UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

IMPACT OF BIKES ON CHRISTCHURCH MULTIMODAL TRANSPORT SYSTEM

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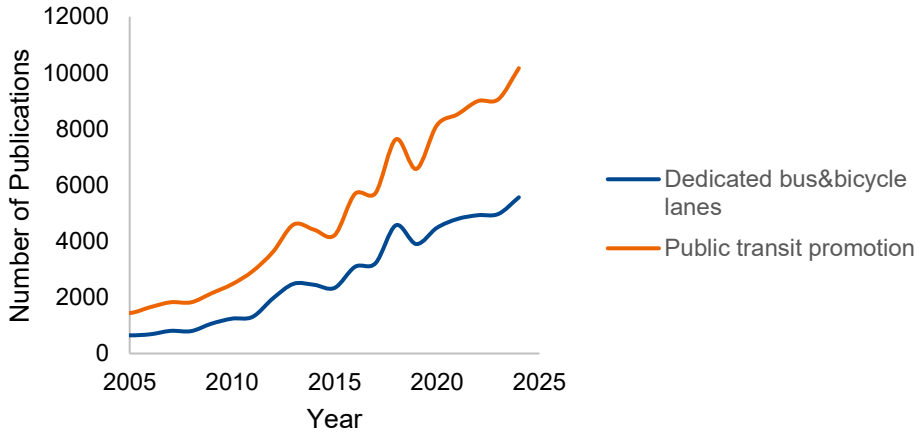
Motivation / Background

How does cycle infrastructure effect:

- Productivity
- Congestion
- Sustainability
- Quality of life

Christchurch city to invest $177.3 million in cycle infrastructure from 2024 to 2034



Skills used

- Large scale data analysis
- Geographical processing
- Detailed network modelling
- Traffic analysis
- Real world engineering

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Why Microscopic Modelling?

Macroscopic

- Simulates as a flow rather than individual
- No intersections

SATURN

VS

Microscopic

- Simulates individual vehicle behavior
- Captures intersection and signal dynamics
- Supports multimodal modeling (cars, buses and bikes)

aimsun.

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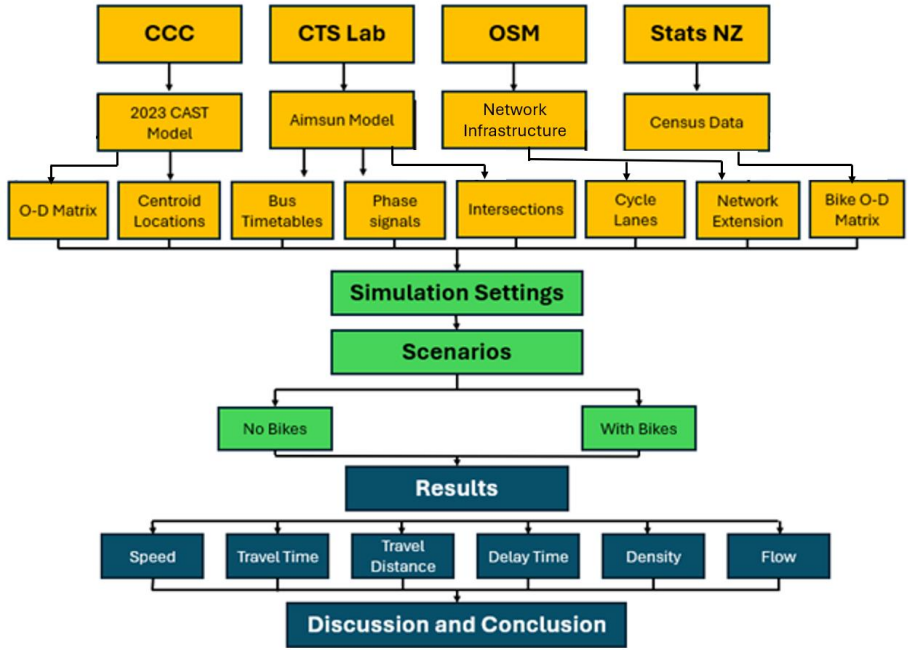
Network Preparation

- Cut CCC SATURN model to get a car OD matrix
- Use the existing CTS Lab Aimsun model
- Build out the model till it is the same as the cut CCC SATURN model
- Add 147 O-D locations to match SATURN network (additional 21%)



