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

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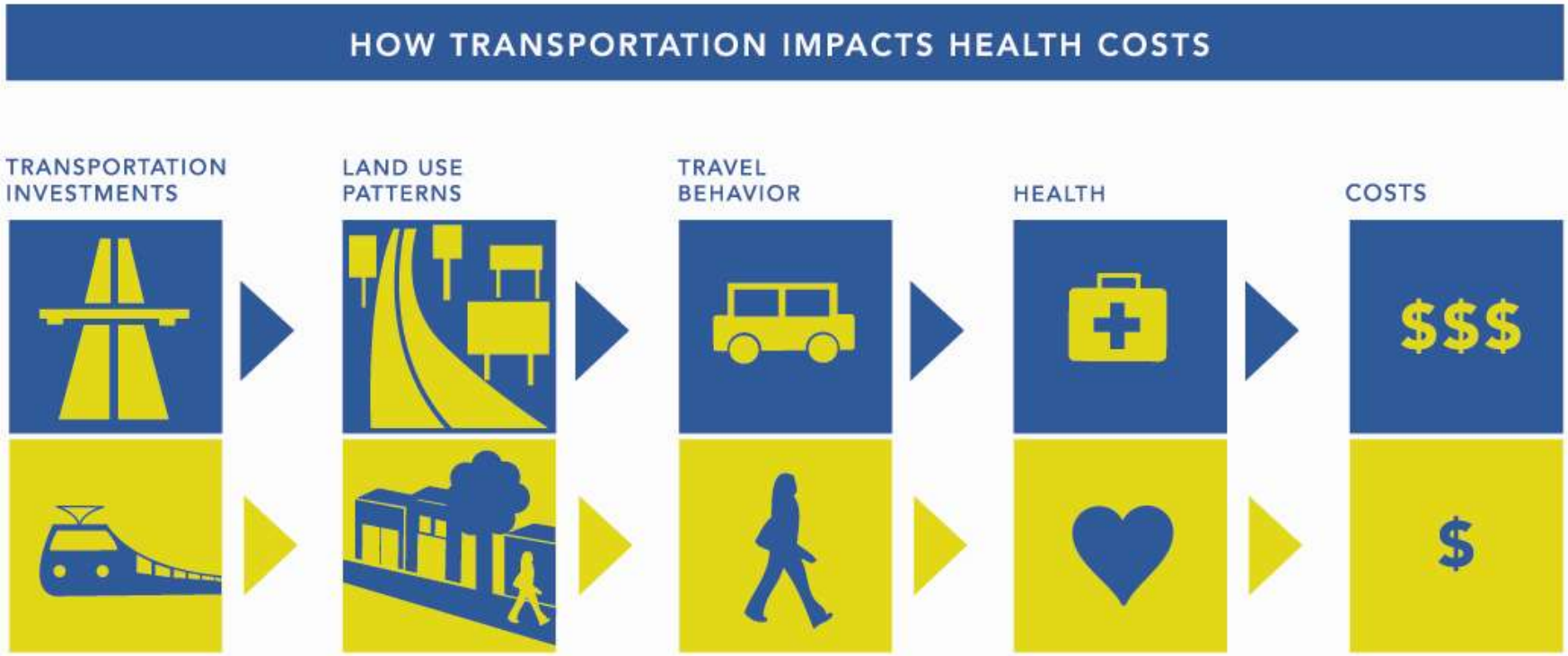
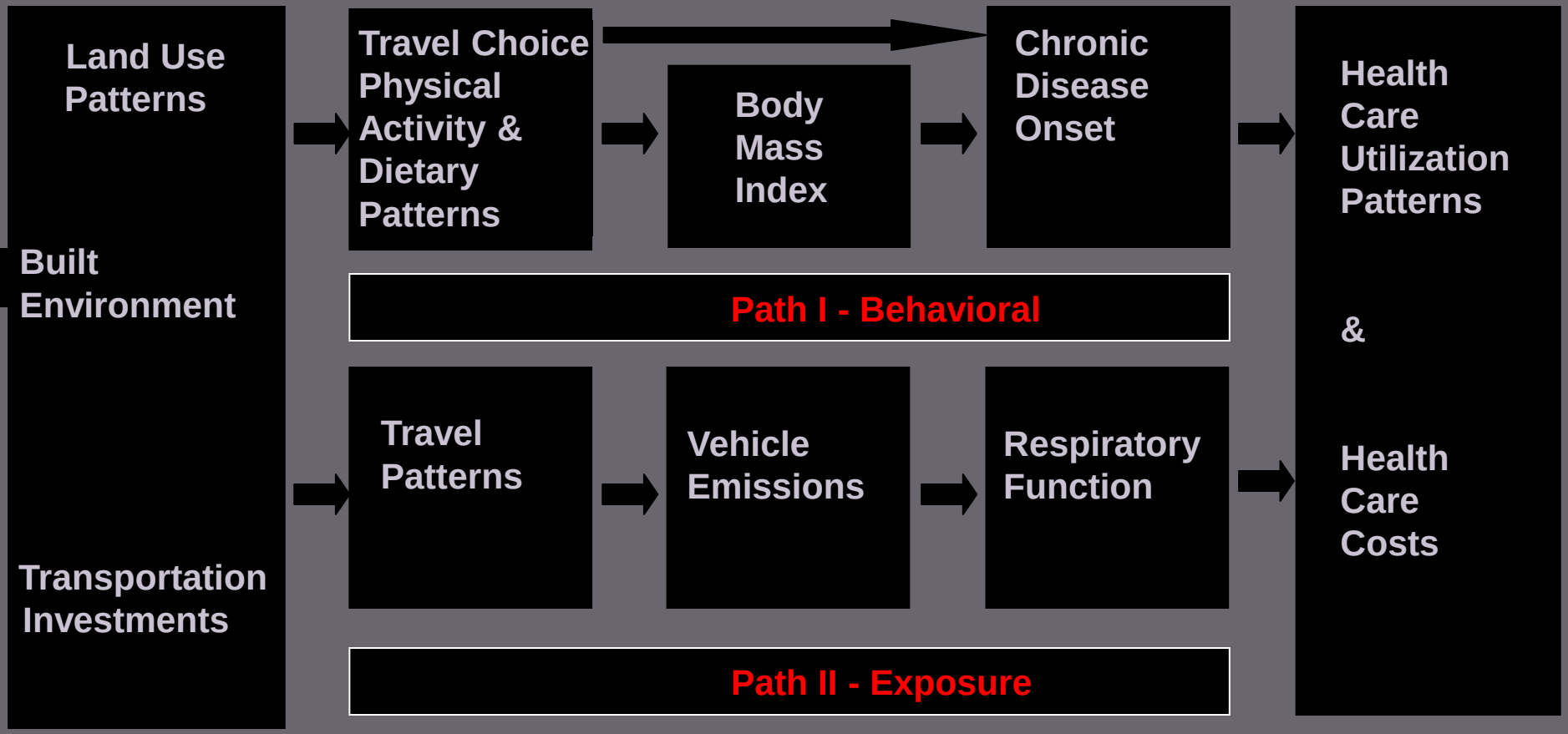


“The Hidden Health Costs of Transportation” - Frank et al 2010
American Public Health Association

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

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 reduce 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

