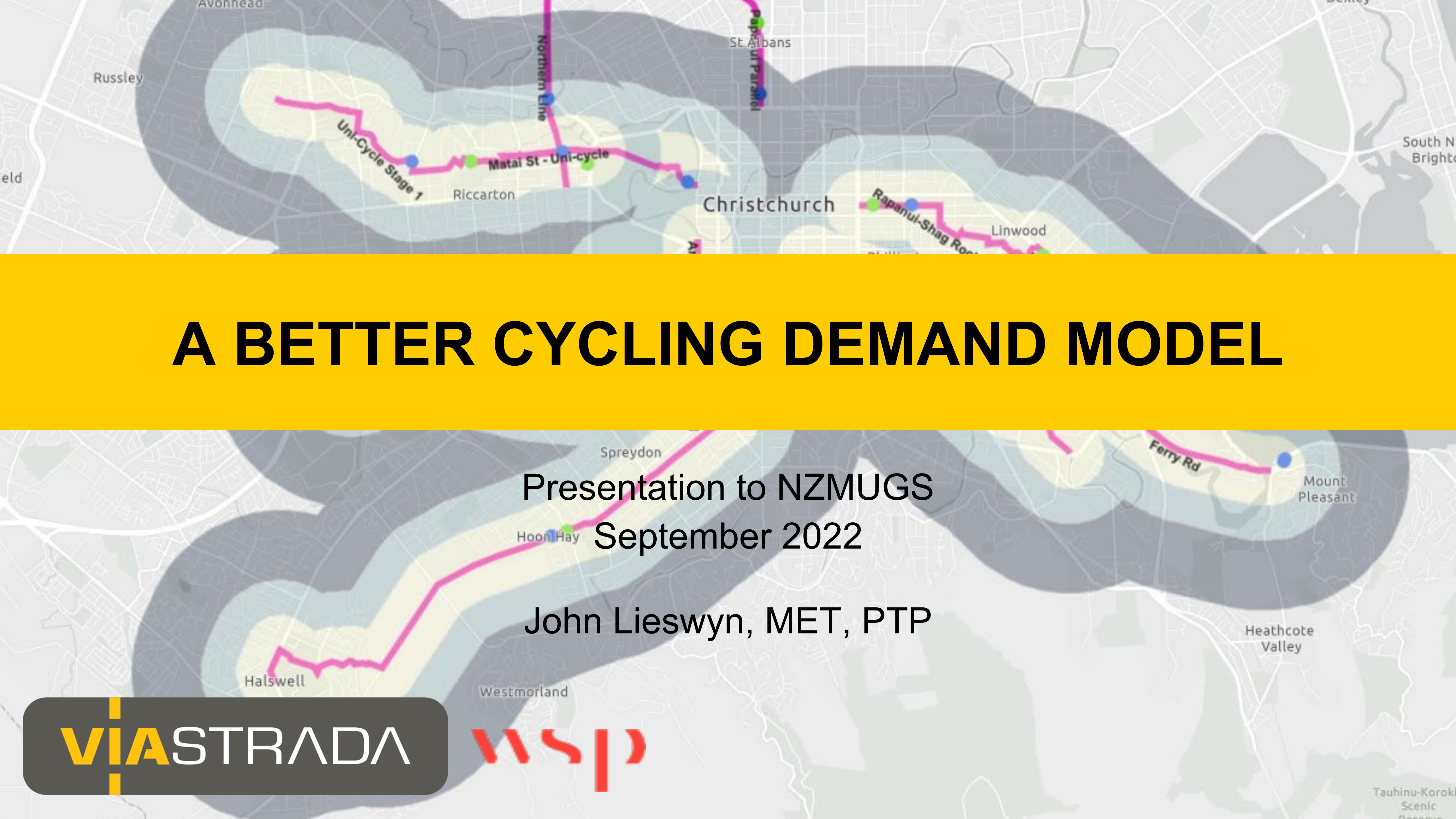


A BETTER CYCLING DEMAND MODEL

Presentation to NZMUGS
September 2022

John Lieswyn, MET, PTP

VIASTRADA

wsp

Problem

- Forecasts of cycling use are needed to develop appropriate designs, inform funding applications, and support decision making and public interest.
- The current Simplified Procedure 11 - worksheet 7 is known to substantially over-estimate demand based on population density and census journey to work inputs only.
- The current procedure is based on data taken from just two sites in the United States