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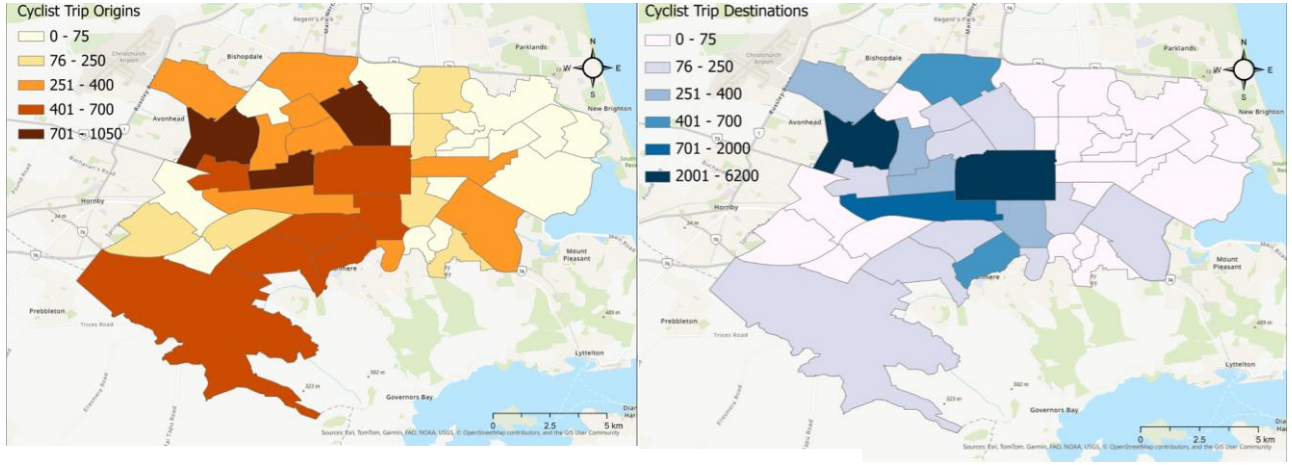
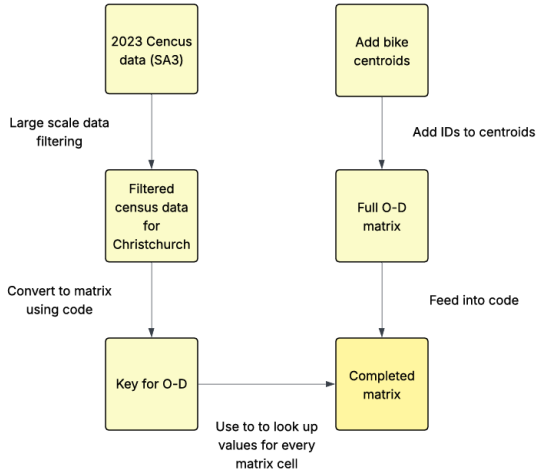
Modelling the Cycleways

- Imported raw cycleway network from OpenStreetMap
- Remodelled and verified using Google Maps & Street View
- Reconstructed intersections
- Add bike centroid IDs with area codes, link information and numbering
- Run code to manipulate 2023 census data on SA3 areas into a bike O-D matrix





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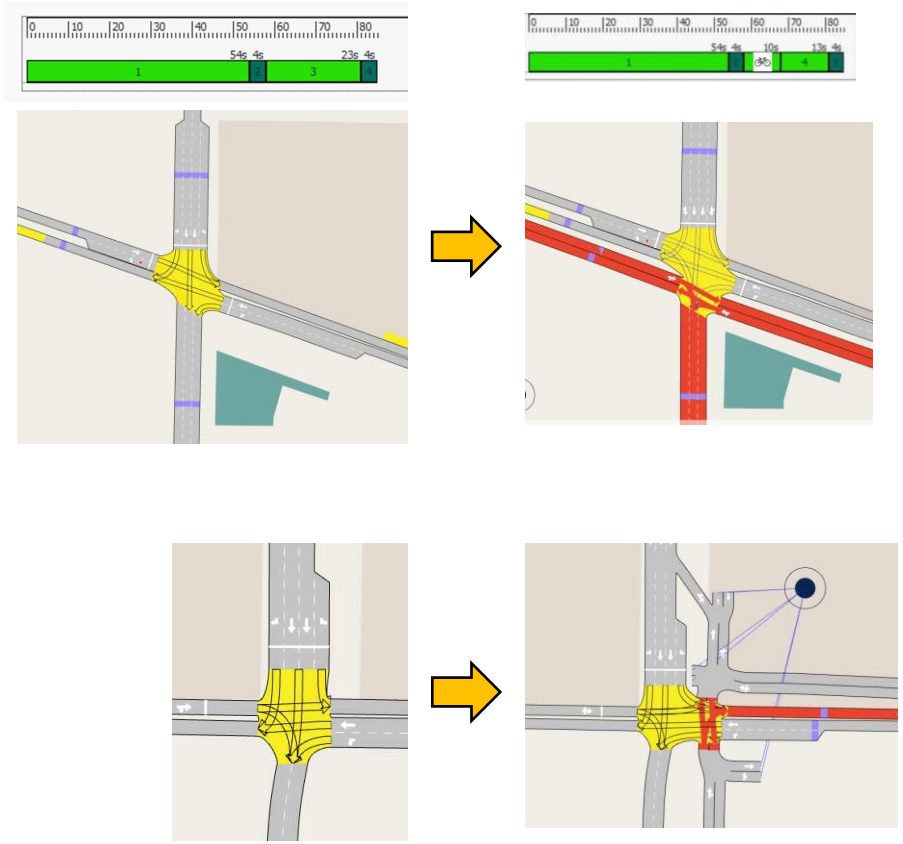
Signal Plan