The Hidden Health Costs of Transportation

Kavage, Frank, and Kolian 2010
American Public Health Association


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

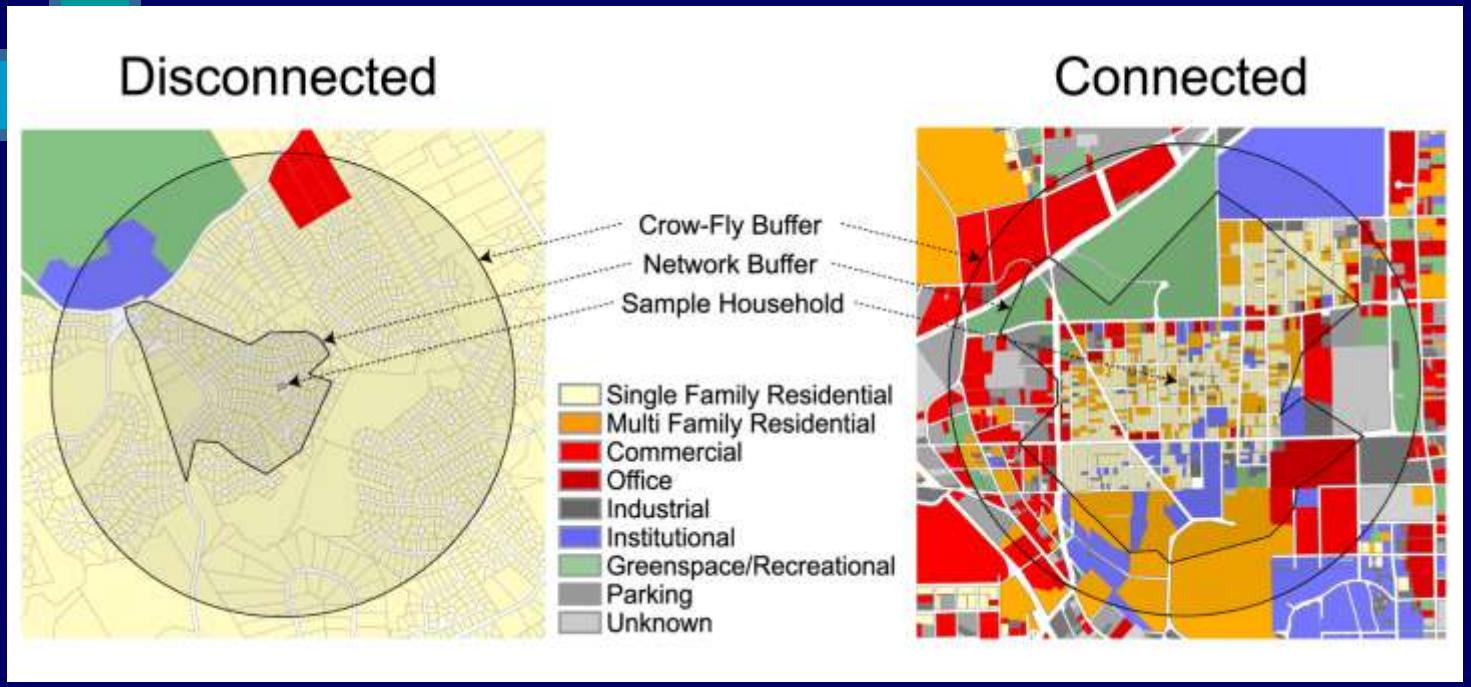
Why Should we care?

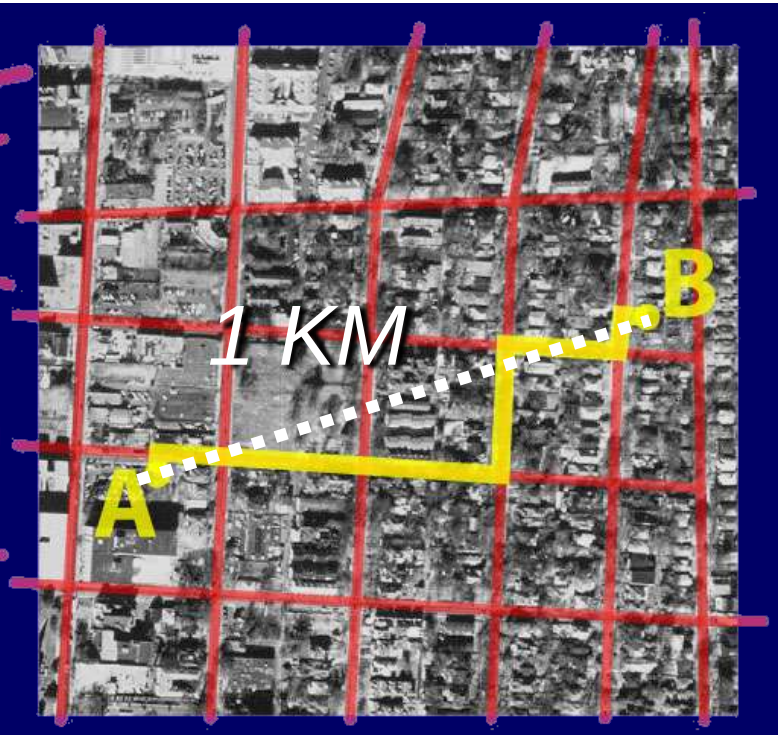
- Health Care Costs
  - Changes in health care system service delivery
    - Affordable care act & Health District Planning
- GHG Impacts and Co-Benefits
  - Energy Security
- Aging population need easy access to facilities
  - Reduced response time
  - increased efficiency of case management
- Meeting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

The Silver Tsunami

- California will see its 65-plus population more than double from 3.5 million in 2000 (10.6 percent of the state's population) to 8.2 million in 2030 (17.8 percent).
  - Where will the 65-plus population live?
  - Access to services, Less reliance on driving for safety reasons, Maintaining Independence
- Lack of Affordable Housing in Walkable Places
  - Cost of service delivery with Aging in central / walkable versus peripheral / unwalkable unbikeable places

