Advanced Design for Cycling

Module 3: Midblocks and pathways

Module 3, Section 1 1

Advanced Planning and Design for Cycling

Module 3 Midblock and Path Design

Section 1
Introduction to Module 3

Module 3, Section 1

Housekeeping

- For new attendees
- Cell phones off, please!
- Toilets
- Evacuation procedure
- Module 2 8:45 am – 12:00 pm
- Module 3 starts at 1:00 pm
  - Afternoon tea 3:30 pm
- 5:00 pm finish

Module 3, Section 1 3

About the Presenters…
Axel Wilke

- ME (Civil)
- ViaStrada (Director)
- 15 years traffic/transportation experience
- Cycling-related projects/publications
  - Design/audit many cycle facilities
  - Develop Cycling Strategies around NZ
  - Peer reviewer to NZ Supplement
  - Technical advice/articles for CAN
  - Cycling papers at numerous conferences/workshops

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About the presenters…
Megan Fowler

- MET
  - Research project in road safety field
- 4 years at ViaStrada
  - Cycle facility design and safety auditing
  - Signal design, intersection modelling
  - Legal implications of SBFs
  - Various research projects and conference presentations
- Enjoys cycling
  - 15 km daily cycle commute
  - A bit of recreational cycling as well

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New attendees

- Quick round of introductions for any new attendees not present in Module 2 this morning
  - Name
  - Organisation
  - Work role
  - *Do you cycle regularly/occasionally?*
  - *Have you attended the Fundamentals course (now "Module 1")? If so, when?*

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Overall Course Structure

Module	Level	Duration	Topic
1	Fundamentals	1 day	Planning & Design for Cycling
2	Advanced	½ day	Planning and Funding • Policy and Legislation • Data Collection and Analysis • Evaluation and Funding • Auditing
3		½ day	Mid-block and Path Design • General midblock issues • Protected cycleways • Cycle Lanes and Parking • Cycle Paths and Shared Paths • Neighbourhood greenways & Traffic Mgmt
4		1 day	Intersection Design • Signals • Roundabouts • Priority and grade separated junctions

Course structure

- Course book
  - Handouts of slides for note taking
  - Course handbook with references
    - Austroads Guides – cycling synopsis
- Questions
  - Any time (but may be addressed later)

References are shown like this on slides

Module 3, Section 1 13

Module 3 Outline

Section	Topic
1	Introduction to Module 3
2	General midblock issues & protected cycleways
3	Paths for cycling
4	Shared roadway facilities for *enthused & confident* • Cycle lanes, bus lanes, vehicular cycling etc
5	Neighbourhood Greenways & Traffic Management
6	Course Summary and Evaluations

Module 3, Section 1 14

Advanced Planning and Design for Cycling

Module 3 Midblock and Path Design

Section 2 General midblock issues and protected cycleways

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VIASTRADA

Section 2 outline

- Cyclist safety issues
- Choice of provision
- Protected cycleways
  - Safety
  - Types
  - Design
  - General issues

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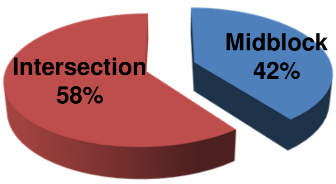
Module 3, Section 2

2

Issues for cyclists – safety

- CAS data 2005-2014
- 10,267 reported crashes involving a cyclist (all severities)



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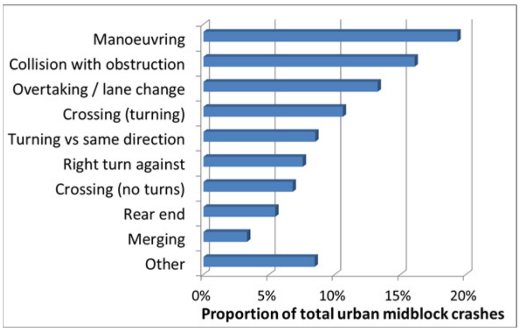
Module 3, Section 2

3

Urban midblock cyclist crashes



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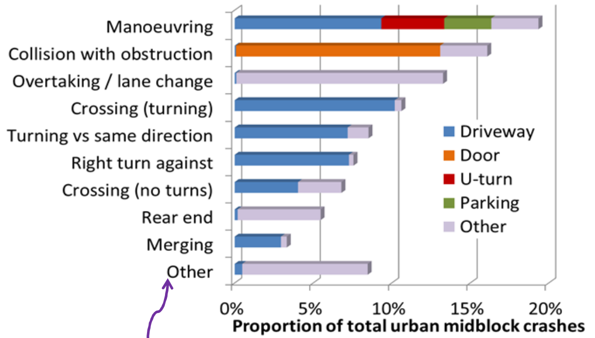
Urban midblock cyclist crashes



Here, "Other" = Lost control (straight); Head-on; Peds crossing; Cornering; Miscellaneous; Peds other

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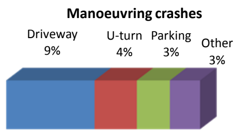
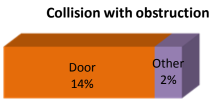
Urban midblock cyclist crashes

- Important points:
  - Main actual safety concerns for cyclists:
    - Manoeuvring vehicles
    - Collision with obstruction
    - Overtaking / crossing / turning vehicles
  - Collision with obstruction
    - Main component is dooring crashes

Percentage of total urban midblock cycle crashes:





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Actual midblock on-road issues

- Cyclists' actual safety concerns:
  - Manoeuvring vehicles
    - Driveways, parking, U-turning
  - Collision with obstruction
    - Car doors
  - Overtaking / crossing / turning vehicles
    - Courteous drivers letting someone else in

Actual midblock on-road issues

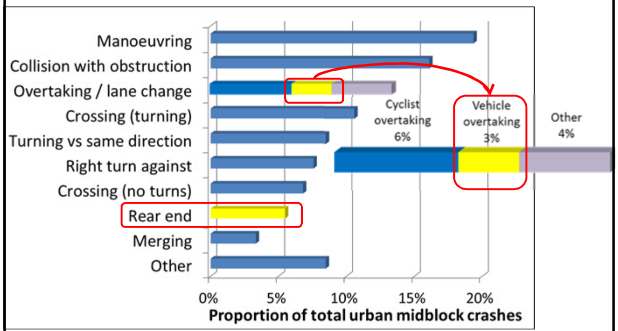
- Causes:
  - driver failure to observe cyclist
    - use of high visibility clothing often prescribed however conspicuous lateral riding position may be more effective
  - drivers misjudge cyclist speed

Perceived midblock on-road issues

- But cyclists' greatest ***perceived*** safety issue is being hit from behind
  - By overtaking (or undertaking) motorists
  - "the whoosh factor"
  - Inadequate separation from vehicles
  - this crash type is proportionally low (all urban locations)
    - And does not have a particularly high fatality rate (although more crucial at night)

9

Perceived midblock on-road issues



- Rear end / vehicle over-taking crashes only 8% of total urban midblock crashes

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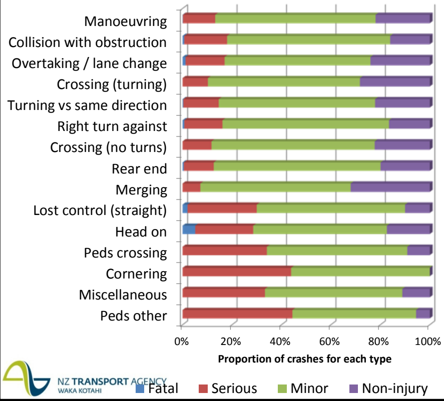
10

Severities of crash types



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Non-traffic crashes

- 46% of all cyclist injuries resulting in hospitalisation do not involve any other party
  - Reasons for these injuries are not stated, could involve cyclists falling off due to:
    - Slippery surfaces – ice, gravel, leaves etc
    - Inexperience?
    - Reaction to driver behaviour
  - Can we improve designs to prevent the occurrence of these crashes and / or their severities?