Background

WAKA KOTAHI
NZ TRANSPORT AGENCY

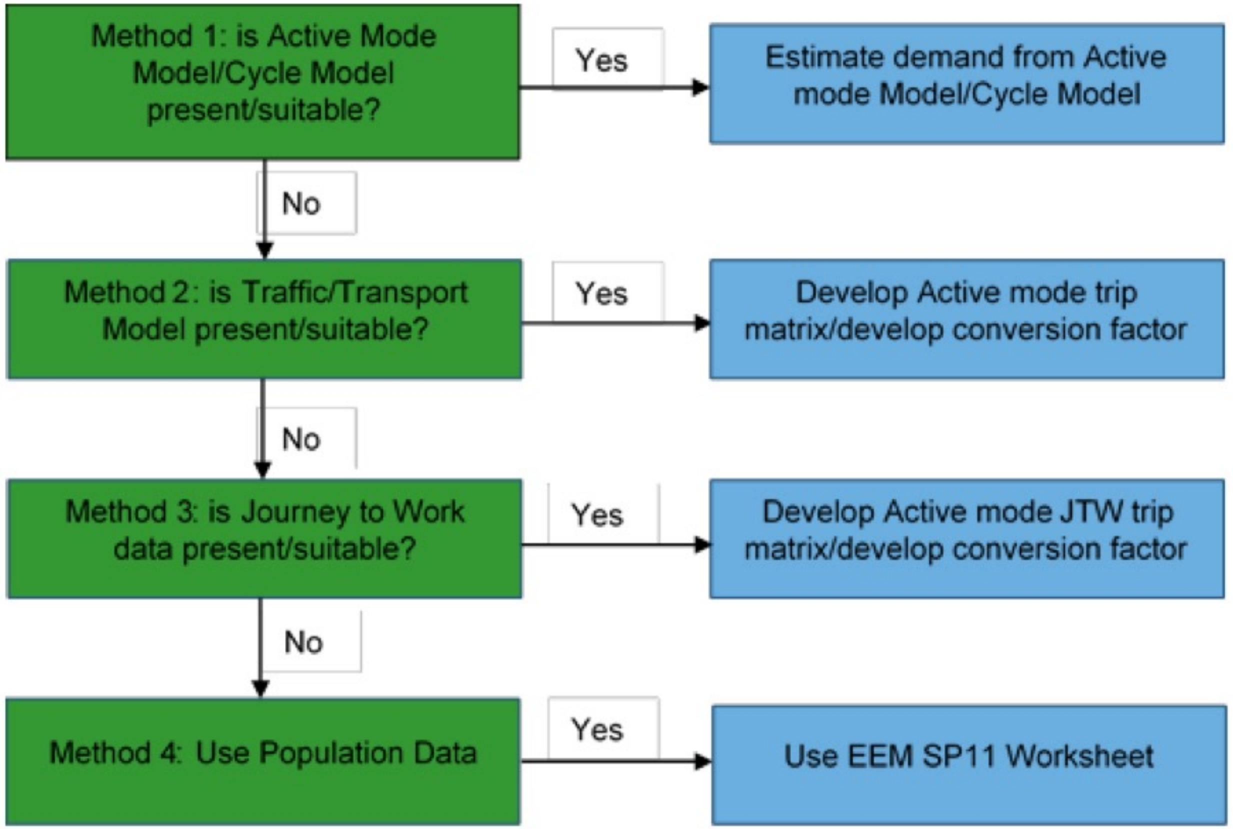
HEALTH AND ACTIVE MODES IMPACTS

A technical paper prepared for the Investment Decision-Making Framework Review

11 MARCH 2020

Waka Kotahi NZ Transport Agency is developing a new Monetised Benefits and Costs Manual (MBCM) to replace the existing Economic Evaluation Manual (EEM). Parameter values for health and active modes, including the use of e-bikes, have been updated.

Active Mode Type	2020 proposed values		Existing
	Health Benefits for New User ($/km)	Maximum Annual Benefit per New User (2018 $)	Health benefits for new User ($/km)
Conventional cycling	$2.20	$2,500	$1.30
Walking	$4.40	$1,250	$2.60
Electric assisted cycling	$1.00	$2,000	n/a



Types of cycling demand models

a. Comparison studies
b. Aggregate behaviour studies
c. Sketch planning method
d. Discrete choice models
e. Traditional demand models
f. GIS-based approaches
g. Combination of the above approaches

Source: Health and active mode impacts report (Weerappulige & Khoo, 2020)

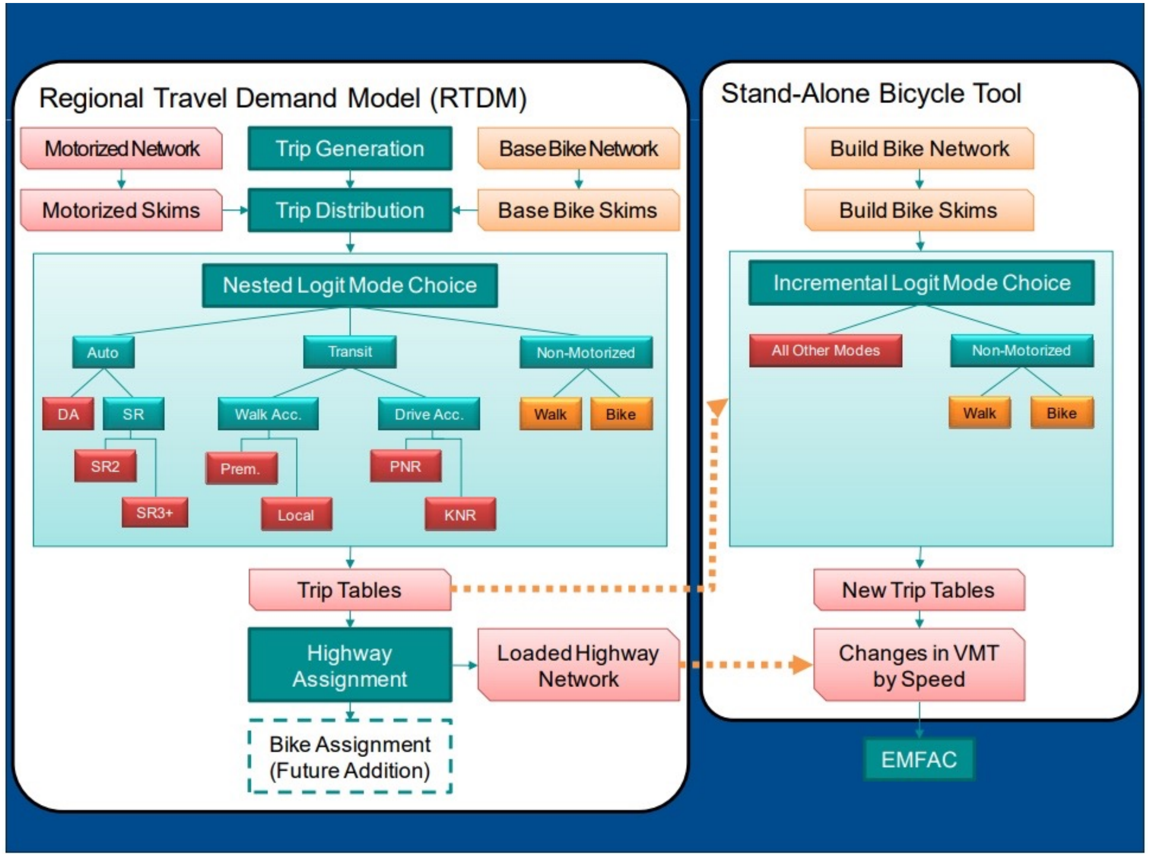
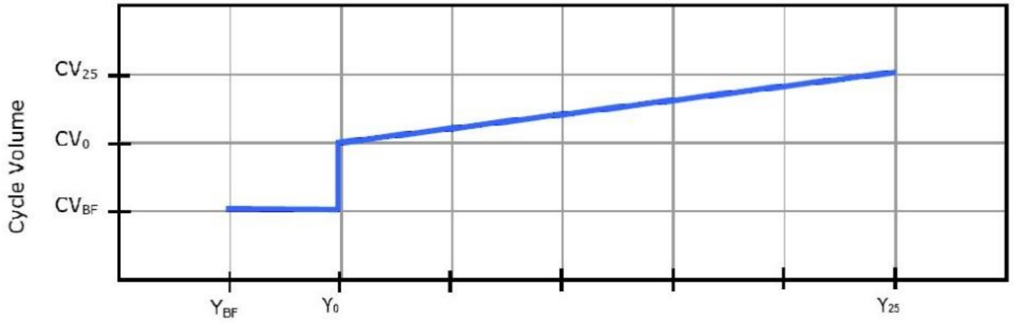