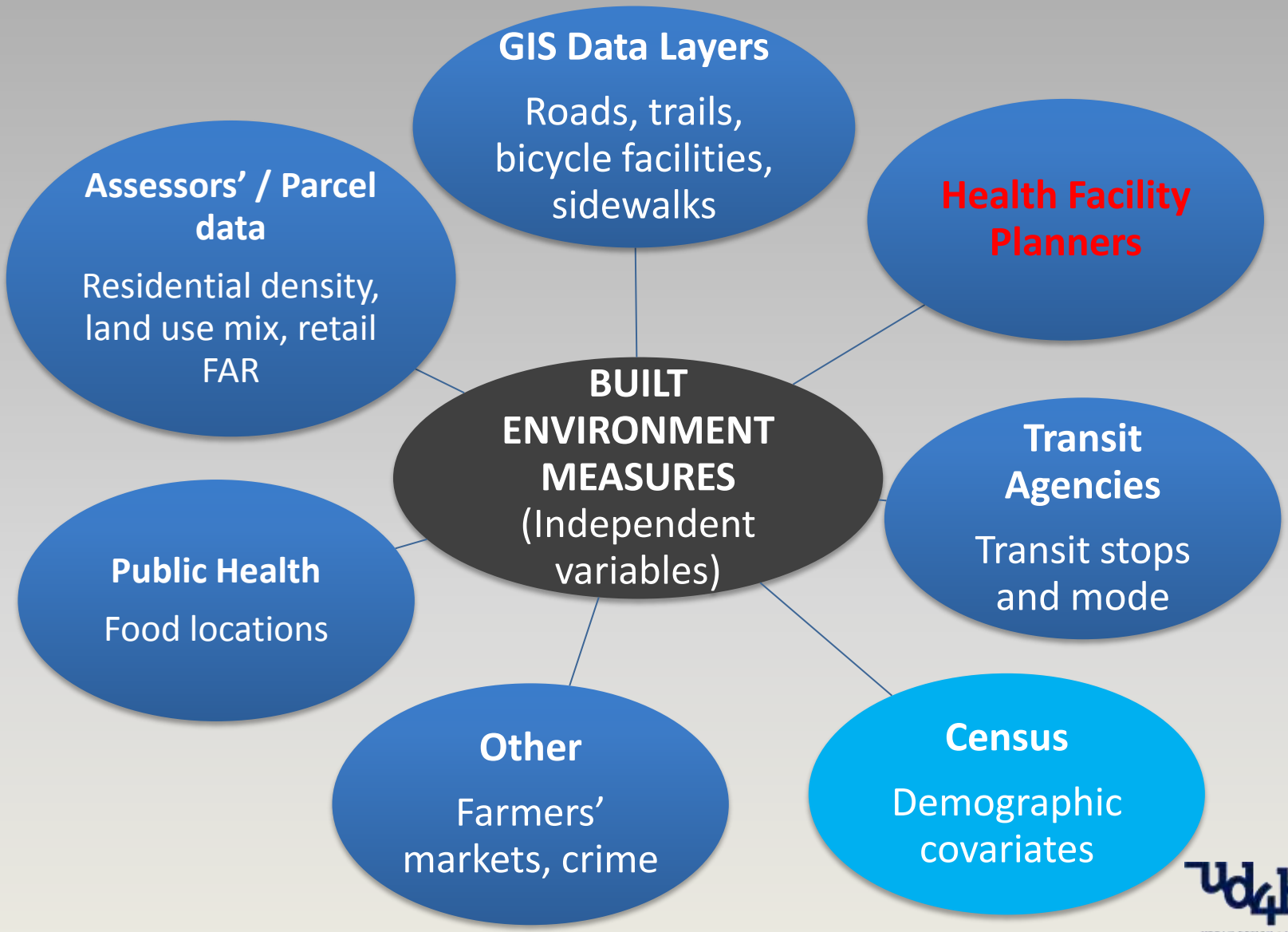
Proximity





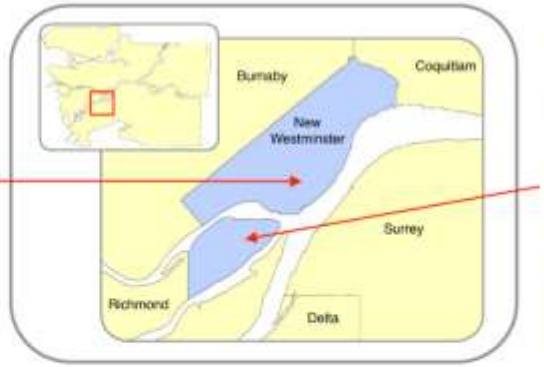
Connect-ivity

Built Environment Data Sources

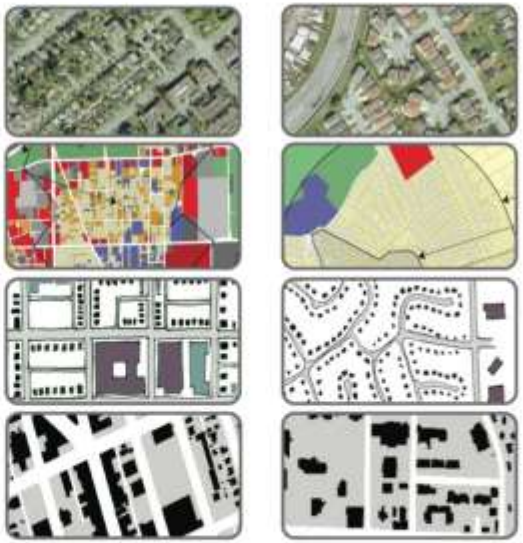


ud4h
URBAN DESIGN 4 HEALTH

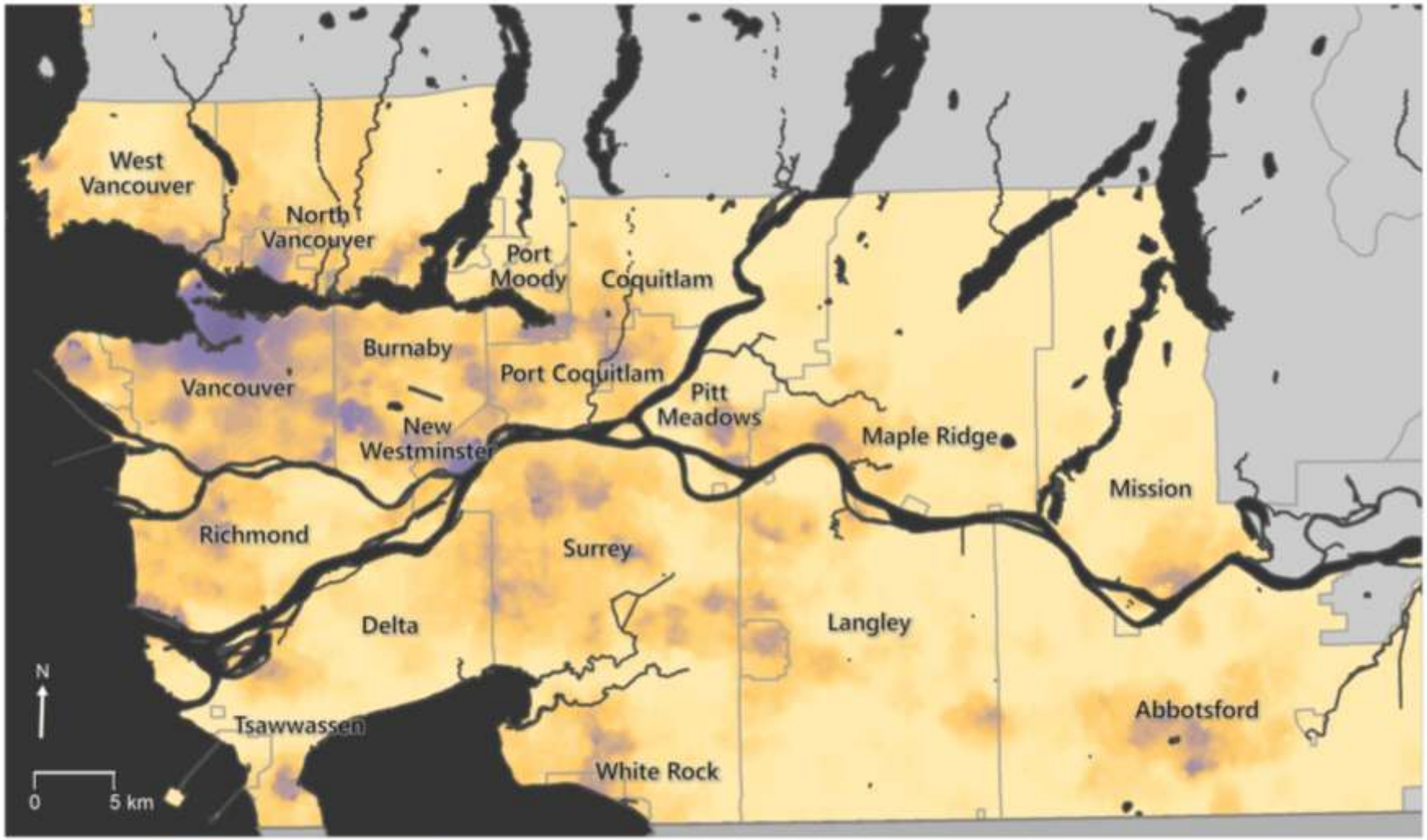
Comparing Two Communities



	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



Transit Use and Physical Activity

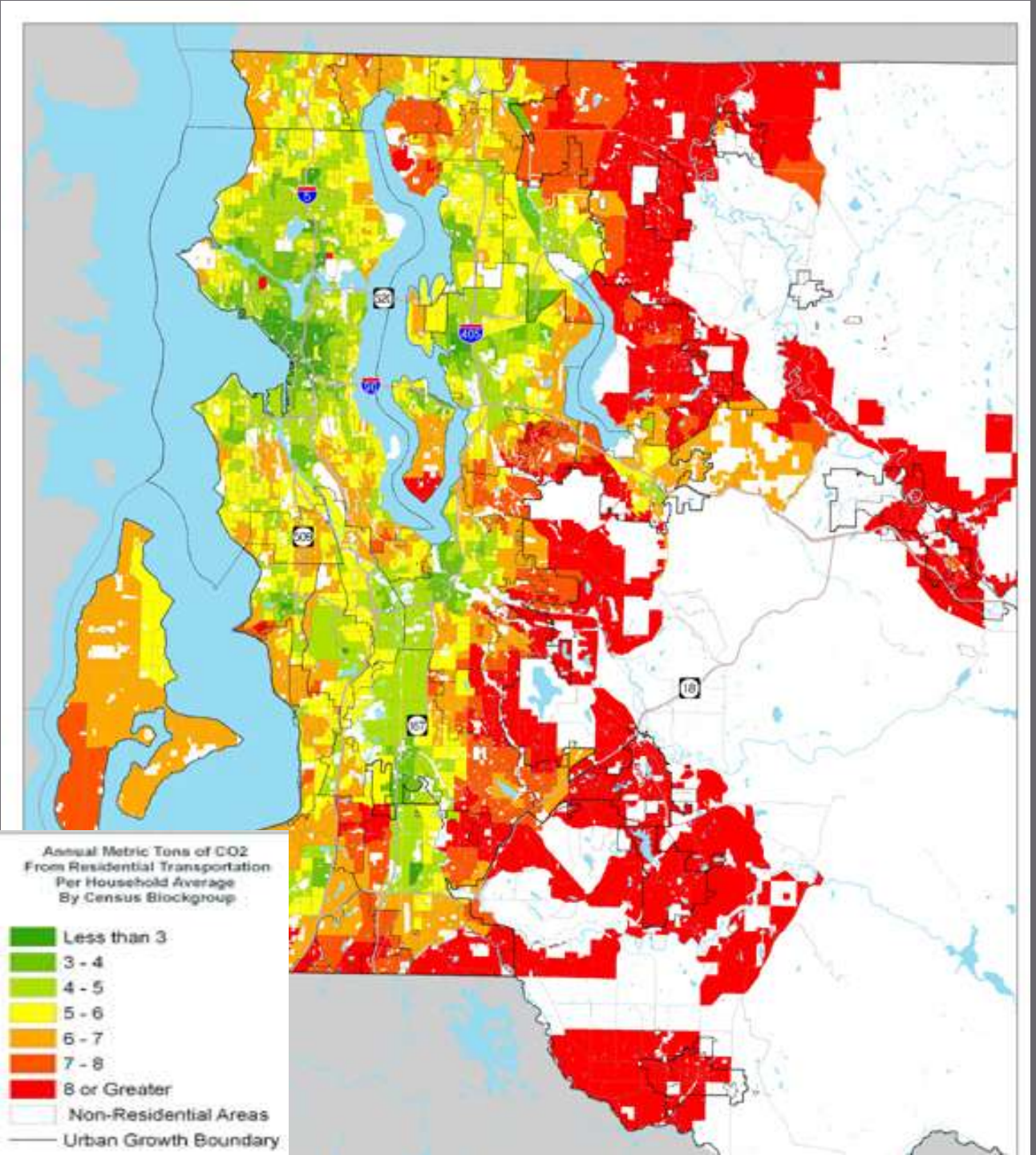
- Transit use was significantly associated with greater odds of meeting physical activity recommendations (OR=3.42; CI=2.40-4.87)
  - by walking for transportation
- The odds of meeting 30 minute Physical Activity Recommendation is negative for additional trips as a car driver when compared to moderate walking (OR =.87; CI=0.76-0.99)

Source: LaChapelle and Frank JPAH, *2009*

Physical Activity Case Study: Estimated Costs Savings from Walkable Urban Design

Land Use/Urban Design Characteristics	Change in Amount of Walking (Miles, over a two-day period)		Number of Persons Who Will Move from First to Second Tertile of Physical Activity		Annual Lives Saved		Present Discounted Value (in Dollars)	