NZTA, Ministry of Health, 2014

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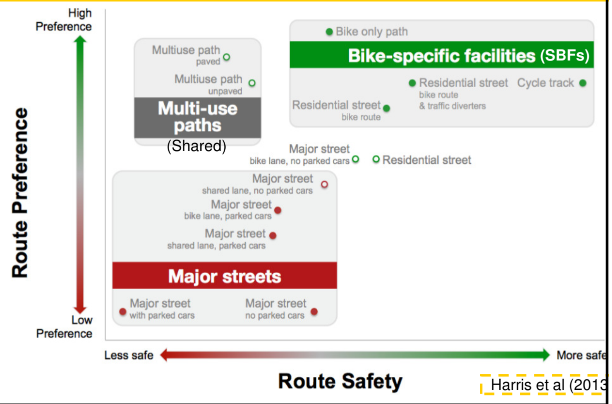
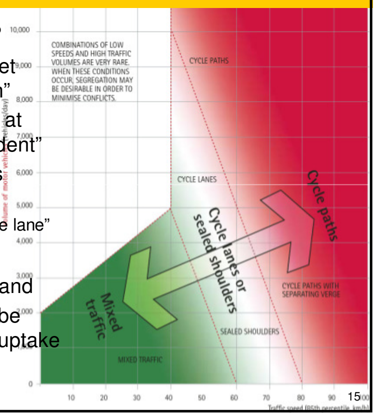
Perceived and actual safety



Harris et al (2013

CNRPG choice of mid-block provision

- Outdated thinking?
  - Not based on "target audience approach"
  - Inherently targeted at "Enthused & Confident"
  - Terminology needs updating
    - e.g. "protected cycle lane"
- Volumes >10k ?
  - Especially in Auckland
  - But basis may still be correct in terms of uptake by non-cyclists



Choice of mid-block provision

- New approach depends primarily on target audience
  - Perception of safety vs requirement for efficiency
- The number of cyclists should not influence the choice of facility type
  - It will influence the priority for implementation
  - May influence size or width of facility

On-road versus off-road

- Remember that paths aren't necessarily the best provision for cyclists
  - Depends on cyclist types, trip types, infrastructure, road layout, route options…
- Also consider provision for on-road cyclists
- Need to weigh up relative merits of all options
  - what suits target cyclist type best?
    - minimising delay?
    - or comfortable separation from heavy traffic?
  - risk of driveway conflict may be outweighed by on-street cycle lane being blocked by parking

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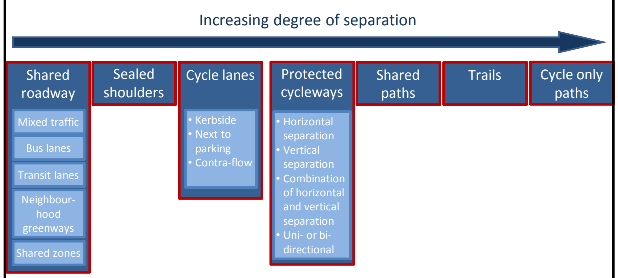
Recap: Midblock provisions for cycling



CNRPG updates

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Physically separated facilities

- Protected cycleways
  - Horizontal and / or vertical separation from carriageway
  - Adjacent to / on roadway
  - Uni- or bi-directional
- Cycle paths "SBFs"
  - Not adjacent to road
- Shared paths

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Protected cycleways

- Horizontal and / or vertical separation from carriageway
  1. Kerb protected
  2. Flag / bollards + buffer
  3. "Danish" / "Copenhagen"
  4. Footpath level
- Adjacent to / on roadway
- Uni- or bi-directional

Benefits of separation from vehicles

- Increased perceived safety
  – Will appeal to more cyclists – greater "safety in numbers" effect - *Walking and cycling international literature review (Krizek, et al. 2009)*
- Will eliminate / reduce some midblock crash types
  – Manoeuvring crashes e.g. parking, U-turning
  – Rear end, lost control, head-on, cornering crashes
  – Collision with obstruction (i.e. car door)

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Disadvantages of separation (1)

- Compared with urban on-road cycle facilities:
  – Short term safety implications
    - While waiting for safety in numbers to kick-in
  – Won't reduce rate of driveway crashes (42% of urban midblock cycle crashes)
    - May even increase, especially where contraflow cycling involved
  – May still involve dooring crashes
    - if path too close to adjacent parking lane
  – Higher relative risk of intersections not addressed
    - Separated midblock facilities might encourage more *interested but concerned* people to cycle, but they may not able to safely negotiate intersections…
    - Leads to the observation that separated facilities result in more crashes compared to cycle volumes

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Disadvantages of separation (2)

- More difficult for cyclists to make right turns
- Delay to cyclists at side streets
- Cycle path phases at intersections delay other users
- Conflicts with pedestrians and queuing / alighting bus passengers
- Obstructions such as weekly rubbish bins
- Can be difficult to fit into corridor
  - May require compromises to other modes / parking removal
- Maintenance (sweeping) is often overlooked

- Many of these issues can be addressed through careful design…

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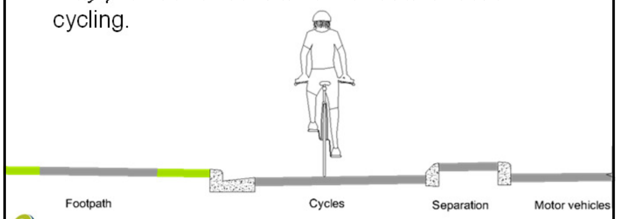
Type (1): Kerb Protected Cycleway

- A protected cycleway at carriageway level
- Physically separated from traffic / parking lanes by a raised kerb
- May provide for contra-flow or dual-direction cycling.



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Types (1): Kerb Protected Cycleway

- A protected cycleway at carriageway level
- Physically separated from traffic / parking lanes by a raised kerb
- May provide for contra-flow or dual-direction cycling.

- E.g. Danish “fortified bicycle lane”
  - -temporary solution prior to road reconstruction

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Type (1): Kerb Protected Cycleway

- A protected cycleway at carriageway level
- Physically separated from traffic / parking lanes by a raised kerb
- May provide for contra-flow or dual-direction cycling.

- E.g. Swanston St, Melbourne

Austroads GRD3 (2009) p65

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31

Kerb Protected Cycleway - design

- Various sizes and styles for kerb protection:

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32

Kerb Protected SBF - design

- Not adequate to be considered “kerb protection”:

- But a good way of delineating cycle lanes for *Enthused & Confident* audience.

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Kerb Protected Cycleway – design

- Accessibility
  - Cyclists who need to enter and exit the cycleway
  - Pedestrians who need to cross the cycleway
  - Enable legitimate vehicle access – to driveways, street sweepers
  - Discourage illegitimate vehicle access
- Durability vs. damage if hit
- Visibility to motorists
- Element width
  - Proportional to cyclists' perception of safety

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Kerb Protected Cycleway – construction

- Resurface former kerbside parking to channel
- Install kerb (may be keyed into pavement)
- Fill with bitumen or concrete – provide for parking meters and signage
- Retrofit storm water grates to be cycle friendly

http://www.bv.com.au/change-the-world/40140/

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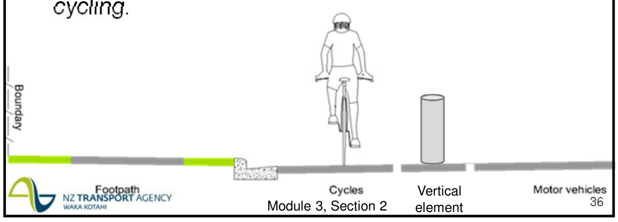
Types (2): Flag / Bollard Protected

- A cycleway at carriageway level
- Physically separated from traffic / parking lanes by a vertical element such as a flag or a bollard
  - Possibly combined with a horizontal element e.g. painted buffer
- May provide for contra-flow or dual-direction cycling.