Figure 5-6: AMBAG Bike Model from NCHRP 08-36 Task 141 Evaluation of Walk and Bicycle Demand Modeling Practice (RAND, 2019)

Available non-proprietary models

- Research Report 340



Off-road paths

$$\therefore NC = 1.6 \times \sqrt{MS \times MV} + 0.5 \times PCV_{BF}$$ *Equation 22*

MS = the mode share (percentage of people that travel to work by bike) from Census data. Values for MS are listed in Appendix G.

MV = the motor vehicle volume on the road parallel to the off-road path.

PCV_{BF} = the existing cycle volume on the road parallel to the off-road path before the installation of the path.

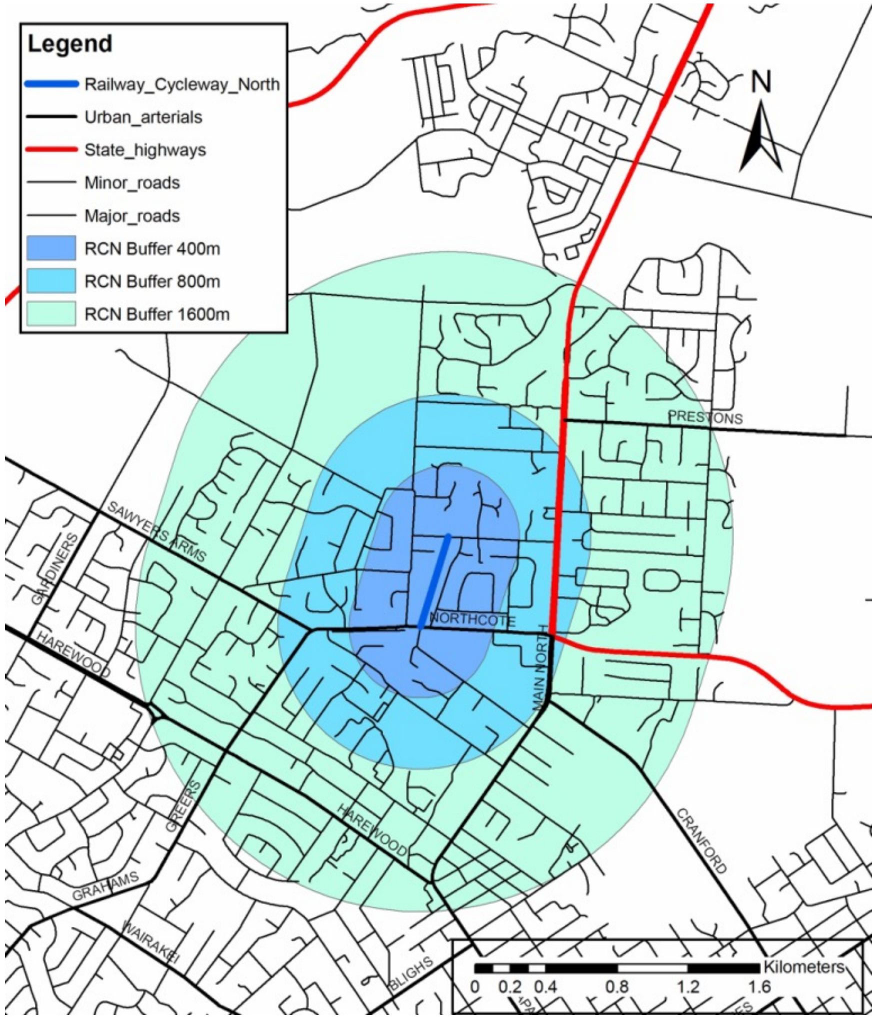
On-road lanes

$$NC = CV_{BF} \times 0.2$$ *Equation 4*

CV_{BF} = the existing cycle volume before installation of a cycle facility.