- Signal plans are a collection of turns grouped together and then activated over certain cycle
- Used old signal plans to construct new ones
- Both separated cycleways and pedestrian crossings indicated by OSM were considered
- Bike phases were added in parallel with car phases for 10 seconds to represent real world conditions



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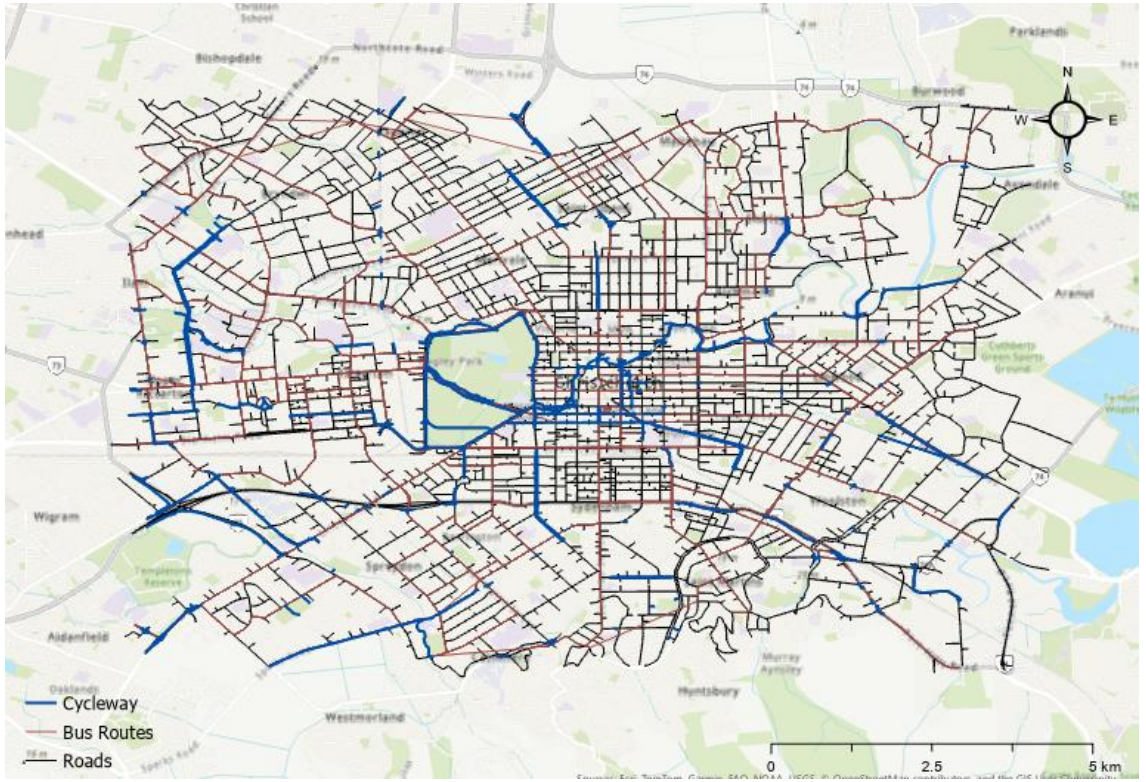
Final Network

Network includes:

- 1,054 centroids (834 car, 220 bike)
- 1,110,916 matrix cell
- Total section length of 1,156.8 km
- 3,737 intersections
- Bus routes
- Signal plan