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Type (2): Flag / Bollard Protected

- Example shows clearway with kerbside cycleway
  - Bollards
  - Combined with painted buffer and rumble strip

Albert St, Melbourne

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37

Type (2): Flag / Bollard Protected

- E.g. Chicago:
  - Bollards
  - Combined with painted buffer (cyclists' side)

38

Type (2): Flag / Bollard Protected

- E.g. Auckland:
  - Flexible posts
  - Delineated with riley kerb

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39

Type (2): Flag / Bollard Protected

- E.g. Allen Street, NYC:
  - Bollards / planter boxes
  - With fence between SBF and footpath (-pros and cons?)

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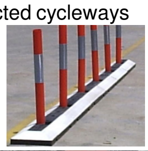
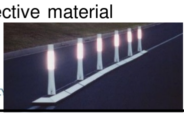
Flag / Bollard Protected - design

- Accessibility
  - Similar considerations as for kerb protected cycleways
- Height of vertical elements
  - Lower than handlebar height (<1m)
- Additional elements
  - Safety buffer for cyclists and motorists
    - Rumble strip
    - painted median
    - Or combine with a kerb element
  - Retro-reflective material





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Choice of vertical separation devices

- Narrow devices (90 mm – 300 mm) OK for intersections approaches or where there is no parking
- When adjacent to parking, provide extra width for opening car doors, at least 600 mm
  - Auckland: requires 1 m, 700 mm absolute minimum)

Saferoads, TCA

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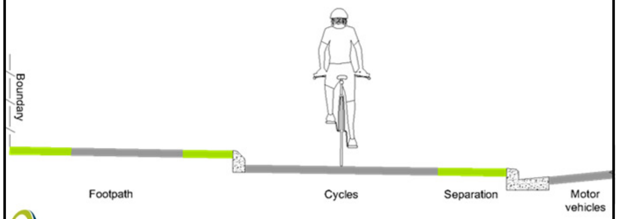
Type (3): Danish Cycle Path

- Kerb separation
- Mid-height between footpath and roadway
- May provide for contra-flow or dual-direction cycling.



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Type (3): Danish Cycle Path

- Also known as “Copenhagen” style

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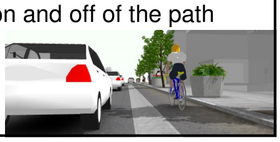
Danish Cycle Path – design

- Require sufficient change in elevation (>50mm) between carriageway and cycle path to give the impression of being physically separated
- Extra separation buffers required if directly adjacent to parking and / or live traffic lane
  - Can be textured, e.g. cobble stones, to encourage cyclists to stick to intended riding space
- Kerb cut-downs at key locations or mountable kerb to ensure cyclists can get on and off of the path

NACTO 2013



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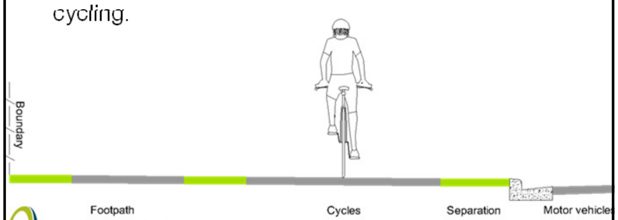
Type (4): Cycle Path at footpath level

- Physically separated from motor traffic
- Intended for the exclusive use of cyclists
  - i.e. not shared with pedestrians
- May provide for contra-flow or dual-direction cycling.



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Type (4): Cycle Path at footpath level

- Physically separated from motor traffic
  - Separation in the form of distance and / or elevation
    - E.g. landscape strip, fence
  - May be completely separate from road corridor
    - E.g. through parks, rail corridor

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Type (4): Cycle Path at footpath level

- E.g. Ottawa

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Type (4): Cycle Path at footpath level

- E.g. Matai St, Christchurch
  - Two-way cycle path on one side of street
  - Built in construction with kerb & channel renewal project

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Cycle Paths – pros and cons

- One way each side of the road – hybrid cycle path and cycle lanes, Tennyson St Christchurch
- Discussion – what are the pros and cons?

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Protected cycleways - general design considerations

- What delineates the separation element?
  - Conspicuity
- What is the profile of the separation element?
  - Chamfer
- What is the surface
  - Maintenance, drainage
- Is the facility sufficiently wide?
  - – see paths section and cycle lanes section for off-road and on-road SBFs respectively

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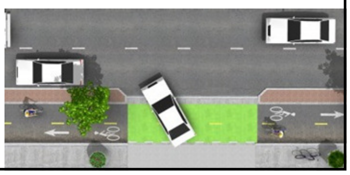
Safety issues for contra-flow cycling

- Motorists are less likely to expect cyclists travelling in the “wrong” (i.e. contra-flow) direction
  - i.e. the opposite direction to the adjacent traffic lane
  - Contra-flow to one-way road, or bi-directional cycleways
  - A problem at driveways and side roads
    - Worse when the cycleway is closer to the road and at road level
  - Exacerbated by speed
    - Don’t design cycleways that involve downhill contra-flow cycling.

52

Safety of cycleways at driveways

- Presence of parked vehicles
  - Obscure intervisibility between cyclists and drivers entering driveway (especially left turn in)
  - Obscure intervisibility between drivers exiting driveway and on-road traffic
- High traffic volumes and speeds
  - Drivers more likely to feel pressured to turn off road quickly
  - Drivers turning out of driveways take greater risks to join the traffic



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Driveways – considerations

- Need to consider the frequency and type of driveways along a route to determine facility type
  - Residential vs commercial driveways
    - Type of vehicle
    - Frequency of driveway crossings
    - Familiarity of users
  - i.e. 2 x uni-directional protected cycleways won’t necessarily be safer than one bi-directional cycleway

54

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Driveways – design methods

- Access management
  - Rationalise number of driveways
  - left-in, left-out only (by raised central median)
- Improve sight lines
  - Parking restrictions
  - Fence cut down or set-backs
- Reduce vehicle turning speeds
  - minimise driveway width and kerb radii; judder bars
  - semi-mountable kerb
- Coloured surfacing, pavement markings, signs and markings
  - especially across commercial accessways

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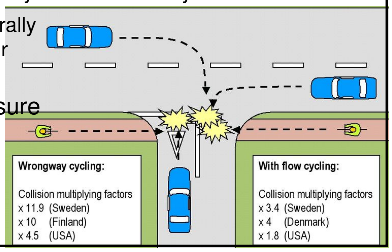
Safety of cycleways at side roads

- Side roads are similar to driveways, except:
  - Current road rules give priority to road traffic, unless traffic control devices are used
  - Side road traffic more likely to be unfamiliar users
  - Simultaneous 2-way traffic more likely at side roads
  - Side roads generally wider, with higher volumes.
- i.e. greater exposure and risk

www.oocities.org/galway cyclist/cycletrack.html



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Protected cycleways – summary

- Separation from motor traffic is likely to encourage *Interested but Concerned* people to cycle
  - Perceived to be safer
  - Actual safety highly dependent on context and design
  - Will not eliminate all risks associated with on-road cycling
- Driveways are critical elements in design
  - Especially for facilities involving contraflow cycling
  - Essentially an intersection design

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58

Advanced Planning and Design for Cycling

Module 3 Midblock and Path Design

Section 3
Paths for cycling

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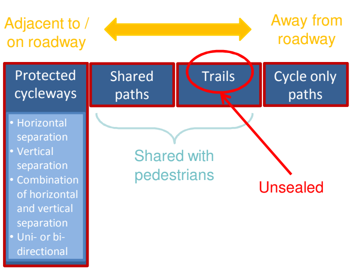
Section 3 Outline

- Safety
  - Conflict between pedestrians and cyclists
  - Conflict with motor vehicles
- Design
  - Widths
  - Horizontal and vertical curves, drainage
  - Pavements
  - Lighting
- Traffic management for pathways
  - Signs and markings
  - Shared spaces