	Low (median–75th percentile)	High (median-95th percentile)	Low	High	Low	High	Low	High
Street connectivity (intersection density)	0.3816	1.1844	22.79	78.59	0.0456	0.1572	$2,255,107	$23,205,007
Retail employment density (retail 0.0652 jobs/square mile	0.0652	0.9734	4.72	62.09	0.0094	0.1242	$466,574	$18,331,955
Total employment density (jobs/ 1.0648 square mile)	0.0019	1.0648	1.57	66.02	0.0031	0.1320	$155,525	$19,492,206
Population density (persons/ square mile)	0.2581	0.549	15.72	28.29	0.0314	0.0566	$1,555,247	$8,353,802
Distance to central business district (miles)	–0.8108	–2.5054	45.58	209.05	0.0912	0.4181	$4,510,215	$61,725,318


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

2050 Payoff Scenarios	VEHICLE EFFICIENCY MPG	FUEL MIX GHGs/gal	DEMAND daily VMT per capita
MAJOR PROGRESS	47	-35%	8.4
TECHNOLOGY BREAKTHROUGH	61	-65%	20.9

Brookings Draft Report – King County

Enhancing Walk Score's Ability to Predict Physical Activity and Active Transportation

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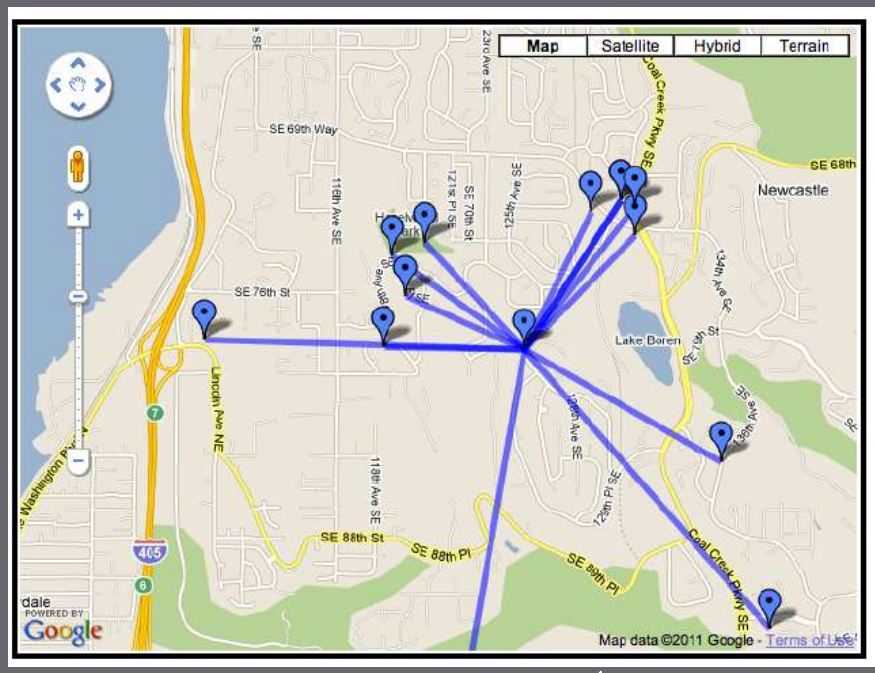
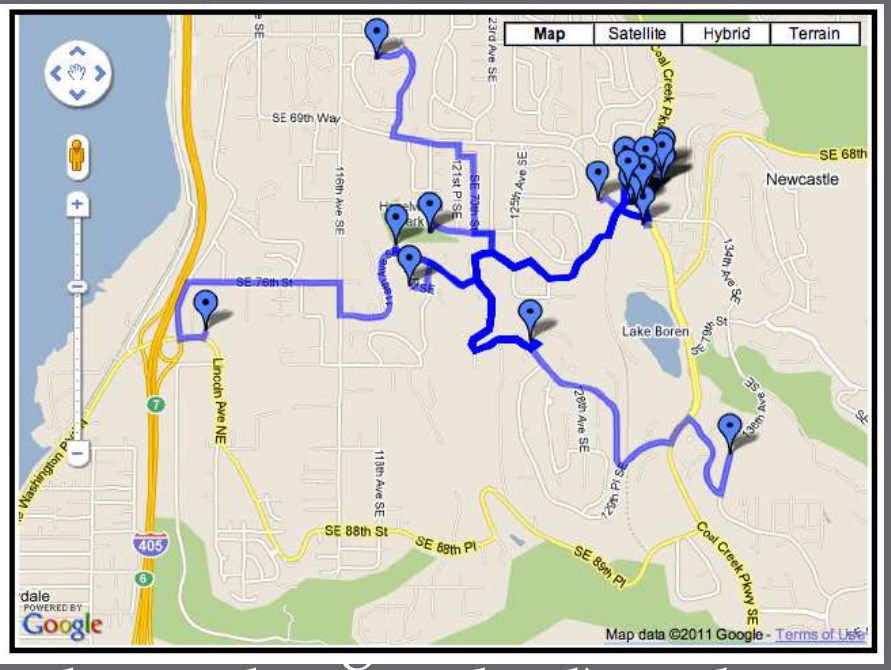
Phase I