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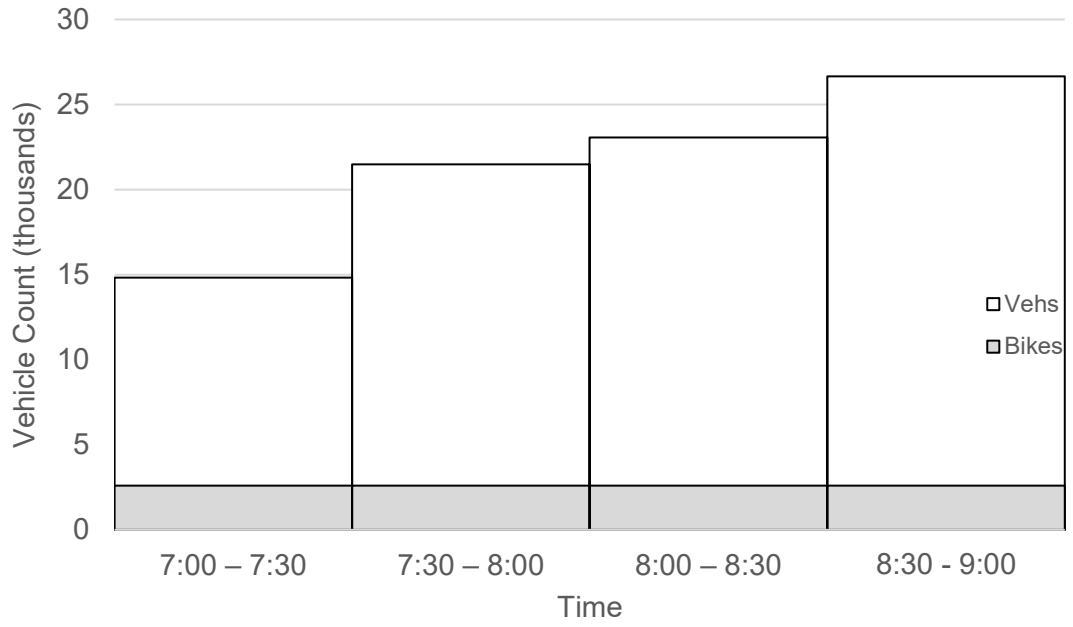
Simulation Scenarios

- Model 1: Cars + Buses (Bimodal)
- Model 2: Cars + Buses + Bicycles (Multimodal)

Simulation Period:

- 7:00 – 9:00 AM (Morning Peak)
- Route choice updated every 90s
- 8 replications per model



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Key Results

	Bimodal Model	Multimodal Model	% Change
Speed (km/h)	31.20	28.67	↓ 8.1%
Delay (s/km)	70.35	84.65	↑ 20.3%
Density (veh/km)	5.47	7.14	↑ 30.5%
Flow (veh/h)	33,290	30,199	↓ 9.3%

Network handled extra cycling demand with only modest impacts on vehicle performance