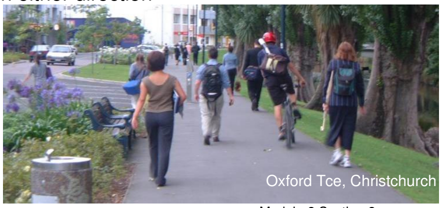
Recap: cycleways vs paths



CNRPG updates

Shared Paths

- Could include some form of “soft” separation
  - By users
  - By direction
- Or, no distinction given
  - Cyclists and pedestrians both allowed to use the entire path, in either direction



Oxford Tce, Christchurch

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Shared Paths

- Need to consider interaction with pedestrians
  - Sometimes shared paths will be required / preferred
    - Space requirements
    - Relative user volumes
    - Planning approach
- Many of the principles discussed for protected cycleways also apply to shared paths
  - Especially consideration of contraflow cycling at driveways and side roads

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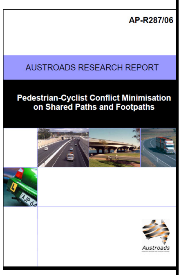
Shared Path Conflicts

- The “Ker Report” 2006
  - Literature review and survey of local authorities
  - Key point is:

    Conflict between pedestrians and cyclists often arises from pressures exerted by motorised traffic. In order to minimise conflict, holistic solutions are needed where conditions are improved for cyclists and/or pedestrians, but not for one at the expense of the other
  - Includes toolkit of *information notes* on strategies
- For paths alongside roads, conflicts with vehicles at driveways are also critical – see discussion in section 2.



NZ TRANSPORT AGENCY Austroads RR 287/06 Module 3 Section 3 6

Safety of shared paths

- Safety is related to conflict between users
  - i.e. the potential for collision
- Different speeds of pedestrians and cyclists can cause conflict
  - Pedestrians feel vulnerable when cyclists pass, especially when approaching from behind
  - Cyclists get frustrated when pedestrians take up the whole path
- Unpredictability also an issue
  - E.g. people stopped on path
  - Dogs (on and off a lead)

Safety of shared paths

- Consider the trade-off in conflict types:
  - Providing off-road shared paths – cyclist vs pedestrian
  - Providing on-road cycle options – cyclist vs motorist
- Most important consideration for shared path safety is width
  - To ensure enough space for users to interact without conflict

8

Path Design Steps

- Identify issues
- Identify options
- Choose provision and traffic management simultaneously
  - inter-related!!!
- Determine widths
- Detailed geometric design
- Pavement
- Lighting
- Signs and markings

Austroads GRD 6A

Module 3 Section 3 11

Principal Path Design References

Main references

- Austroads guides (refer to handout)
- *VicRoads Cycle Note 21*, 2012. VicRoads

Other references

- *Greenways: A Guide to Planning, Design, and Development,* 1993. The Conservation Fund
- *Shared-Use Paths / Sidepaths*, PedBikeinfo.org
- *Cycle Infrastructure Design*, Department for Transport UK.

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Module 3 Section 3 12

Shared path width

- NZTA only funds shared paths wider than 2.2 m
- Depends on volumes of users, mode split and directional split (tidal vs non-tidal)
- Austroads 14 recommends between 2.0 - 4.0 m, more for "high use"
  - Auckland minimum is 3.0 m
- See VicRoads Cycle Notes 21 (2012)

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Module 3 Section 3 13

Path Width Estimations

- Depends on
  - Mode split
  - User characteristics (cyclist target audience, speed etc…)
  - Directional split of users
    - Tidal or non-tidal?
  - Target LOS

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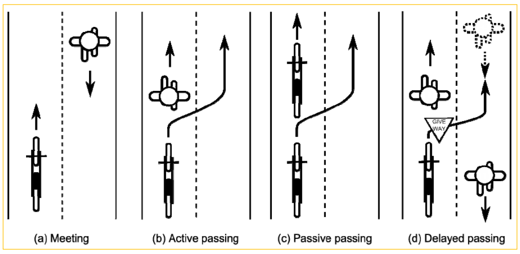
Module 3 Section 3 14

Path Width Research

- VicRoads Cycle Note 21 - best available research
- based on volumes, characteristics, speeds, directional split, interactions of path users (graphic below)



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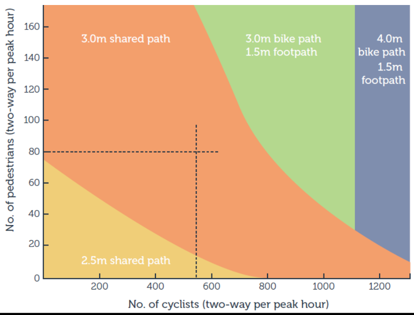
Module 3 Section 3

15

Path Width Research

- Commuter Path – Directional Split 90/10 example:
  - 3.0 m path / 550 cyclists, 80 pedestrians during AM peak
  - Conclusion: width is appropriate

VicRoads Cycle Note 21



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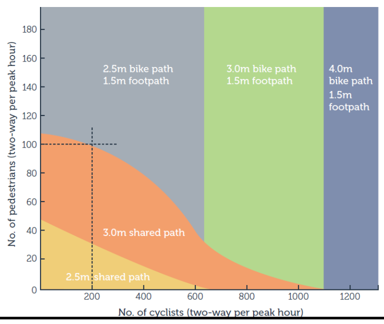
16

Path Width Research

- Recreational Path – Directional Split 50/50 example:
  - 200 cyclists, 100 pedestrians during weekend peak hour
  - Conclusions: 2.5 m bike and 1.5 m footpath (as existing) is suitable

VicRoads Cycle Note 21



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17

Geometry

- Traditionally, cycle paths were designed like footpaths with little consideration for
  - operating speed
  - design vehicle characteristics
  - road and path user interaction
- Need to consider both vertical and horizontal geometry

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Module 3 Section 3 18

Geometry - Vertical

- Gentle gradients (max 10% for 30 m or 8% over 60 m)
- As flat as possible, or with level breaks
  - Vertical geometry at structures informed by the NZ Design for Access and Mobility standard (NZS 4121)

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19

Geometry - Horizontal

- Keep corner radii as large as possible
  - Usually design for 30 km/h
  - 30 m minimum radii desirable
    - 15 m where constraints exist
    - < 5 m minimum means low speeds, wobbling
  - Keep curves free of dense vegetation and away from buildings
    - (CPTED)

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Module 3 Section 3 20

Drainage

- 2% crossfall max; 1% preferred
- Ideally, no more than 5% longitudinal gradient
- Surface water runoff:
  - swales
  - ditches
  - sheet flow
  - catch basins, drain inlets, culverts and subsoil drains
  - Porous base for water storage under the path

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21

Services

- Locate utilities alongside path, not under it (if possible)

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Module 3 Section 3

22

Pavements

- But it's just for pedestrians and cyclists!
  - paths are used by maintenance trucks
  - Edge-break

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Module 3 Section 3

24

Pavement Thickness

1. Generally start with a footpath design
2. Determine any ‘other’ loadings
   - No MVs, gardening vehicles, utility or HCVs?
3. Determine the native soil load carrying characteristics

Path type	Thickness (mm)		
	Surface	Metal course	Sub base
1.5 m footpath	20	75 AP20	
Light duty shared path	20	125 AP40	
Heavy duty shared path	20-25	125 AP40	150 AP65

Christchurch City Council, Ministry of Business Innovation and Employment, and National Trails Training Partnership

Pavements – Sub base

- Laying sub base for 3.0 m path

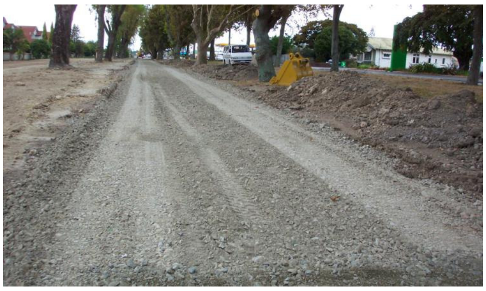


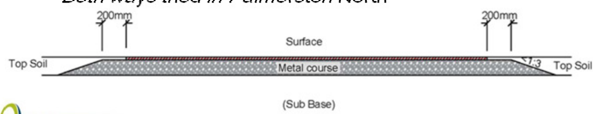
Photo: Erdinc Atalay, PNCC

Pavements - Edging

- To edge or not to edge?
  - Clearly, unsealed and paver surfaces are edged
  - But what about AC?
- Batten edged
  - tidy when new
  - as battens break down, shoving & edge break more likely
  - alternatives

Pavements – Not edged

- No battens used
  - Batter the basecourse
  - During AC placement, edges are tapped with a “T” shaped timber for shape correction
  - Fill with topsoil
    - not done so well in this photo!
- Contractor claims it’s stronger and cheaper
  - Experience shows they may be right
  - Both ways tried in Palmerston North



Ministry of Business Innovation and Employment

Construction - acceptance

- Example path pavement acceptance criteria from Christchurch:

Straight edge	Measurement not to exceed (mm)	
	Individual gaps	Sum of gaps
3 m longitudinal	5	10
1 m transverse	5	7

- Could use a laser profilometer (left photo), or
- a straight edge (right photo)

Construction Standard Specification, Christchurch City Council

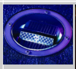
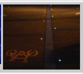
Module 3 Section 3 31

Lighting – is it needed?