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





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**

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

Recommended Walk Score components and weights

Walk Score component	Adult	Senior	Teen	Child
Banks	.04	.12	.09	-
Books	.18	.04	.10	-
Parks	.18	.24	.08	.16
Coffee	.26	.26	.23	-
Entertainment	.10	.11	.13	.12
Grocery	.04	.08	.08	-
Restaurants/bars	.04	.01	.04	-
Shopping	.05	.08	.08	.09
Link:node ratio	.10	.06	.17	-
Average block length	-	-	-	.63

Note: weights sum to 1.00 for each age cohort

Vision California – Urban Footprint

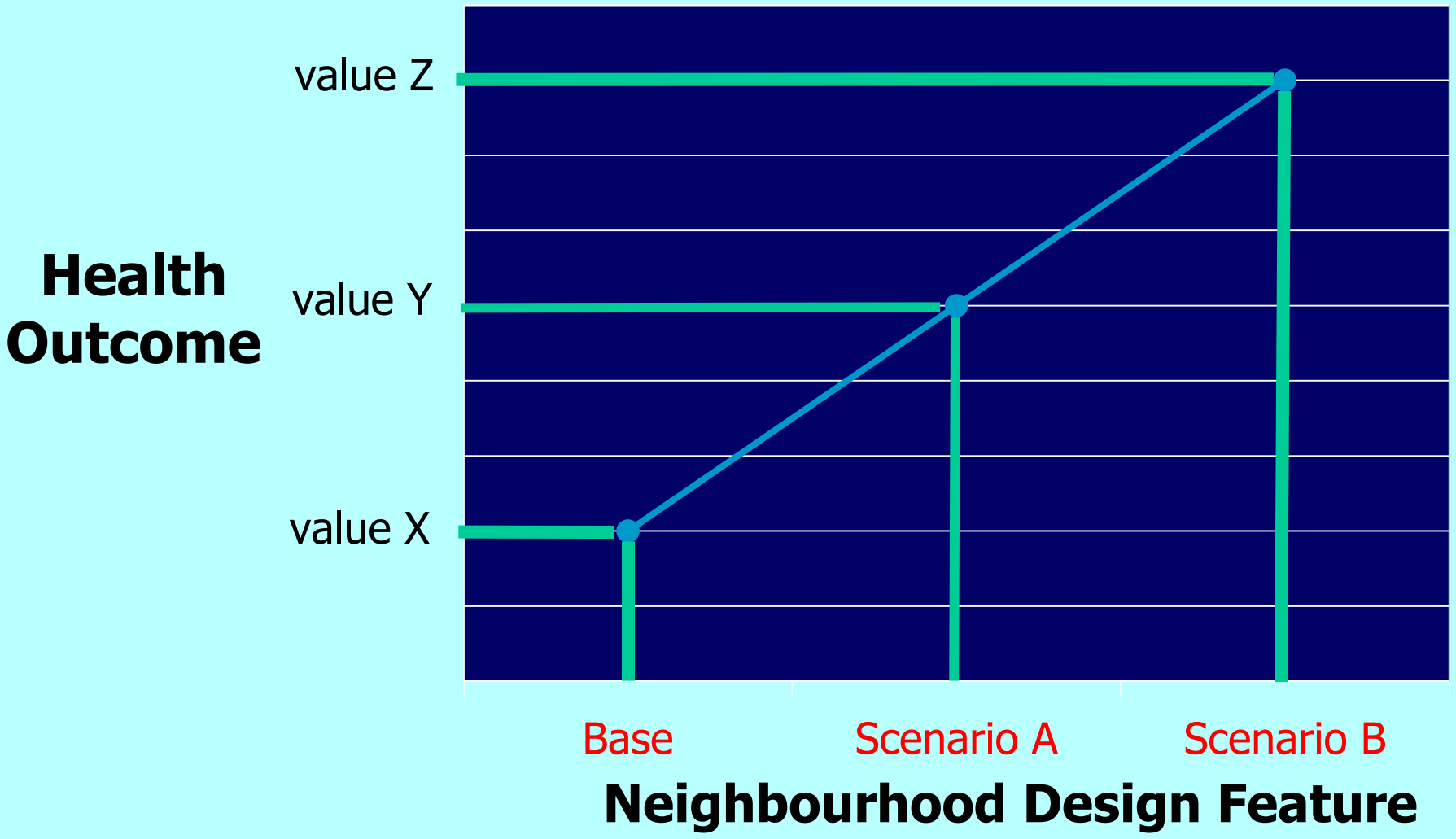
Evidence based research on relationships
(regression models)

Urban Form Patterns
Residential Density
Land Use Mix
Street Network Connectivity
Retail Floor Area Ratio

Outcomes
Physical activity
Obesity / Body Mass Index
Transportation patterns
Greenhouse gas -- CO2