$$CGR = (BG + 8\%) / 2$$ *Equation 8*

- SP11



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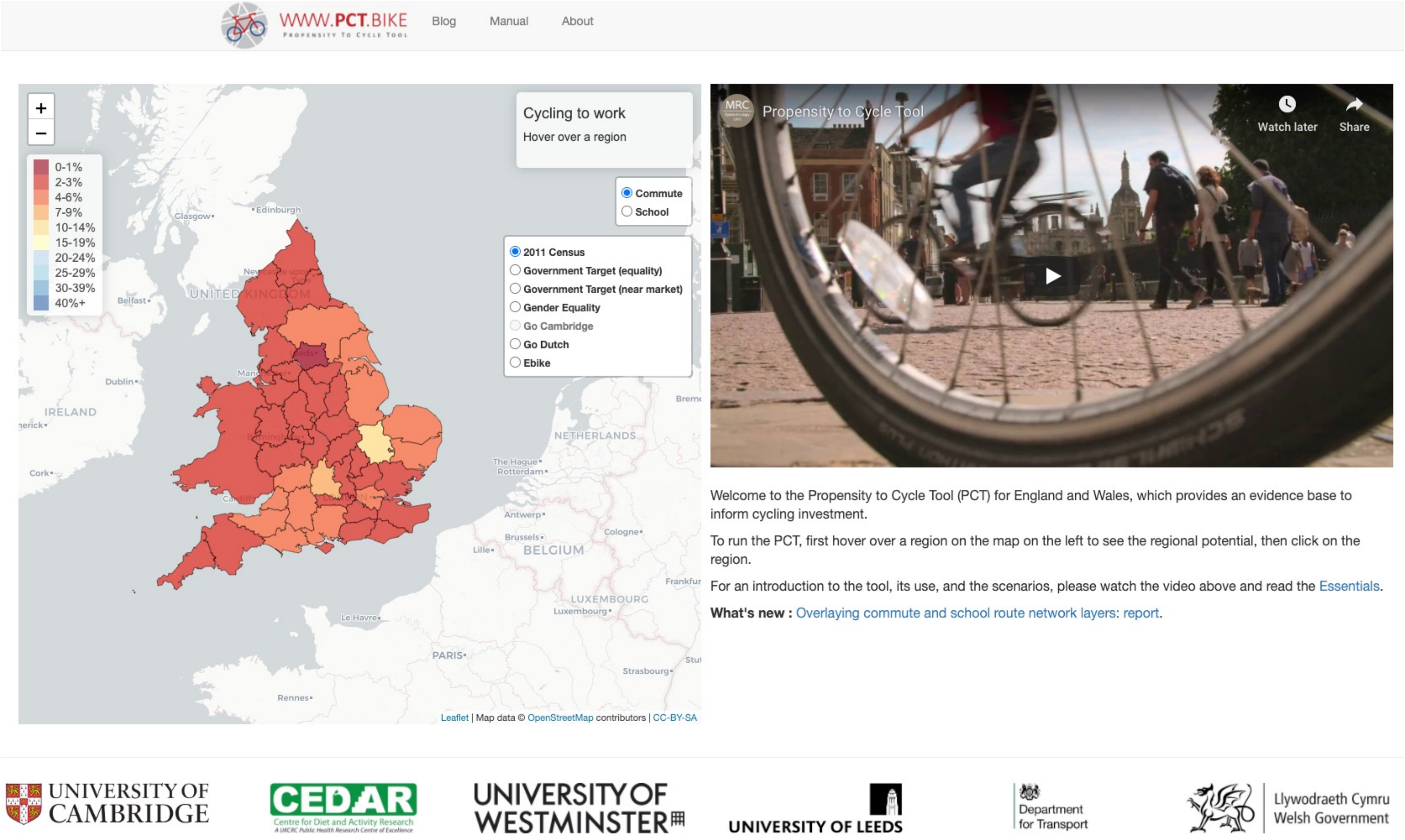
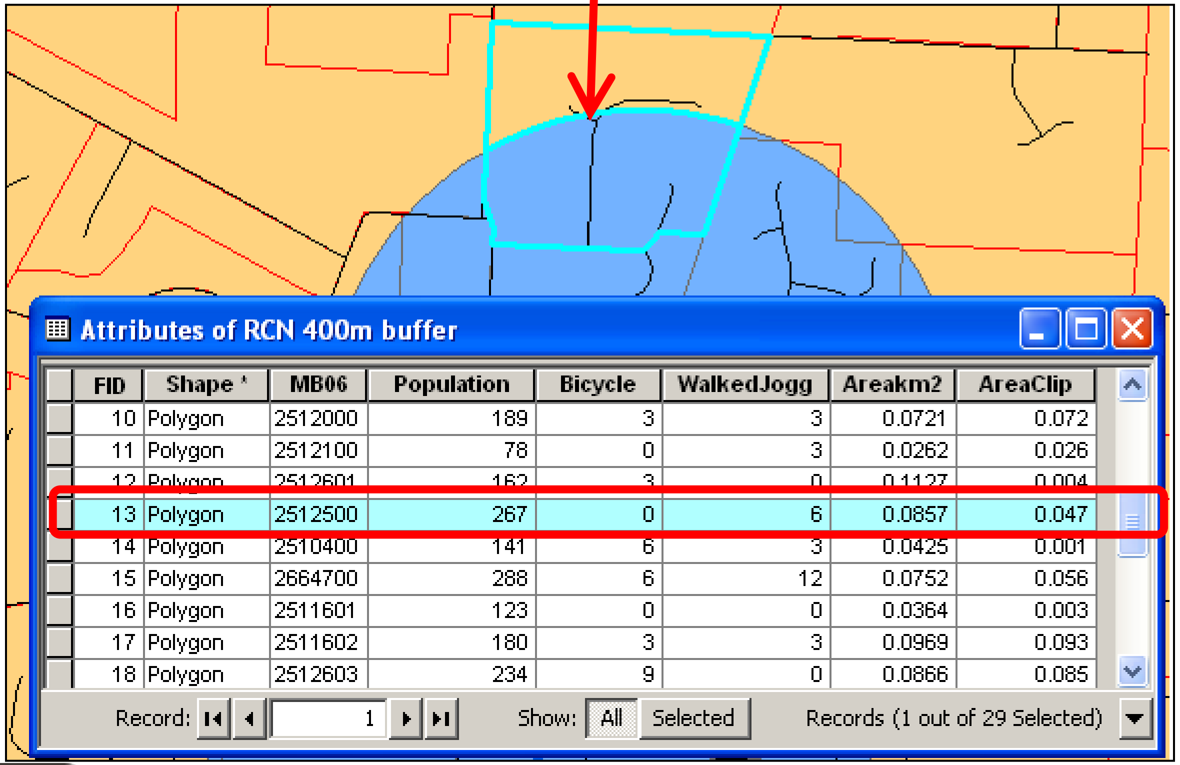
Propensity to cycle tool

- Based on hypothetical national scenarios of cycling uptake
- Does not provide estimates of cycling resulting from a given intervention
- Deterministic (not probabilistic) route choice



What is SP11?

- AADT estimation from population buffers 400, 800, 1600
- Cut the meshblocks to obtain population within them



FID	Shape *	MB06	Population	Bicycle	WalkedJogg	Areakm2	AreaClip
10	Polygon	2512000	189	3	3	0.0721	0.072
11	Polygon	2512100	78	0	3	0.0262	0.026
12	Polygon	2512601	162	3	0	0.1127	0.004
13	Polygon	2512500	267	0	6	0.0857	0.047
14	Polygon	2510400	141	6	3	0.0425	0.001
15	Polygon	2664700	288	6	12	0.0752	0.056
16	Polygon	2511601	123	0	0	0.0364	0.003
17	Polygon	2511602	180	3	3	0.0969	0.093
18	Polygon	2512603	234	9	0	0.0866	0.085