- Previously, NZTA required justification for providing lighting
  - Expensive project component
- Now, NZTA require justification to not provide lighting
- Determining requirements
  - Use NZS 1158 standard
  - engineering judgement where adjacent to road
  - if in doubt, use lux meter

Module 3 Section 3 32

Lighting Types

Design	Power	Distributor	Example
Traditional street / path lights	Streetlight circuit		
Smartstud - Recessed	Inductive	Harding Traffic Systems www.hardingsytems.com	
Studs (4mm)	Solar	www.safe4u.co.nz	 
RRPMs	Solar	www.stmstraffic.co.nz	
Recessed	Solar	EcoCounter NZ	

Module 3 Section 3 33

Solar Lighting

- Reduce light pollution of the night sky
- Delineate the pathway
- May improve personal security perceptions
- Lower capital and operational costs
- Solar lighting examples and trials
  - Roads: SH2 Dowse Interchange
  - Developments: West Coast Road site, Waitakere
  - Cycleways: Nelson, Olympic Park Waitakere, North Shore

Module 3 Section 3 34

Lighting - Design

- Lighting is important for paths
  - Key CPTED principle
  - Attracts more commuter use
- Need to ensure that lighting provision does not adversely affect path
  - E.g. poorly placed poles reducing effective width of paths
- Much more expensive to provide where no adjacent streetlight circuit exists
  - E.g. new paths along reserves
- Guidance on cycle path lighting is found in Austroads GRD 6B and AS/NZS 1158

Module 3 Section 3 35

Bridges / Tunnels and Grade Separation

- Often most difficult barriers for cyclists
  - May be no alternative routes (or safe ones)
  - Long-term planning required to resolve
- Proper solutions can be costly
  - Interim cheaper solutions can often be found
  - Use abandoned / alternative structures
  - Provide alternative route across ford
  - Reallocate road/path space in bridge/tunnel
  - Warning signage and lower speed limits

NZ TRANSPORT AGENCY Module 3 Section 3 36

Structure Design Standards

- Underpasses usually preferable to over
  - Good sight lines, drainage, clearances
- Paths need to be wider (**2.5 m +**) through structure
  - Longer design life – so over-spec width within your span / budget constraints
- Minimise gradients and sharp curves
- Provide safe connections back to road
- Watch surfaces (joints, frost)
- Eliminate flooding issues

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Bollards (1)

- Bollards used to prevent motor vehicle access or highlight conflict points
- Extra warning required
  - Where groups of cyclists may be expected
  - Where visibility is compromised

Brisbane

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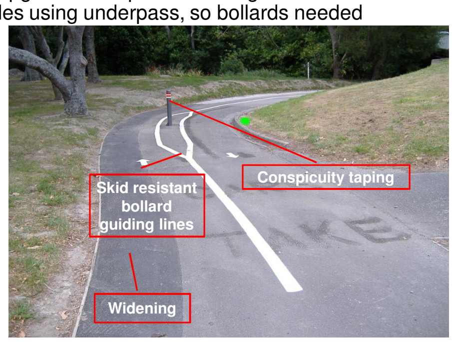
Bollards (2)

- Path upgrade example – widening resulted in motor vehicles using underpass, so bollards needed



Tennent Drive at Massey, Palmerston North

Module 3 Section 3 39

Signs and Markings

- Paths may need markings and signage
  - Segregation by user type often not practical
  - Segregation by direction can work better
  - Provide consistent rules for behaviour
  - Avoid the wording “Give way to pedestrians”

Shared Path Signage

- 4 main messages to address safety concerns
- Used in 3 levels
  - Level 1 – Keep Left
  - Level 2 – adds other three messages
  - Level 3 – adds site specific messages
- Which level depends on user volumes

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VicRoads Cycle Note 10

Module 3 Section 3 41

Pedestrian Areas (1)

- Conflict between cyclists and pedestrians?
  - Often more perceived than real
  - Very low proportion of pedestrian accidents involve cyclists

Hospital admissions data:

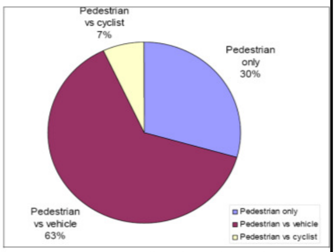

Figure 4.5 Type of accidents involving pedestrians.

LTNZ Research Report 289

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Module 3 Section 3 42

Pedestrian Areas (2)

- TRL study from the UK (1993) found no reason to exclude cyclists from pedestrian areas
- Findings
  - While pedestrians change their behaviour in the presence of motor vehicles they do not do so in the presence of cyclists;
  - Cyclists modify their speeds...in response to increases in pedestrian density;
  - Only one crash between a pedestrian and a cyclist occurred over the 15 site-years of the study; and
  - Segregating cyclists from pedestrians is advisable for particularly high flows of either pedestrians or cyclists.

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DfT 1993

Module 3 Section 3 43

Pedestrian Areas (3)

- Motor vehicle free links encourage more cycling
- Assume that cyclists are permitted unless there is a substantiated reason not to
- May be desirable to mark cycling path
  - Can use different surfacing, edge delineation
  - Could encourage slower and more considerate cycling in high-use pedestrian areas

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Module 3 Section 3 44

Pedestrian Areas (4)

- Low speed cycling does not equal low LOS
  - near origin or destination

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45

Module 3 Section 3

Section 3 Summary

- Off-road paths still have negative aspects
  - E.g. conflicts at driveways
- Planning
  - Soft separation of modes, or directions?
- Design
  - Widths
  - Horizontal and vertical curves, drainage
  - Pavements
  - Lighting
- Traffic Management
  - Bollards, signs and markings
  - Allowing cyclists in pedestrian areas

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46

Module 3 Section 3

Advanced Planning and Design for Cycling

Module 3 Midblock and Path Design

Section 4
Mixed traffic, shared lanes and cycle lanes

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VIASTRADA

Section 4 outline

- Shared roadway facilities, most suited for an enthused & confident audience
- Cycle lane design considerations
  - Width
  - Issues – parking, driveways, turning vehicles
- Shared cycle / bus lanes
  - Bus stop layouts
- Finding space
- Marking products
- Alternatives
  - Vehicular cycling

Why still design cycle lanes?