Integrate findings into existing software

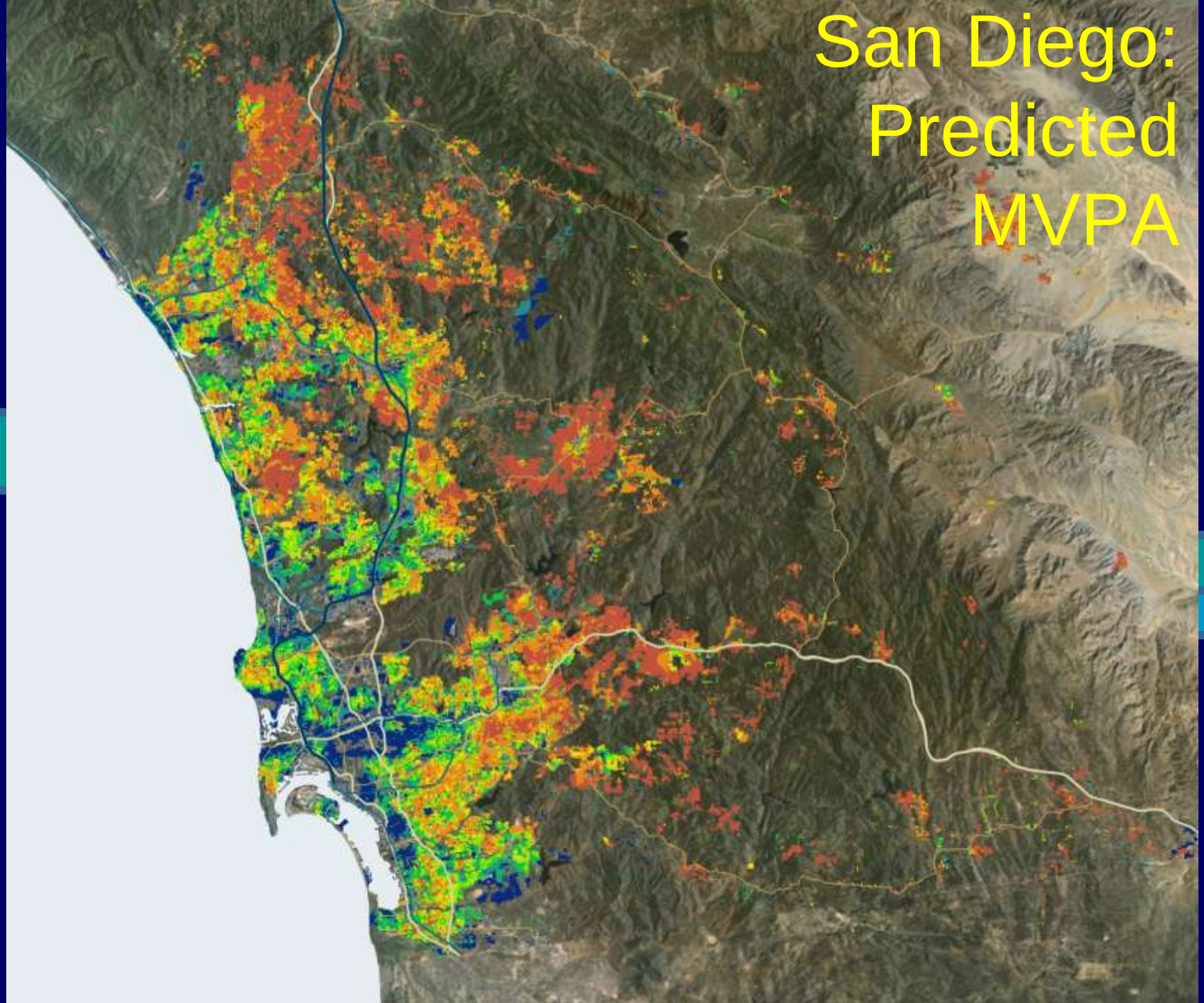
Calculated Outcome Changes



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



SANDAG Healthy Works CPPW / ARRA Grant

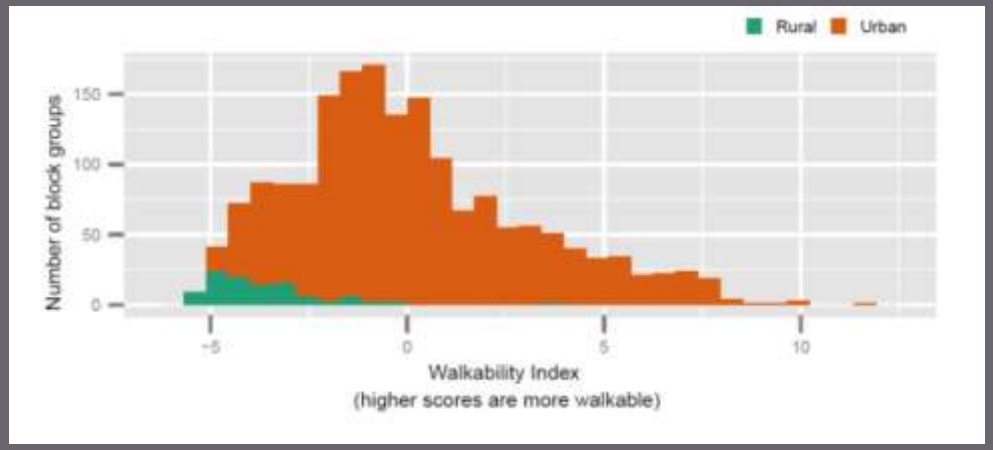
Many Innovations

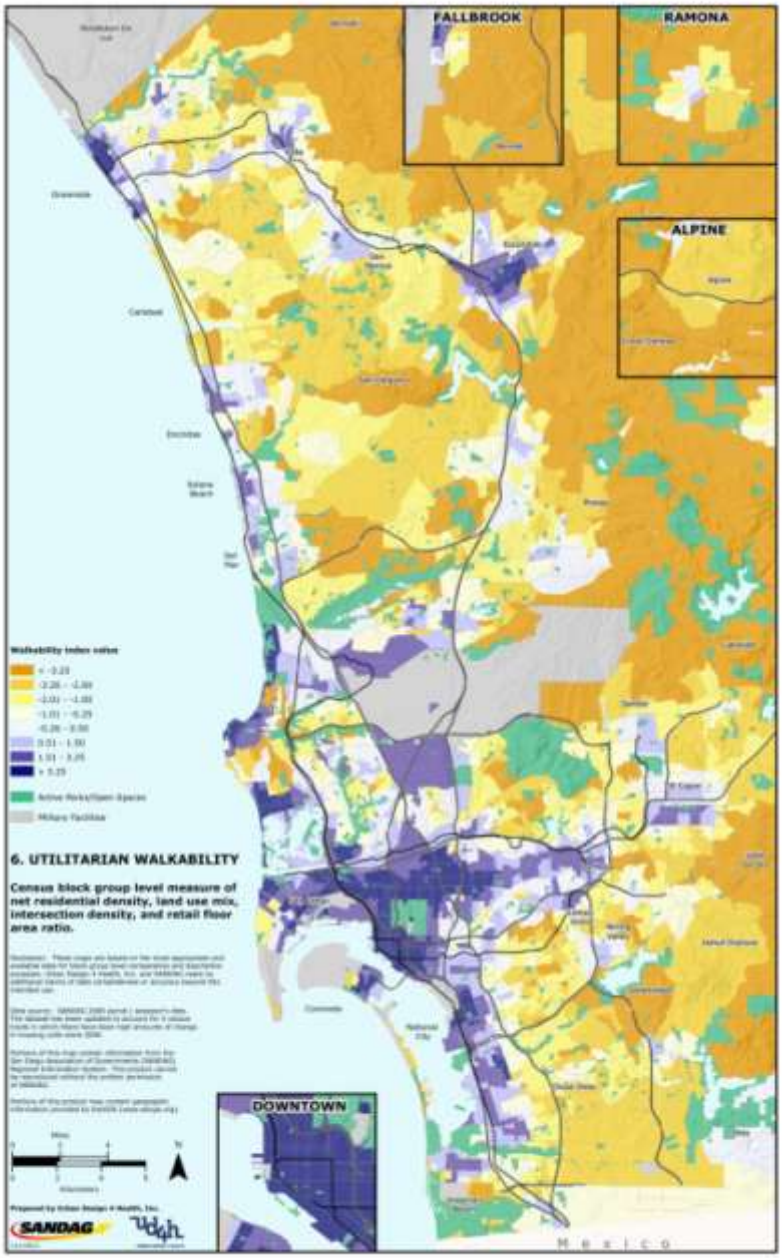
- First large scale study to spatially match a prevalence (health outcome dataset - Calif. Health Interview Survey) with detailed parcel level built environment measures
  - Piloted in San Diego County N= appx 18000
- One of 3 efforts to date that have imported elasticities linking local (walkability) 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