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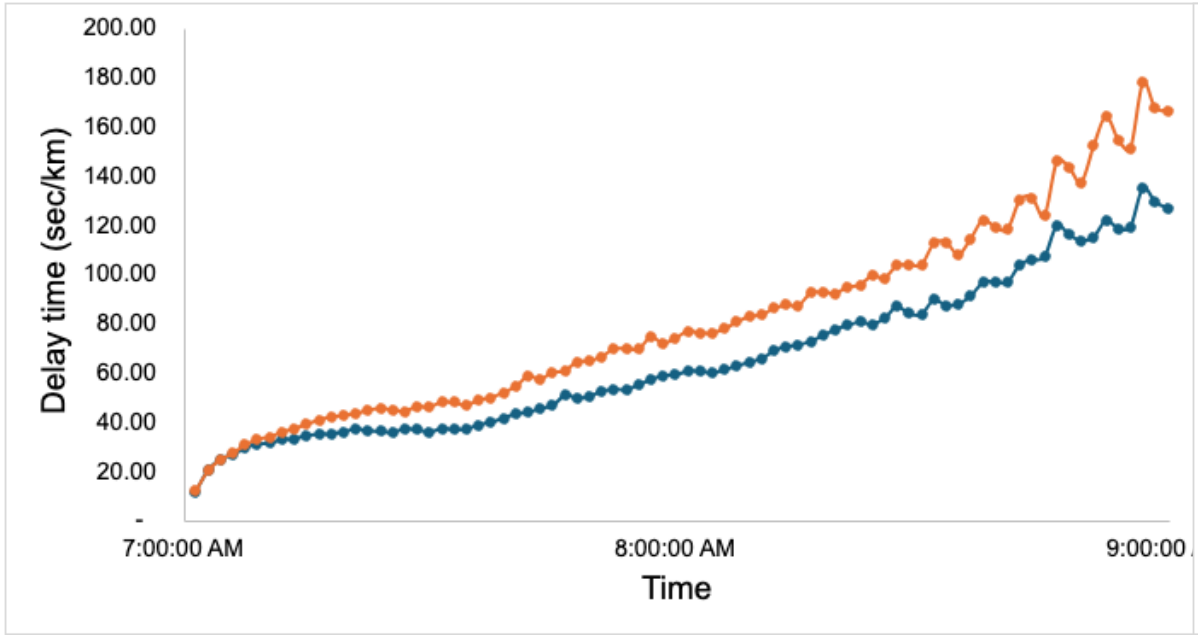
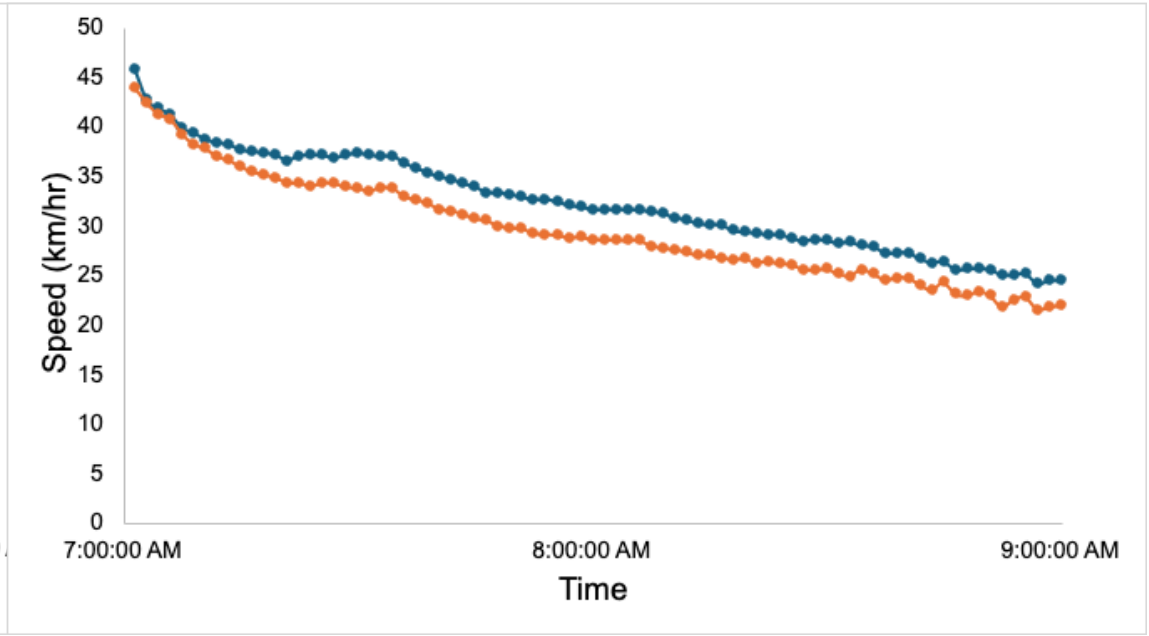
Time-dependent Performance





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Discussion

- Small reduction in overall vehicle speed (8.1%)
- Bicycle demand caused a moderate delay increase (20.3%)
- Creates a more multimodal network
- Delay most likely caused by intersections and shared lanes
- Network remained stable and functional
- Environmental and social benefits, likely outweigh the small reductions in vehicular performance observed
- Cycling and vehicle efficiency can coexist when infrastructure is well designed

Limitations

- Cycleways based on OSM – only included separate cycle lanes or shared paths
- Simplified signal plans (no actuated phases)
- Cyclist behavior was set to default settings provided in Aimsun
- Some bus routes missing due to model expansion

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Conclusion

- Bicycles slightly reduce vehicle speeds and flow, but didn't compromise overall network performance
- Christchurch can support growing cycling demand with manageable impacts if investment continues in protected and well integrated cycleways
- Supports Christchurch's sustainable goals
- Future work: improved cyclist behaviour modelling and signal coordination