- The latest planning approach seems to be focused on providing for *Interested but Concerned*
- But this doesn't mean we should neglect the *Enthused & Confident* altogether!
  - May still be the chosen Target Audience for some routes
  - Need a holistic approach in network planning
  - Ensure that directness is provided for strategic routes
- Target Audience concept is a spectrum
  - Some on-road facilities are also suitable for a certain percentage of *Interested but Concerned*
- Principles for designing cycle lanes follow through to other facilities

Midblock elements

- Midblock carriageways may have:
  - General traffic lanes
  - Parking
  - Bus stops
  - Medians (flush or solid)
  - Bus lanes
  - Cycle lanes
  - Protected cycleways

- Cycle facilities can be hard to accommodate with all the other elements

Cycle lanes

- Identify where motor vehicles and cyclists should position themselves to interact safely
  - Especially important at “pinch” or “stress” points
  - Helps remind motorists of possibility of the presence of cyclists
- Cycle lanes legally designated by cycle symbols
  - Motorists can't normally drive on cycle lanes
    - Maximum length of 50 m for manoeuvres - RUR 2.4(4)b
  - Motorists can’t park on a cycle lane
    - Broken yellow (no stopping) lines strongly recommended (Wilke & Ferigo 2009)

Cycle lanes – width

- “Your space – my space”
  - Cyclists are legally allowed to ride in traffic lane even when cycle lane is marked
  - However motorists may expect that cyclists should stay in cycle lane
- Suggests that mixed traffic lane preferable to narrow cycle lanes

Parkin and Meyers (2009)

On-road issues: insufficient space

- Should not include channel when calculating cycle lane width if:
  - Debris & sumps in channel reduce its rideability
  - Differences in levels between edge of channel & seal due to added pavement layers
    - Important issue for resealing programmes
    - Don't count on channel, or always mill
- Channel can be included in cycle facility width if it is a smooth, rideable surface

Gasson Street, Christchurch

Module 3, Section 4 7

Cycle lane & parking widths

- Without parking (kerbside):

Road Speed	≤ 50 km/h	70 km/h	100 km/h
Desirable Min. Width (m)	1.5	1.9	2.5
Acceptable Range (m)	1.2 - 2.2	1.6 - 2.5	2.0 - 2.5

  - Use speed limit unless 85th percentile significantly higher
  - Can interpolate for different speed limit values
  - If shoulder is greater than 2.5 m, chevron markings should be used to create cycling space 1.5 – 2.0 m wide separated from general traffic lane

NZ Supplement

Module 3, Section 4 8

Cycle lane & parking widths

- With parallel parking:

Road Speed / Lane	≤ 50 km/h	70 km/h	Parking
Desirable Min. Width (m)	1.8	2.2	2.0
Acceptable Range (m)	1.6 - 2.5	2.1 - 2.5	1.9 - 2.5

  - Use speed limit unless 85th percentile significantly higher
  - Can interpolate for different speed limit values
  - Absolute min. width (1.6 m) only to be used in low speed environments where wider cycle lane not possible
    - But note: Auckland abs min width next to parking = 1.8 m
  - Absolute min. width of cycle lane plus parking = 3.7 m (for 50 km/h) or 4.2 m (for 70 km/h)

NZ Supplement

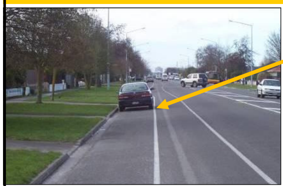
Module 3, Section 4 9

Cycle lane & parking widths

- Caveat – NZ Supplement guidance on widths
  - Dimensions based on (historical) industry consensus
  - Some localities now have different standards
- US research suggests that current layout not safe; cyclists forced to ride in door opening zone
  - Also applicable to on-road SBFs
    - but remember that the element width is in addition to the facility width
- Example:
  - Supplement: cycle lane plus parking - 3.7 m abs min
  - Applying Furth research to NZ conditions = 4.2 m (absolute min)

NZ TRANSPORT AGENCY Module 3, Section 4 Furth et al, 2010 12

Issues: Cycle lanes adjacent to parking



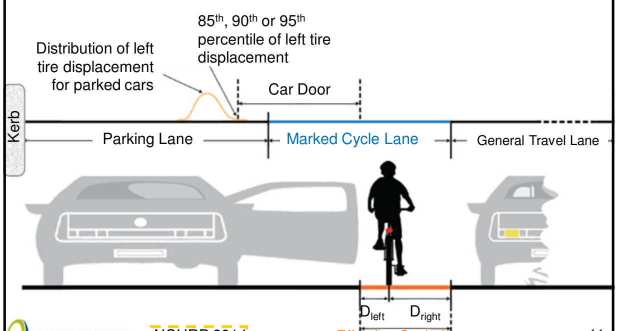
- Narrow parking lanes to constrain vehicles
  - Add 10 cm to parking lane width → motorists park 4.4 cm further from kerb (Furth et al, 2010)

- Dashed lines allows overlap for trucks

ule 3, Section 4 13

Issues: Cycle lanes adjacent to parking

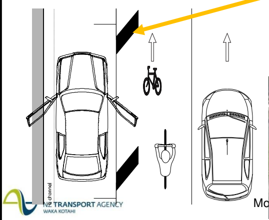
- The “dooring” issue…



NZ TRANSPORT AGENCY NCHRP 2014 14

Issues: Cycle lanes adjacent to parking

- Currently investigating the best method to encourage cyclists to avoid "dooring zone"
  - Buffer markings?
  - Coloured surface?



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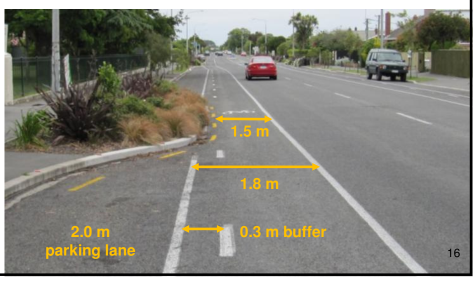
Issues: Pinch Points

- E.g. Cycle lanes at kerb extensions
  - photo: 1.8 m cycle lanes against parking are reduced to 1.5 m at kerb extensions – OK
  - see also Module 3 Section 4, Traffic Management



16

Electronic Warning Signs

- Used at pinch points or locations of poor visibility
- Illuminated when cyclists present to warn motorists

- Called by push button
- Could alternatively be called by inductive loops

Fleet & Kortegast, 2009

17

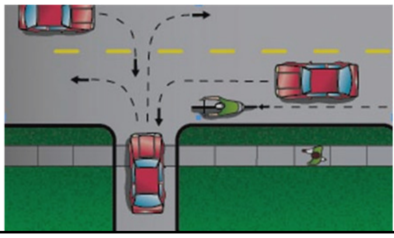
Issues: Cycle / crossing motorist crashes

- Auckland research shows that right turners being waved through queues is a major issue for cyclists and motorcyclists

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 Newcombe 2012 18

Issues: Driveways

- As previously discussed for protected cycleways
- Reduce motor vehicle turning speeds into midblock accesses
  - minimise driveway width and kerb radii
  - May need to do this via land development standards



NZ TRANSPORT AGENCY WAKA KOTAHI 19

Contra-flow cycle lanes

- Use when:
  - substantial travel time savings compared to motor vehicle route
  - the contra-flow route is short and directly accesses a significant destination
  - there are few conflict points (e.g. **driveways**) on the side of the proposed contra-flow lane
  - safe and convenient connections at both ends are provided
  - cyclists observed already using the link in contra-flow direction
  - a cycle lane of generous width can be fitted

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 TRB NCHRP Report 500, Vol. 18

Contra-flow cycle lanes – design

- Durable surface colouring
  - such as thermoplastic or coloured aggregates
- Prohibit parking adjacent to contra-flow lanes
- Contra flow lane widths
  - Absolute minimum 1.5 m
  - Desirable1.8 m
- Ideally provide kerb separation
  - Absolute minimum .6 m
  - Desirable 1.0 m

Austroads GRD3 (2009) p.66

Module 3, Section 4 21

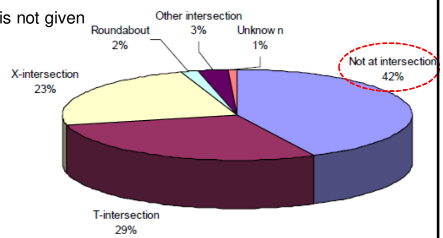
Should cycles be allowed in bus lanes?