Utilitarian Walkability

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

Regional walkability distribution, by block group



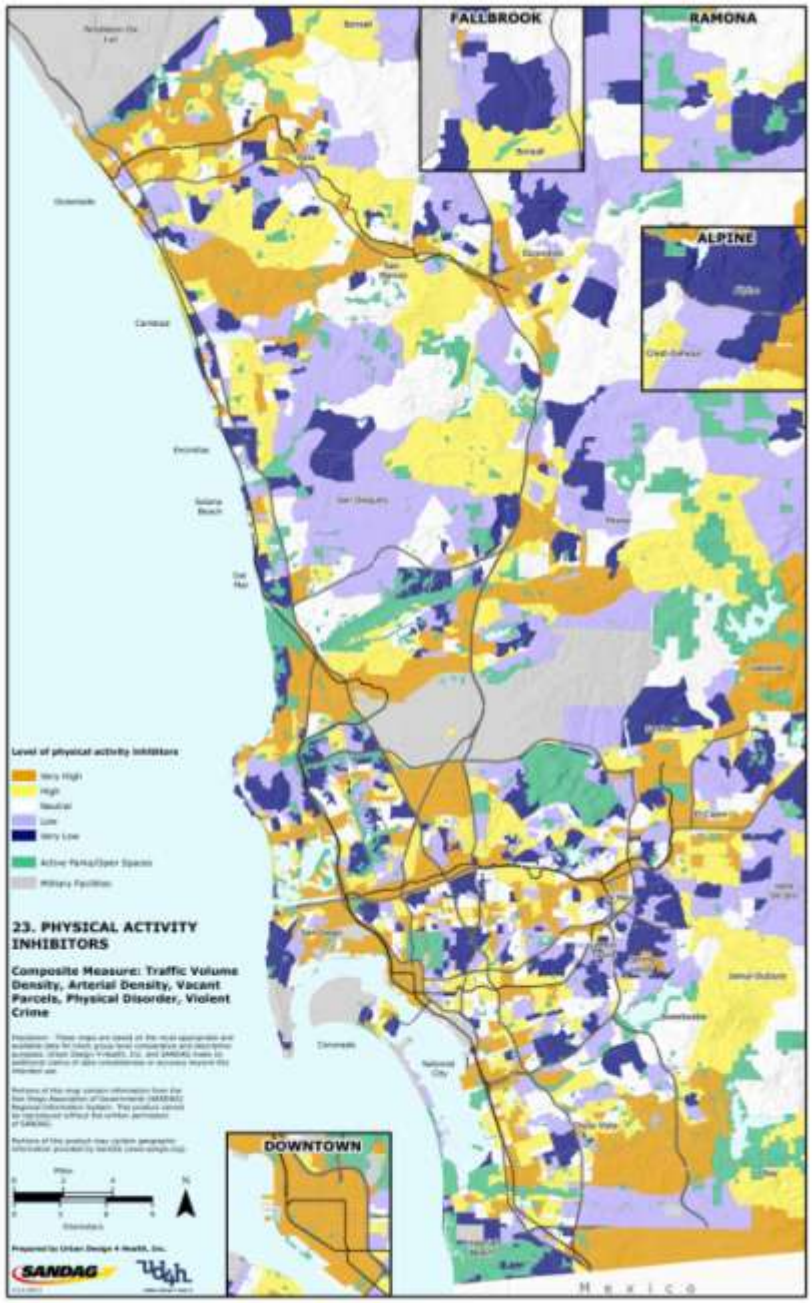


Physical Activity Inhibitors: Composite Map Methodology

Made up of the following Base Maps:

- Traffic Volume Density
- Arterial Density
- Vacant Parcels
- Physical Disorder
- Violent Crime

- To calculate the composite score:
- Each Base Map measure was given a standardized value (z-score) for each block group.
- The final composite score per block group is the average of the Base Map z-scores.
- Block groups were separated into quintiles (5 groups with equal numbers of block groups in each) based on their composite score.
- Although only the western third of the region is shown in the map, the analysis is based on all 1,762 block groups in the San Diego region.



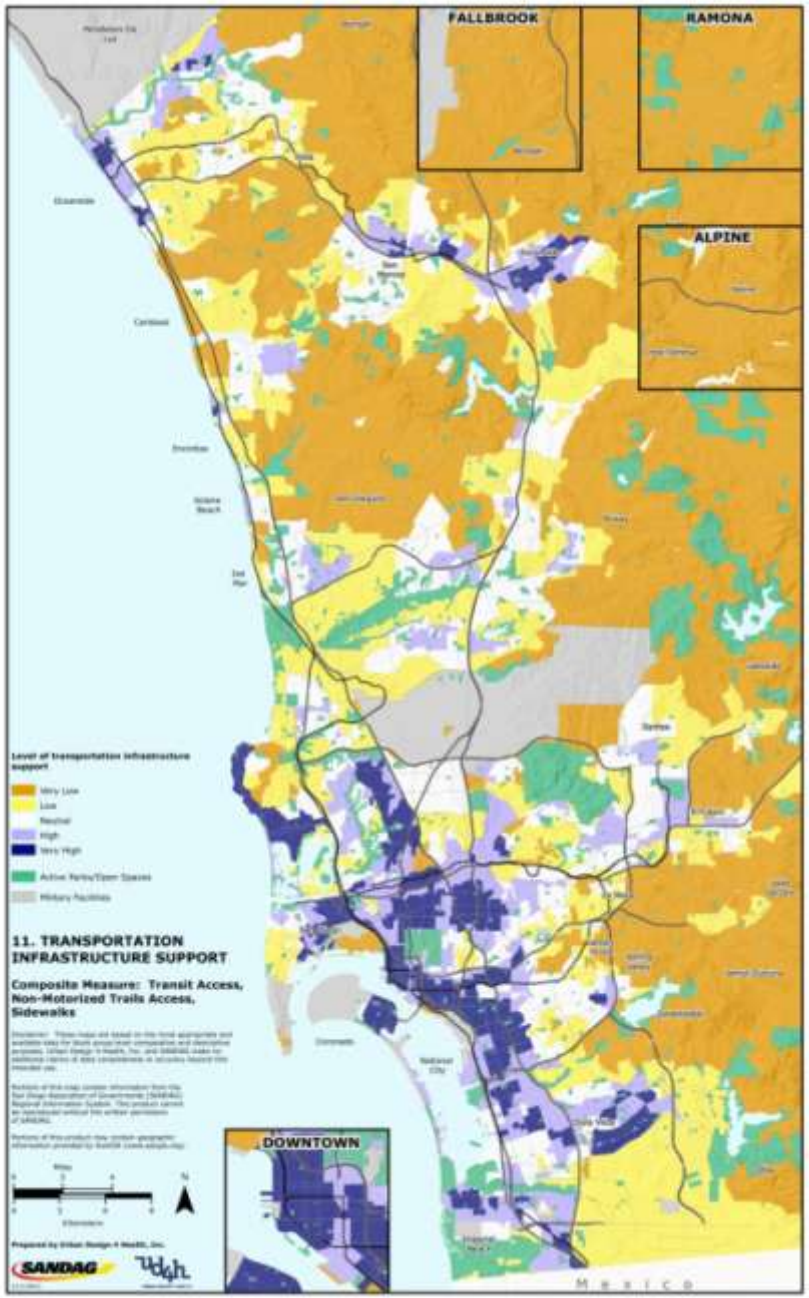
Transportation Infrastructure Support: Composite Map Methodology