$Population_{400m}$ =

0.047 / 0.0857 * 267

= 146

SP11: AADT estimation from census data

	New and existing cyclists				
	Buffers (km)	<0.4	0.4 to <0.8	0.8 to ≤ 1.6	
1	Area (km^2)	**0.93**	**2.24**	**8.50**	
2	Density per square kilometre	**2,264**	**2,450**	**1,787**	
3	Population in each buffer **(3)** = **(1)** × **(2)**	**1,993**	**5,488**	**15,193**	
4	Total population in all buffers (Sum of **(3)**)	**22,674**			
5	Commute share (single value for all)	**6.6**			%
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21	
7	Row **(7)** = **(3)** x **(6)**	**2,073**	**2,964**	**3,190**	
8	Sum of row **(7)**	**8,227**			
9	Cyclist rate **(9)** = ((**5)** x 0.96) + 0.32	**6.66**			%
10	Total existing daily cyclists **(10)** = **(4)** × **(9)**	**1,510**			
11	Total new daily cyclists **(11) = (8)** x **(9)**	**548**			

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SP 11 limitations

- Based on two sites in the USA – quite old
- Only based on residential population
  - does not consider trip attractors e.g. workplaces
- Considers facility in isolation
  - no allowance for connecting to existing facilities / strategic network
- Relative attractiveness of different cycle facility types only affect travel time calculations, not cycle volumes
- Cycling likelihood multiplier based on census data for territorial authority
- Generally, substantially over-estimates
  - Or, will under-estimate if low surrounding residential population

Build a database

Overview of the project							*Usage (before)*			*Usage (after)*						
	RCA	Project cluster no.	FACILITY OVERVIEW	LOS BEFORE	LOS AFTER	USAGE BEFORE	CYC BEFORE	W&C BEFORE	USE AFTER	CYC AFTER	W&C AFTER	BEST PRACTICE	CONTEXT	DESTINATIONS	CONTACTS	VARIABLES
What is the name of the project?																

Key Figures Map

Last Year

Whole Domain

Compared to Previous Year

Current Year	Whole Domain

Daily Average

103,606

Last Year	Whole Domain

Daily Average

91,939

Current Year	Whole Domain

Total

21,032,100

Current Year	Whole Domain

Peak Day

Tuesday Apr 13, 2021

199,892

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Categorisation schema for long list variables

Type	Type 2	Value	Description
Data format	Categorical	Nominal	named categories, no implicit order
		Ordinal	categories with an implied order assigned by modeller
	Numerical	Discrete	only particular values are possible (either by the nature of the variable, or as assigned ranges by model developers), can be counted but not measured
		Continuous	any numerical value along a scale is possible, can be measured
Relevance		High	very important to accuracy of output
		Medium	reasonably important to accuracy of output
		Low	a “nice to have”; a modifier
Likely availability		High	already provided in existing data source
		Medium	available from external source or modeler’s interpretation
		Low	may require further investigation to obtain

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Variables that:

- We can change
- Constants of the urban area e.g. underlying environmental / urban area / cultural variables captured in HTS/JTW)
- We are mostly interested in new trips (latent demand) because the biggest benefits accrue to new users
  - Trips diverted from other routes are less important to the economics from a social benefit
  - Those variables that will have a bigger impact on attracting new users rather than re-routing existing users

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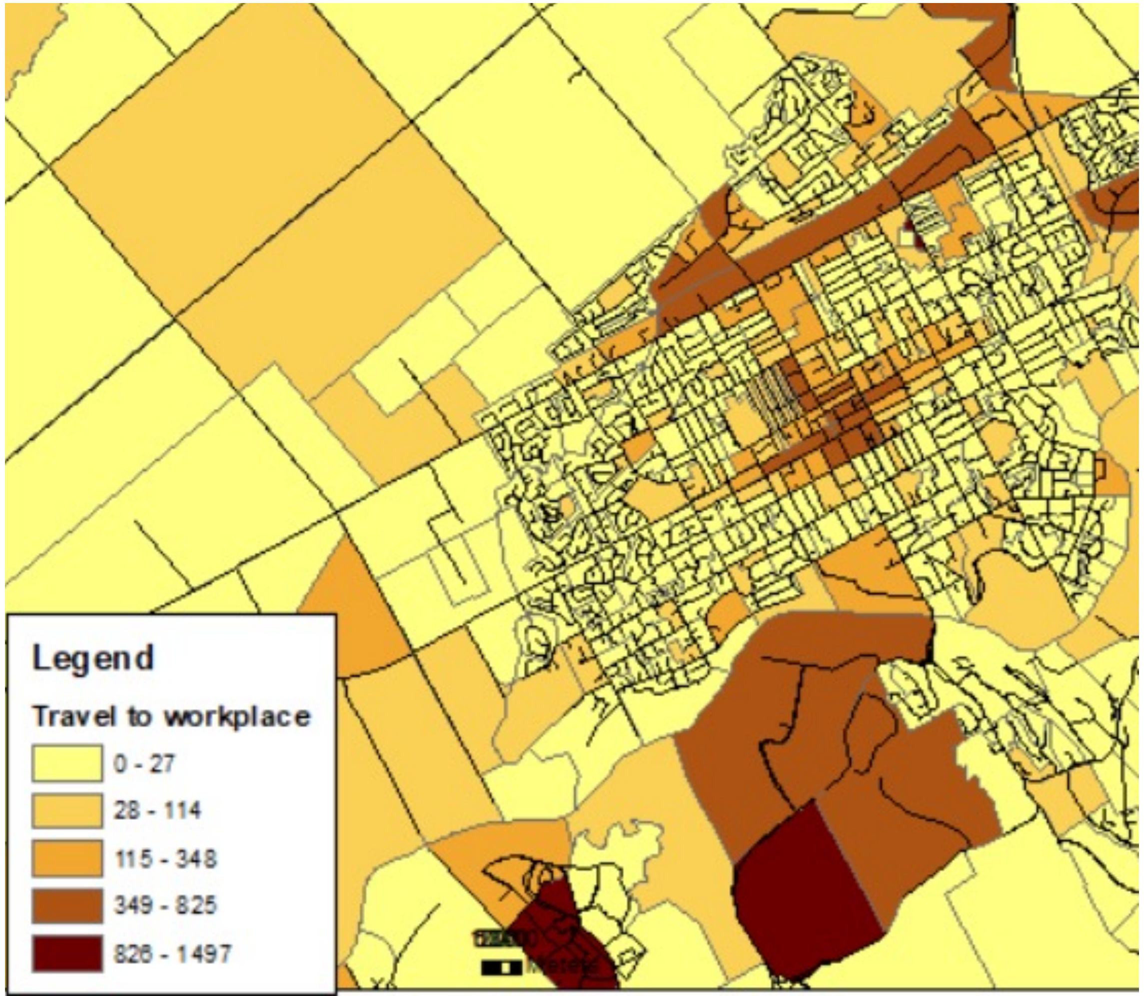
Variables – measures of existing cycling demand

Possible calibration coefficients?