- RUR 1.6: *"**bus lane** … for the use of:*
  - a) *buses; and*
  - b) *cycles, mopeds, and motorcycles (unless 1 or more are specifically excluded by the sign)"*
- Generally level of service to cyclists is improved by allowing cyclists to share bus lane
  - Safety, convenience, amenity
- **Only** prohibit cycles from the bus lane if alternatives offer a better LOS for cyclists
  - Consider 5 Main Requirements: (**directness**, **coherence**, safety, attractiveness, comfort)

Module 3, Section 4

Bus / cycle crashes

- Mid-block crashes are the major issue
- Number of crashes appears low given prevalence of shared bus / cycle lanes in Australia
  - Note exposure is not given



AP-R266/05

Figure 12 Fatalities and Serious Injuries in Bus-Bike Crashes, 1989-1996: Australia – by location of crash (Source: ATSB, 2003). [N = 112 or 14 per year]

Module 3, Section 4 23

Shared bus / cycle lanes

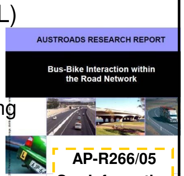
- If bus lanes are present can consider making them shared bus / cycle lanes
  - Need to be careful of widths used – see subsequent slides on width
  - Still not attractive to *interested but concerned* cyclists

Germany

NZ TRANSPORT AGENCY WAKA KOTAHI 25

Bus / cycle lanes

- A type of Special Vehicle Lane (SVL)
- Remember that cyclists and buses are different:
  - Speed differential and frequent stopping
- Two options:
  - Wide lanes (4.2 m or wider)
  - Narrow lanes (3.2 m or narrower)



AP-R266/05
See Information Note No 4

- **Not an option - in between widths (3.3-4.1m)**
  - ***Note: this guidance is not documented; you will only learn about it here***
  - ***Austroads allows absolute minimum shared lane width of 3.7 m – we suggest this is not suitable***

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 26

Bus / cycle lanes – design

- 4.2 m (or wider) bus / cycle lane
  - Ideal situation (for *enthused and confident*)
  - Accommodates bus and cyclist side by side
  - Can be a part-time bus lane
    - Off-peak times: convert to 2.3 m parking plus 1.9 m cycle lane
  - Often argued that cars use wide bus lanes when parking allowed
    - Is this really a big enough problem?
  - "Leap-frogging" between buses and cycles
    - May be uncomfortable for some cyclists

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3,

Bus / cycle lanes – design

- 3.2 m (or narrower) bus / cycle lane
  - Ensures bus and cyclist cannot pass each other
  - Less ideal due to delays incurred
    - Moving buses slowed behind cyclists
    - Cyclists stopped behind stopped buses
  - May not be appropriate for high bus / cycle volumes
  - Should not be used for part time lanes
    - Width not sufficient to act as parking lane plus cycle lane
    - Places cyclists into door opening zone
  - Buses may encroach on adjacent traffic lane to overtake cyclists

NZ TRANSPORT AGENCY   Module 3, Section 4   28

Bus / cycle lanes – design

- Intermediate width (3.3 – 4.1 m) bus / cycle lane **should not be used**
  - Users may be tempted to pass each other but the width does not ensure this can occur safely

NZ TRANSPORT AGENCY   Module 3, Section 4   29

Bus / cycle lanes – examples

Part-time bus lanes:

4.2 m

Ample room for cyclists

3.0 m

Cycling fully within the door opening zone

Auckland

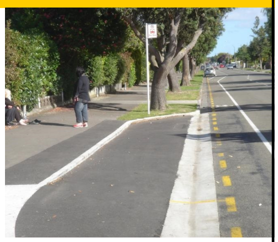
NZ TRANSPORT AGENCY   Module 3, Section 4   30

Bus stops – issues

- Bus stops can create "pinch points" in available carriageway width
  - Space otherwise available for cycle lanes except for at discrete locations

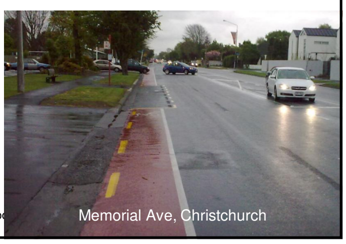
Bus stops – design

- Ensure enough footpath width remains
  - for shelters, seats and queuing passengers
- Disadvantages buses
  - forced to find re-entry gap in traffic
- Requires longer stop length
  - Therefore more kerb work and parking removal
- Indented bus stops are best to be avoided



Bus stops – design

- Generally preferable to interrupt cycle lane by bus stop than not provide cycle lane at all
  - Take into account the frequency of buses using the stop
  - Do not use this option for a bus lay-over point
- Indented bus stops not favoured
  - Buses usually still overhang into cycle lane
  - Delays when re-entering traffic



Memorial Ave, Christchurch

Bus stop layouts

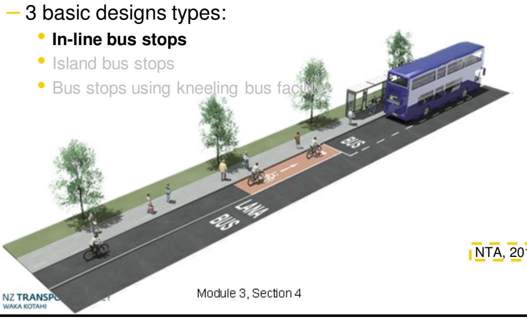
- Ireland's National Cycle Manual (NTA 2011)
  - Section 5.1.5
  - 3 basic designs types:
    - In-line bus stops
    - Island bus stops
    - Bus stops using kneeling bus facility

NTA, 2011

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 34

Bus stop layouts

- Ireland's National Cycle Manual (NTA 2011)
  - Section 5.1.5.1
  - 3 basic designs types:
    - **In-line bus stops**
    - Island bus stops
    - Bus stops using kneeling bus facility

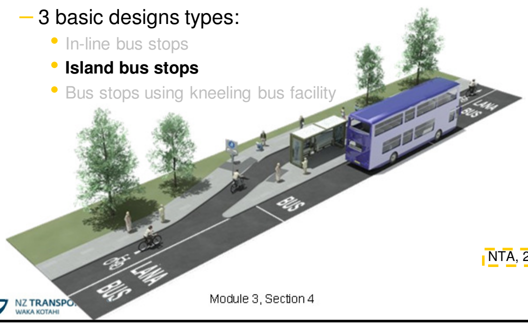


NTA, 2011

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 35

Bus stop layouts

- Ireland's National Cycle Manual (NTA 2011)
  - Section 5.1.5.2
  - 3 basic designs types:
    - In-line bus stops
    - **Island bus stops**
    - Bus stops using kneeling bus facility

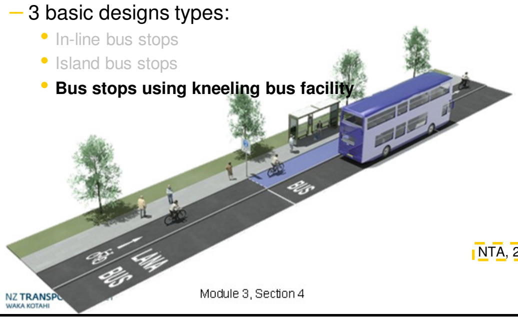


NTA, 2011

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 36

Bus stop layouts

- Ireland's National Cycle Manual (NTA 2011)
  - Section 5.1.5.3
  - 3 basic designs types:
    - In-line bus stops
    - Island bus stops
    - **Bus stops using kneeling bus facility**



NTA, 2011

Module 3, Section 4 37

Finding space: Modify general traffic lanes

- To accommodate cycle lanes it may be necessary to reduce the widths of general traffic lanes
  - In urban areas it is often preferable to narrow traffic lanes to a width less than 3.5 m (NZ Supplement)
  - Example – City of Yarra, Melbourne: 2.5 m – 3.0 m (McDonald 2012)
  - But minimum width cycle lanes adjacent to narrow traffic lanes should be avoided
- May also be possible to reduce the number of general traffic lane ("Road Diet")