Made up of the following Base Maps:

- Access to Transit
- Sidewalks
- Non-motorized Trails Access

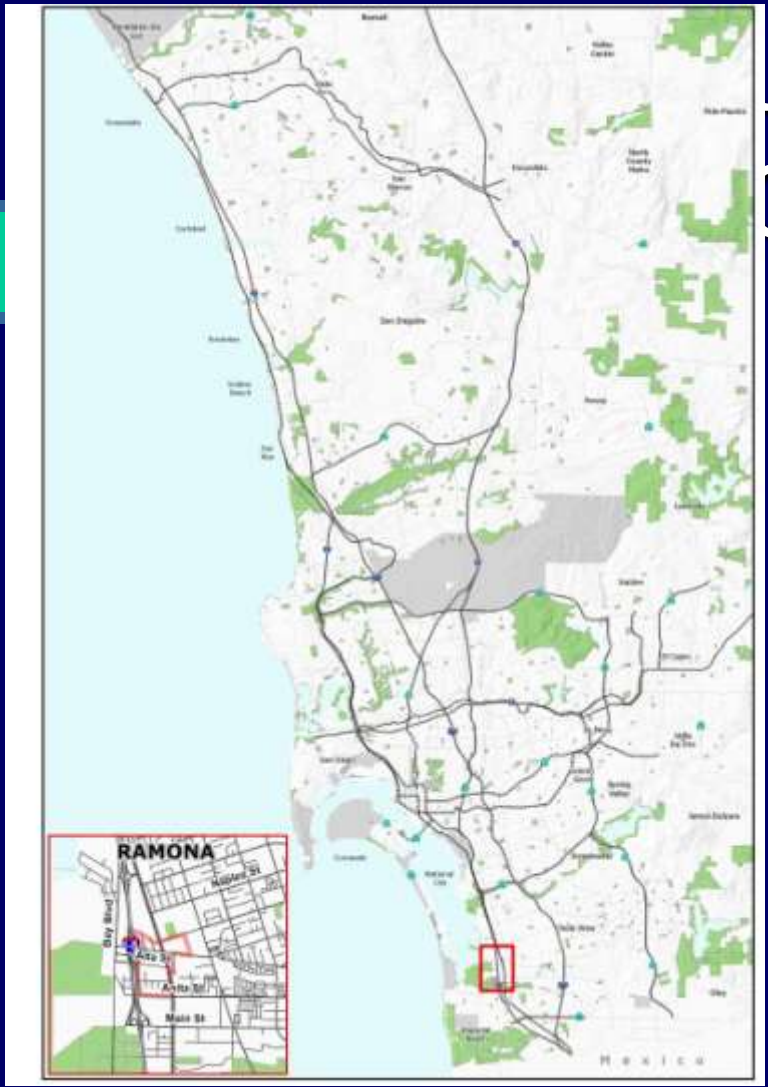
To calculate the composite score:

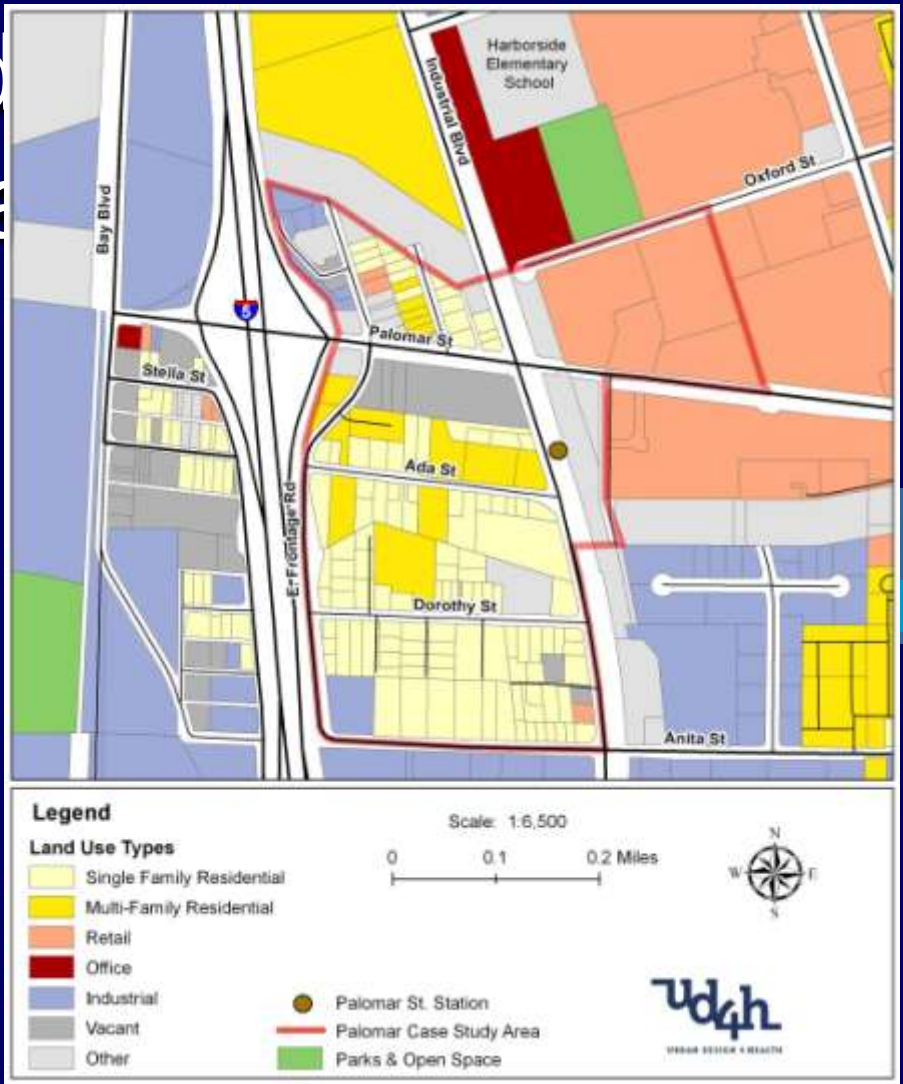
- Each Base Map measure was given a standardized value (z-score) for each block group.
- The final composite score per block group is the average of the Base Map z-scores.
- Block groups were separated into quintiles (5 groups with equal numbers of block groups in each) based on their composite score.
- Although only the western third of the region is shown in the map, the analysis is based on all 1,762 block groups in the San Diego region.



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


RAMONA
Bay Blvd
Main St
Mexico


Harborside Elementary School
Industrial Blvd
Oxford St
Bay Blvd
Palomar St
Stella St
Ada St
E. Frontage Rd
Dorothy St
Anita St
Legend
Land Use Types
Single Family Residential
Multi-Family Residential
Retail
Office
Industrial
Vacant
Other
Palomar St. Station
Palomar Case Study Area
Parks & Open Space
Scale: 1:6,500
0
0.1
0.2 Miles
N
W
E
S

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 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	68393	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)

Case study 2 – South Bay BRT

- Regional-scale, using an MGRA-level tool
- Analysis will identify the health impacts of introducing BRT and transit-oriented development along the South Bay BRT corridor

Contact with Nature

- Healing power of nature suggests a key feature of health districts will need to be green space
  - Designated park space
  - Key corridors linking health facilities, shops and services, and homes
- Raises economic challenge over competition for space and who pays for cost of green space
- Enhanced walking environments and green space improvements will increases land value and impact affordability

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

“If We Want More Evidence Based Practice We Need More Practice Based Evidence”

Dr. Larry Green