- Proportion of cycle/e-scooters using similar facilities
- Current cycle volumes
- Cycling trip to work mode share



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Variables – environmental characteristics

- Relative size of city / town
- Location of facility
- Local road default speed limit
- Motor traffic volume on corridor
- Length of facility
- Proximity to residences
- Proximity to school students age 10+
- Degree of connectedness with trip generators / cycle network
- Avg gradient / hilliness
- Max gradient / hilliness
- Destination elevation
- Directness of facility

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Variables – cross-elasticities of other modes

- Network level variables influence all routes in the area
  - Degree of motor vehicle congestion
  - Availability / price of parking at destinations
  - Availability / LOS of PT provision
  - Level of integration with PT
  - Availability of bike (or e-scooter) share schemes

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Variables – facility design

- Type of facility
- Number and type of intersections / crossings
- Number of driveways crossing facility
- Alignment with best practice
- Expected (change in) LoS (QoS)

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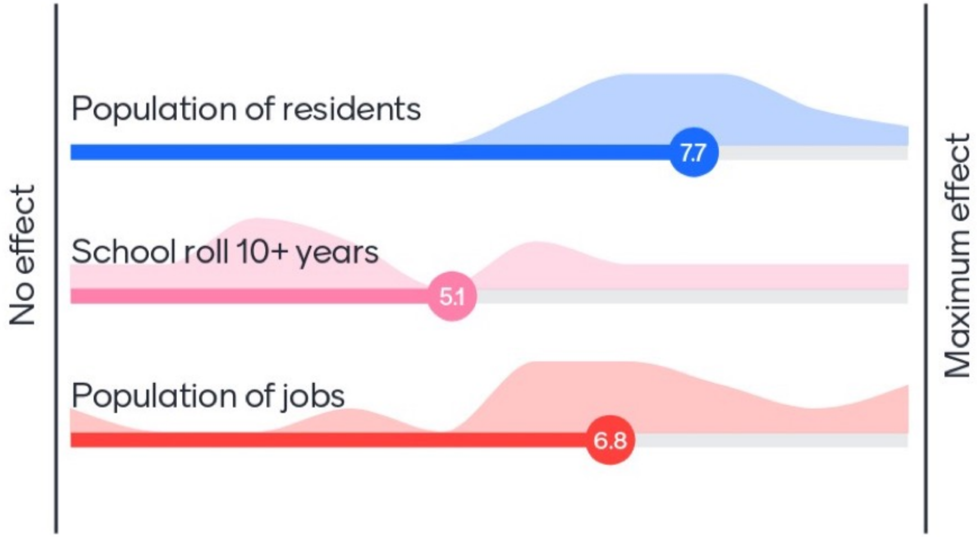
Variables – network planning

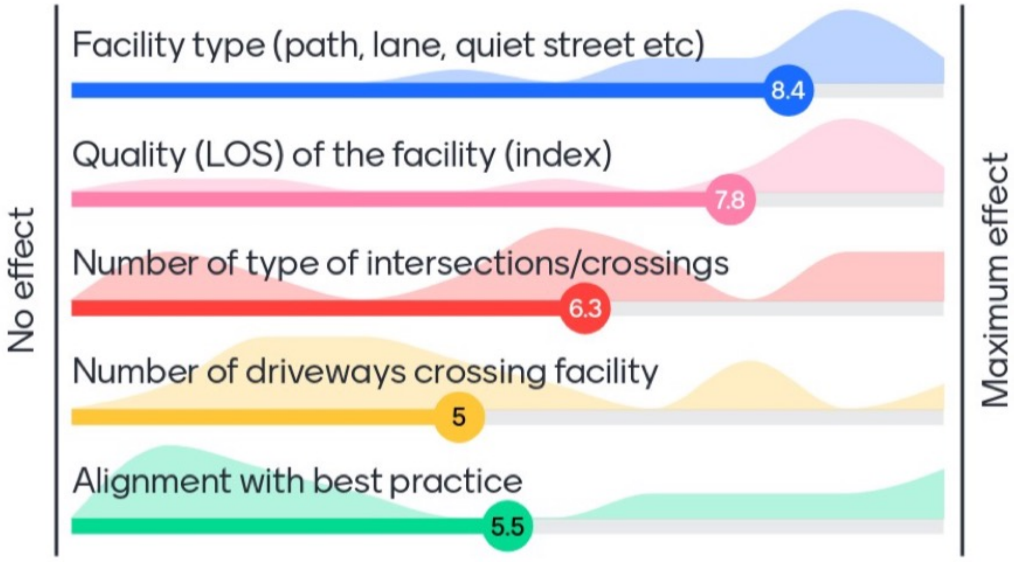
- Type of user(s) anticipated
- Aesthetic attractiveness of surroundings
- Network impact of facility
- Degree of e-bike uptake

Menti results

Transport demand variables



Takeup of cycling (latent demand)



