTRAQ Atlanta Regional Commission Household Travel Survey** | 16,873 participants 5 years or older | Walkability (composed of land use mix, street connectivity, net residential density) | 1-kilometer buffer of respondent's home | Gender, age, education, ethnicity, number of children under 18, household income, vehicle ownership | BMI, transportation-related physical activity, time spent in automobiles, social cohesion |

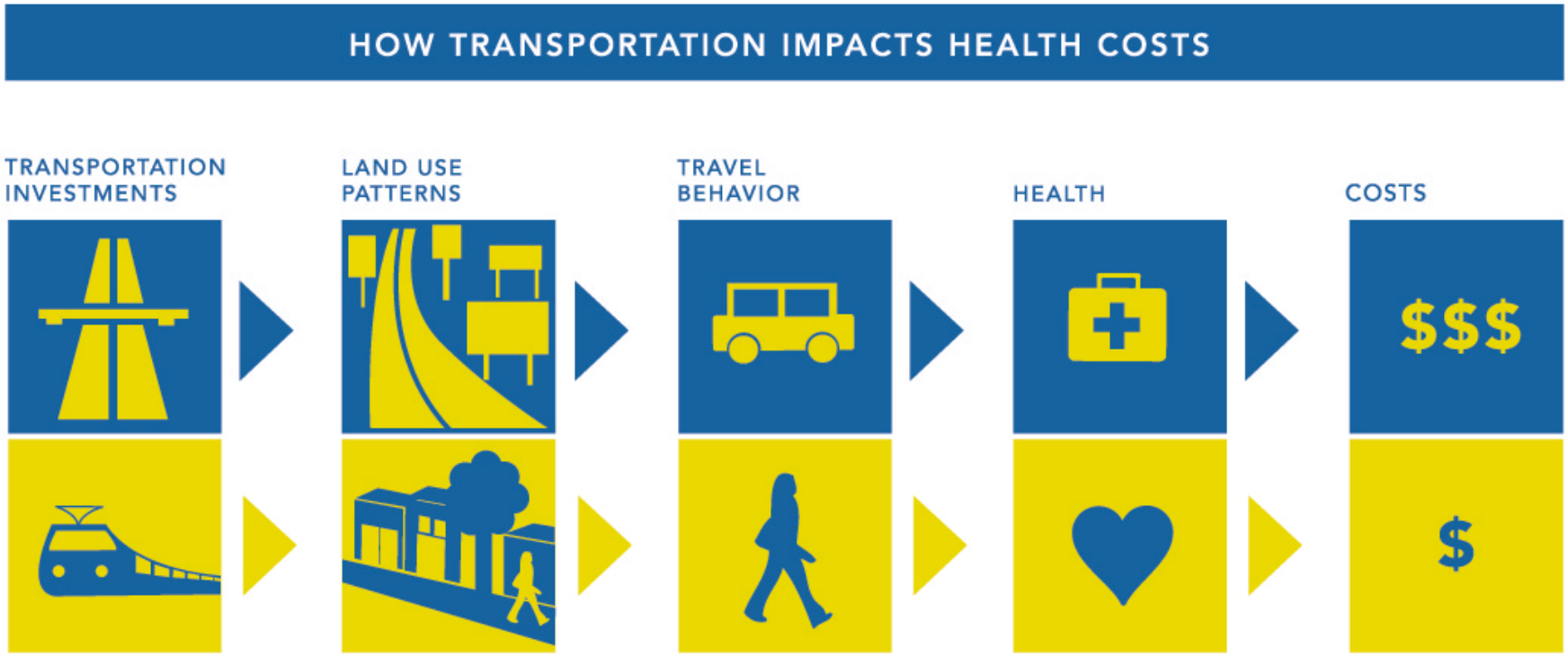

San Diego:
Predicted
MVPA

# The Hidden Health Costs of Transportation

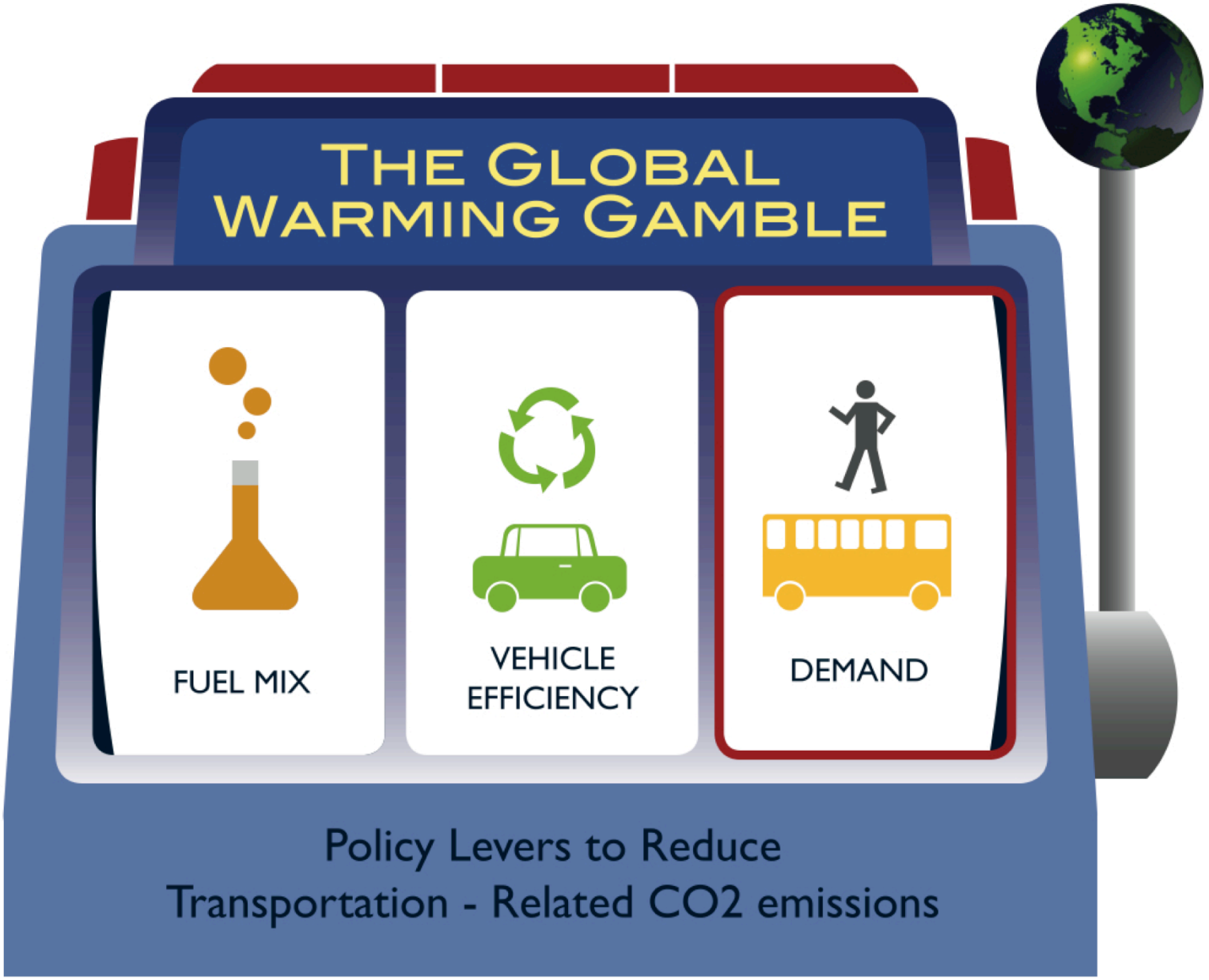


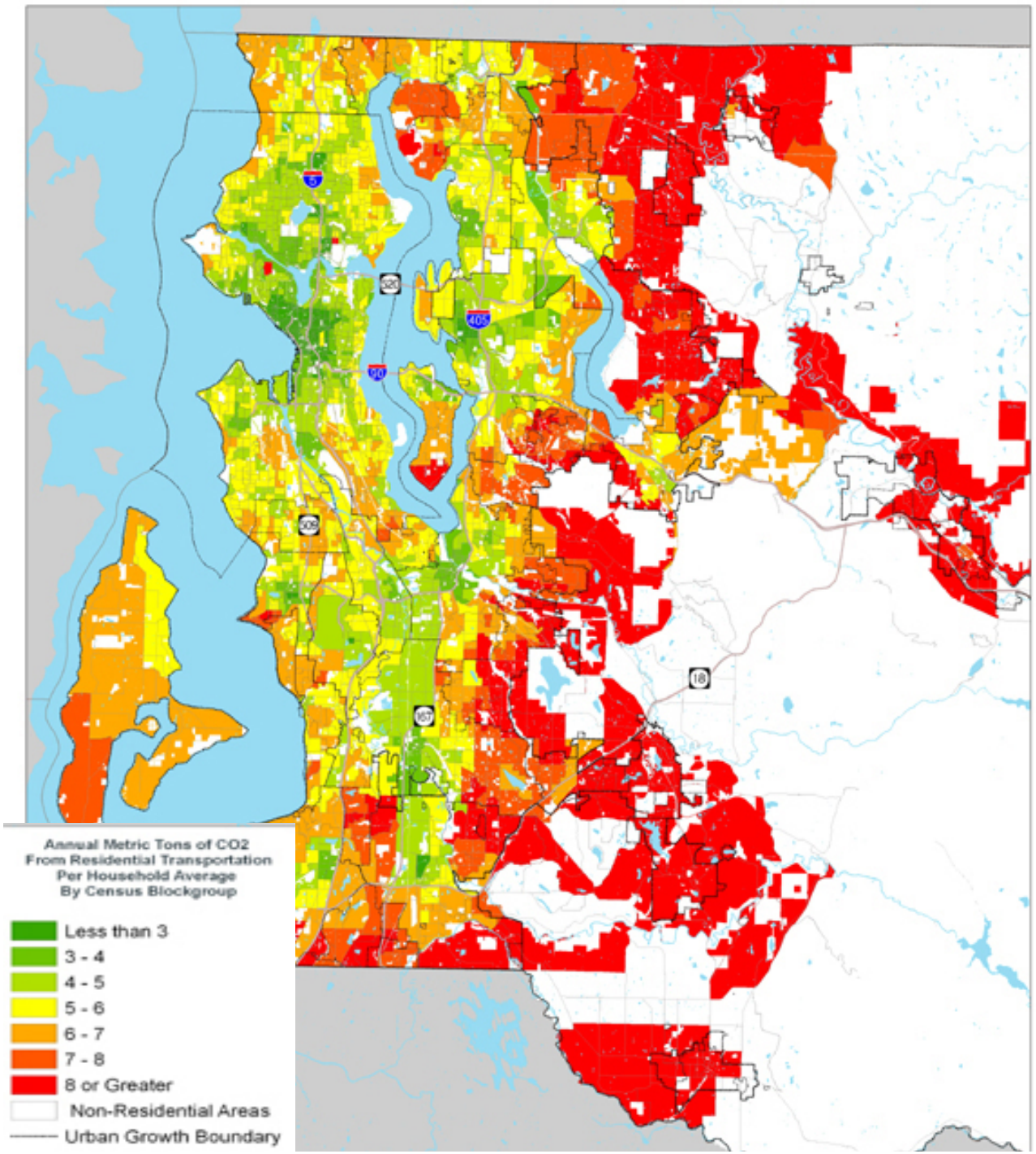



Kavage, Frank, and Kolian 2010
American Public Health Association




"The Hidden Health Costs of Transportation" - Frank et al 2010
American Public Health Association


THE GLOBAL WARMING GAMBLE
FUEL MIX
VEHICLE EFFICIENCY
DEMAND
Policy Levers to Reduce
Transportation - Related CO2 emissions




# Final Map of CO2 emissions from transportation

Includes:

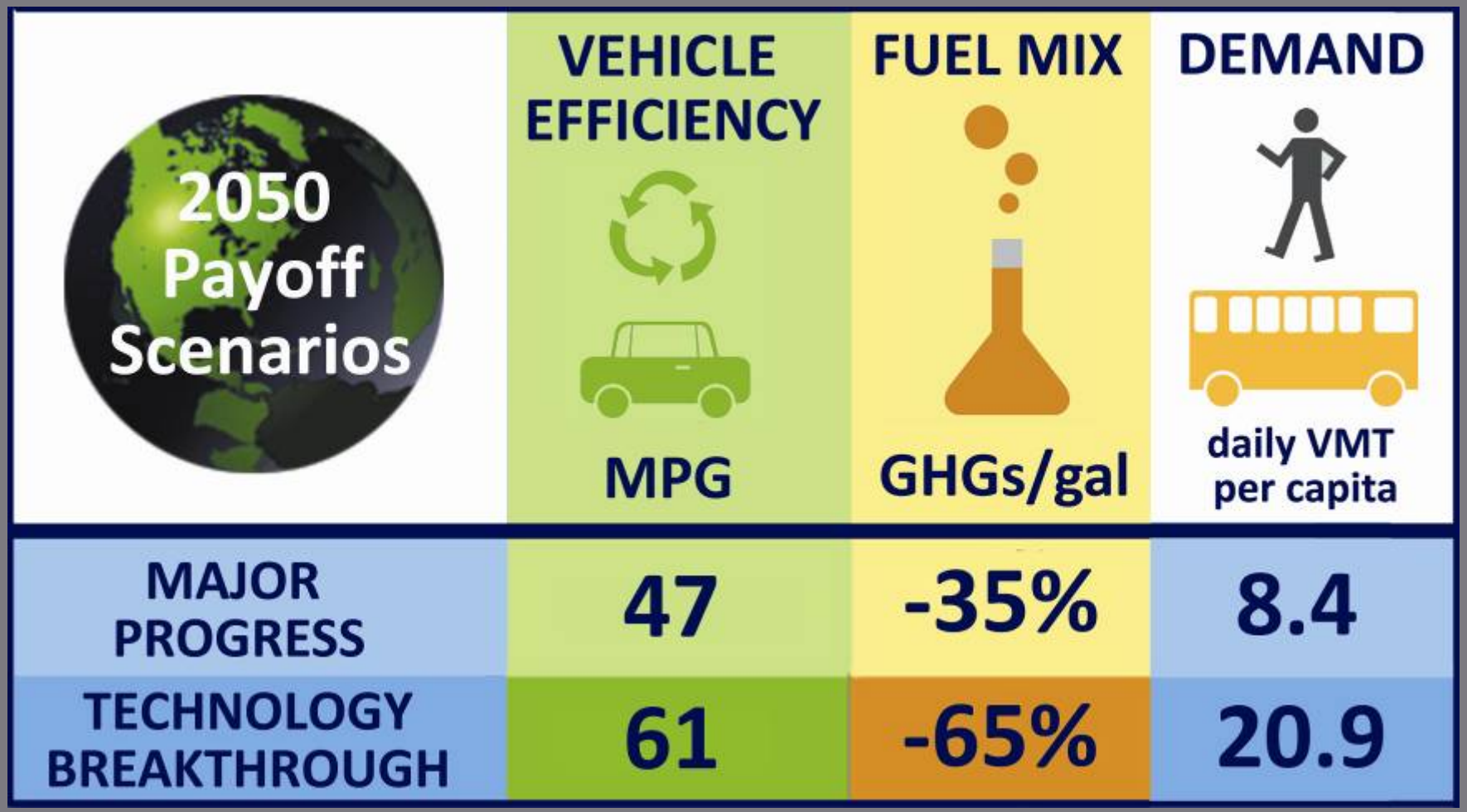
Local urban form (land use mix, intersection density, retail FAR)

Regional location (auto travel time

Transit accessibility & travel time

Demographics

# Driving 1/3 As Much in 2050




Brookings Draft Report – King County

# Conclusions

- Evidence is quickly mounting on the health impacts of community design
  - The ability to apply the evidence is also growing
- There is a latent demand for walkable places
  - More research is needed to understand the type of gaps between supply of and demand for residential environments
- Designing communities that fully integrate health care is essential to meet health and environmental goals of the 21rst Century


Quality
of Life
Environmental Quality
Air Quality and Greenspace
Human Behavior
Travel Patterns and Physical Activity
Built Environment
Transportation Investments and Land Use

*For More Info:*

*WWW.UD4H.COM*