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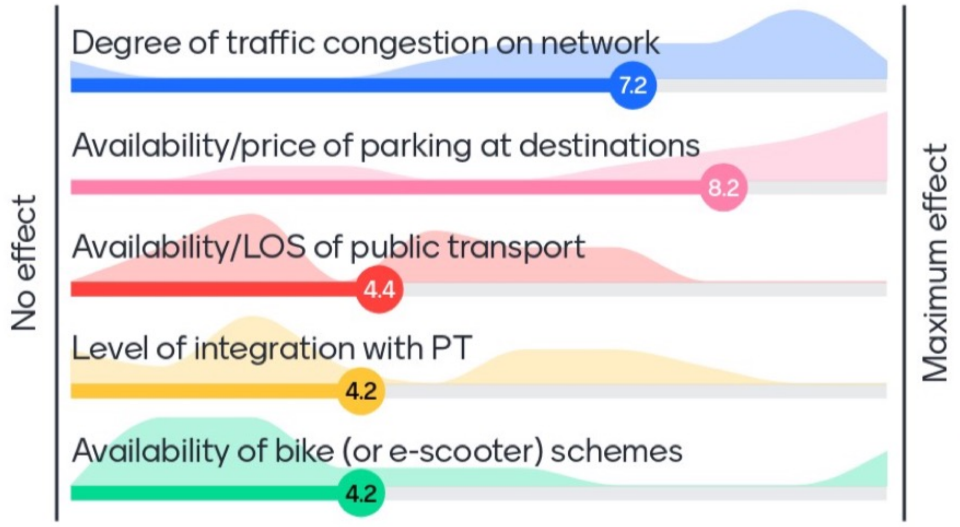
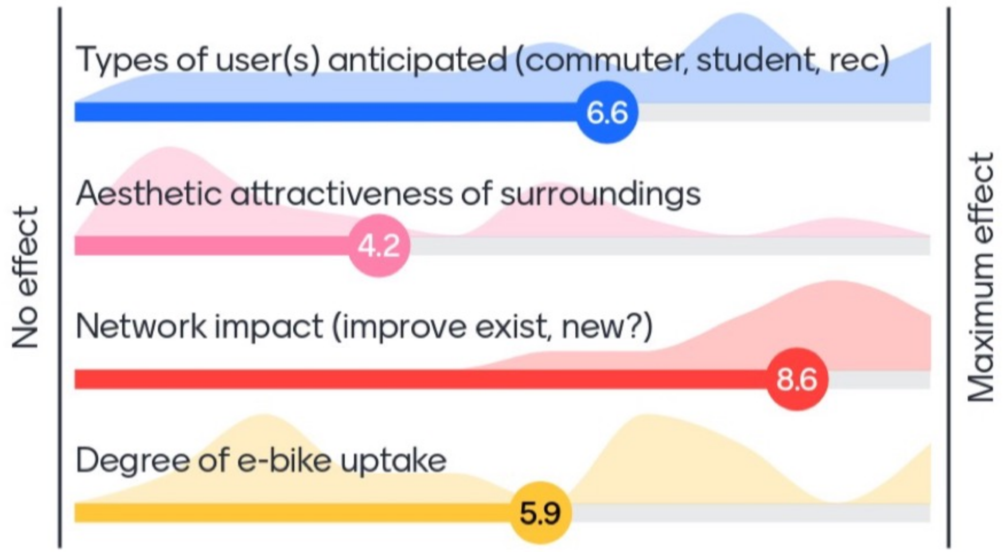
Menti results

Cross elasticities



Network planning variables



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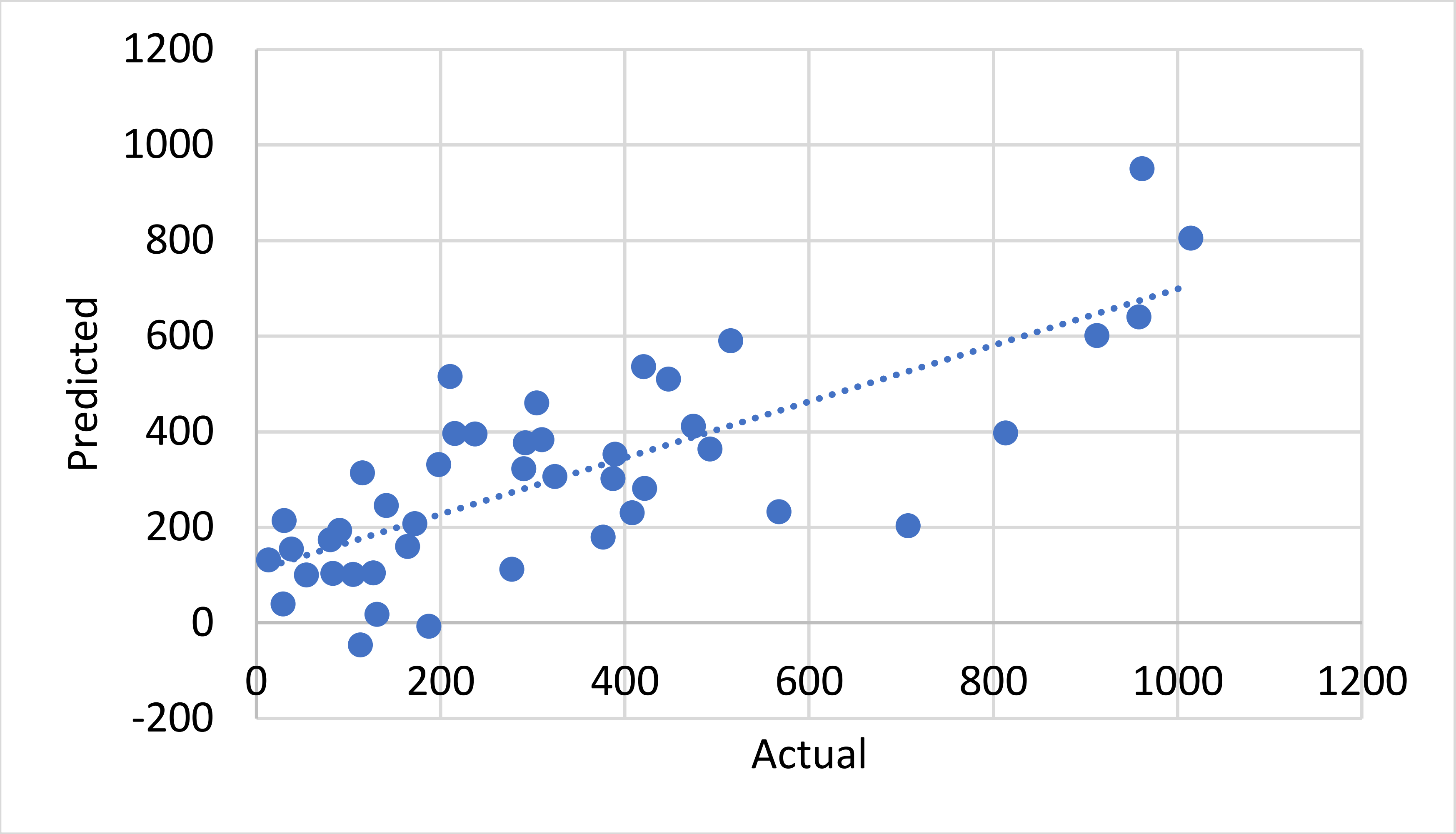
Variables tested in the modelling

- **Rd** is the route density score (0= viable alternate routes, 1= alt routes available but subject route preferred, 2= no other routes)
- **QoS** is the corridor average Quality of Service Score (where 4 is best, and 0 is worst - a transformation of the Auckland Transport QoS method that includes facility type, gradient, intersections, etc)
- **Pop** and **Job** are the census population and jobs respectively within 400, 800 and 1600 m buffers of the corridor, weighted as per previous SP11 method
- **TTR** is the travel time ratio (worst peak period travel time by car / best off peak travel time by car) – a measure of congestion. People are more likely to cycle when the alternative is unattractive in terms of the generalised cost of travel.
- **Parking** is the degree to which parking is abundant and low cost

Model 8

Model 8 includes directness and is slightly more accurate, Model 10 does not

*Count = e^(-3.608+(.789 * QoS)+(0.00001682 * Jobs) + (7.387 * Directness)*



Accuracy comparison

	Model 8 negative binomial	Model 10 negative binomial	Model 8c pooled	SP11
Model coefficients				
Directness	7.387	n/a	1745.4	-
QoS	.789	.867	252.8	-
Jobs	0.00001682	0.00001661	0.0061	-
Predicted vs. actual count (absolute error %)				
estimation before	205%	242%	147%	3979%
estimation after	47%	46%	31%	647%
estimation before & after	126%	144%	89%	2313%
validation after	52%	62%	51%	383%
estimation after & validation after	48%	51%	38%	547%

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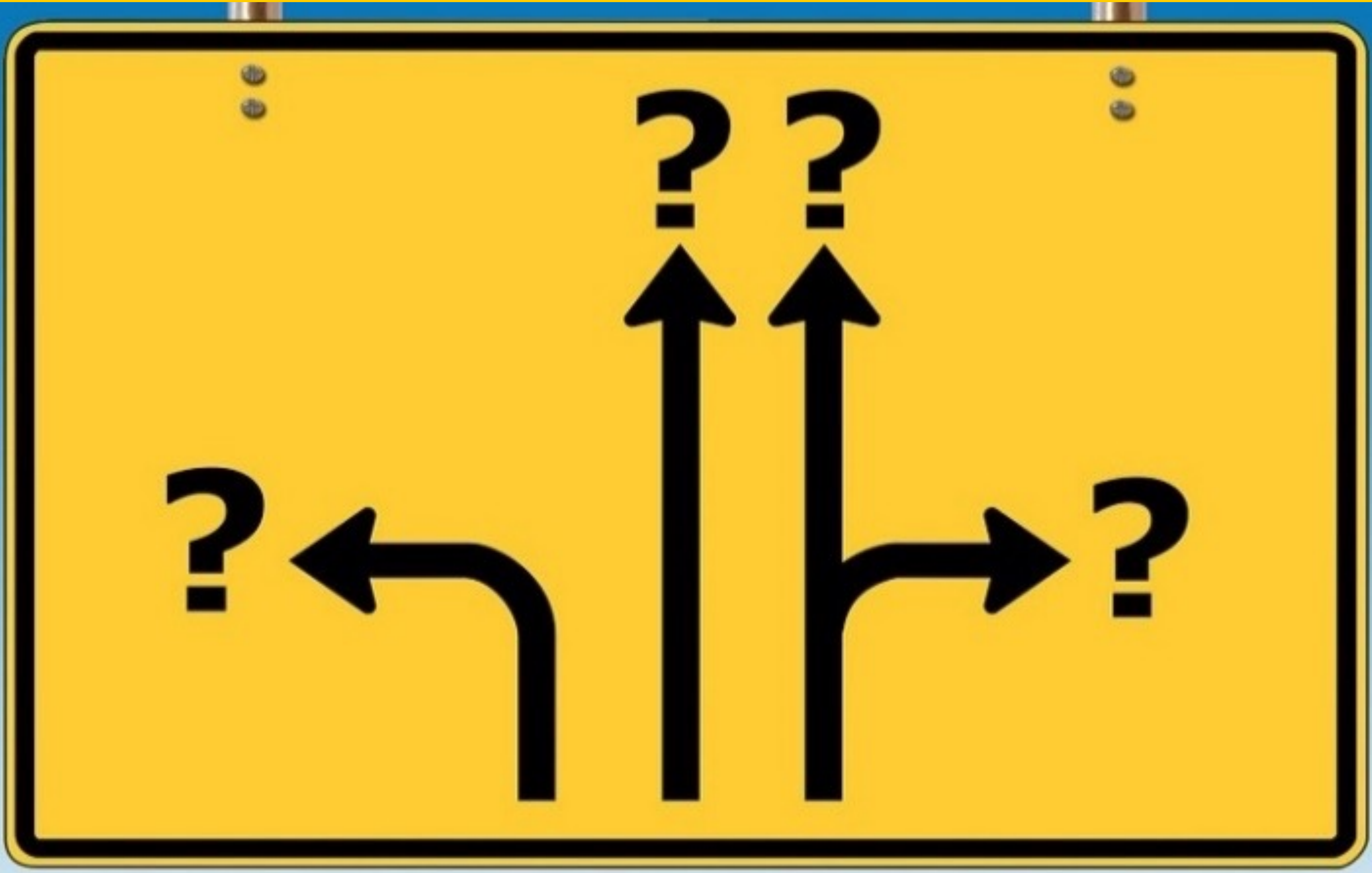
Model results

- Based on the 22 sites considered in the modelling, a half-point improvement in QoS score results in an increase of approximately 130 riders per day.
- For the 22 sites, the average change in ridership after implementation was a +81% increase in daily cycling numbers.
- The models tend to over-predict if the actual count is low, and to under-predict if the actual count is high. This is typical of models that that are subject to measurement error. For future work, it is critical to obtain larger samples of “before” implementation count data (i.e., longer duration counts).

Thank you, are there any questions?



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TRANSPORT PLANNING AND DESIGN