Module 3, Section 4 38

Finding space: Road diet

- Kaikorai Valley Road, Dunedin
  - 2003 conversion
  - Arterial approx. 10,000 AADT
  - 4 to 2 lanes with median
  - Cycle lanes, landscaping
  - Improved safety, mobility and accessibility
- Highlighted in Road Diet Handbook (Rosales, 2007)

http://www.streetsblog.org/2007/05/03/the-benefits-of-a-road-diet/

Module 3, Section 4 39

Finding space: Road diet

- Convert 4-lane road to:
  - 2 general traffic lanes plus cycle, bus lanes / median
  - "2+1" general traffic lanes plus cycle lanes
- Benefits
  - Reduced speeds
  - Reduced conflict points
  - Improved sight distance
- Reduced capacity may not be significant – consider objectives and hierarchy

Dan Burden: http://www.walkable.org/assets/downloads/roaddiets.pdf

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 41

Finding space: Modify medians

- Flush medians traditionally installed to:
  - Reduce head-on crash rates
  - Provide space for right turners to queue & reduce rear end crashes
  - Provide space for crossing pedestrians
  - Narrow traffic lanes
- But these may not always be necessary
  - Need to weigh up against the potential benefits of providing space for cycling
    - Cycle safety
    - Increasing cyclists' comfort and therefore cycle volumes
    - Reduced motor vehicle speeds

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 42

Finding space: Modify medians

- Installing cycle lanes also narrows traffic lanes
  - Therefore can result in speed reductions (often an intention behind introducing medians)
- May be possible to reduce median widths or remove them altogether

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 4 43

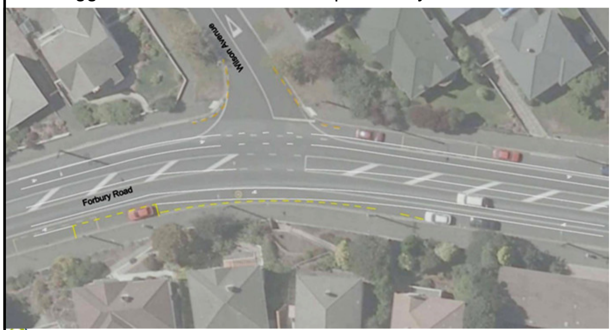
Finding space: Modify medians

- Before - median and no cycle lanes

Module 3, Section 4 44

Finding space: Modify medians

- Suggested - remove median to provide cycle lanes



Module 3, Section 4 45

Finding space: Remove parking

- Midblock parking areas often have low utilisation rates
- But parking removal may have strong public opposition
- Check any applicable road user hierarchies or parking policies
  - Mobility (e.g. cycling) may be higher priority than storing private property (parking)
  - Could be supported in parking strategy
  - Draft AT parking strategy sees the removal of parking from arterial roads in the long term

Module 3, Section 4 46

Finding space: Remove parking

- Don't always have to remove parking from both sides of the road
  - Alternate sides of road with parking
    - Transition points at intersections to maximise space
  - Ensure parking provided outside critical areas
    - Dairies & local businesses
    - Parks

47

Finding space: Modify parking – indent bays

Module 3, Section 4

48

Finding space: Modify parking – alternate sides

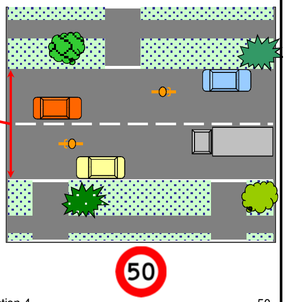
- Parking provided on one side at a time
- Side with parking alternates along the road
- Side roads are handy locations for transitions

Strickland Street, Christchurch

49

Examples: finding space – case 2

- Situation:
  - Urban (50 km/h)
  - Collector Rd (4,000 vpd)
  - Residential frontages
  - 9.4 m carriageway
    - 5 m berms with trees
  - 20% average parking occupancy
    - Both sides

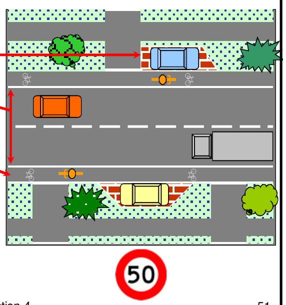


Module 3, Section 4 50

Examples: finding space – case 2

- Suggested solution:
  - Parking bays in the berm as required
  - 3.2 m traffic lanes
  - 1.5 m cycle lane both sides (no parking)

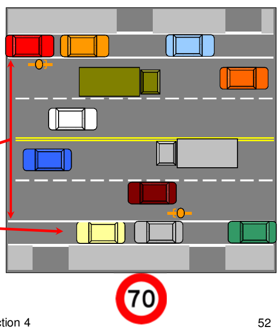
Consider traffic calming area instead?



Module 3, Section 4 51

Examples: finding space – case 3

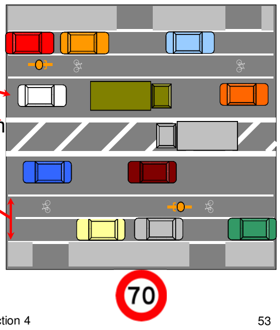
- Situation:
  - 70 km/h Minor Arterial
    - 16,000 vpd
  - Comm./Indus. frontages
  - 17.6 m carriageway
    - 2 m concrete berms
  - 2 x 3.4 m lanes
  - 2.0 m parking lanes
  - 90% avg. parking occupancy



Module 3, Section 4 52

Examples: finding space – case 3

- Suggested solution:
  - Only one 3.4 m traffic lane each side
  - 3.0 m flush median
  - 1.9 m cycle lane next to 2.0 m parking lane



Consider alternative route or reduce speed limit?

Module 3, Section 4 53

Cycle lane colour – purpose

- To make motorists aware of the likely presence of cyclists, particularly in conflict points
  - Side streets
  - Intersection facilities (ASB, ASL, hook turn)
  - Sections of cycle lane with continuity lines
- To inform cyclists of presence of facilities
  - Start of cycle lane
  - Transition to off-road path
  - Advanced stop box
  - Hook turn

MOTSAM

Module 3, Section 4 54

Cycle lane colour – efficacy

- The Effects on Motor Vehicle and Bicycle Behaviour of Colouring Bicycle Facilities at Signalised Intersections
  - Study of 18 intersection facilities (ASBs or ASLs)
  - Found motorists are much less likely to encroach on coloured ASBs and ASLs than uncoloured ones

Koorey & Mangundu, 2009

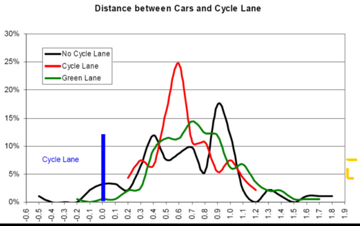
- The Impact of Coloured Surfacing on Car Drivers' Compliance with Bus and Cycle Lanes
  - Compliance rates of motorists with respect to coloured and uncoloured bus and cycle lanes
  - Coloured surfacing markedly improved compliance of moving vehicles
  - However, rates of parking / loading infringements were relatively unchanged

Rye, Bradley & McKeown, 2007

Module 3, Section 4 55

Cycle lane colour – efficacy

- Effect of Colouring a Cycle Lane
  - The introduction of an uncoloured cycle lane improved motorist behaviour
  - When the cycle lane was coloured both cyclist behaviour and motorist behaviour and compliance improved further
  - Stationary cars parked closer to the kerb and moving cars stayed within their lanes



Skilton, 2007

NZ TRANSPORT AGENCY 56

Cycle lane colour – products

Coloured / printed asphalt

Epoxy glue coloured chipcoat

Skilton, 2007

Thermoplastic

NZ TRANSPORT AGENCY Module 3, Section 4 57

Cycle Lane Colour - Products

- Costs depend on size of job and exclude traffic management, any setup charge
- Resins can be scattercoat (bonded) or troweled (bound)

Product	Initial Cost	Lifespan	Cost over 25 years	Colour retention
Asphalt[1]	$90 / m^2	4-5 years	$342 / m^2	Low
Epoxy[1]	$65 / m^2	7 years	$219 / m^2	Medium
Thermoplastic[1]	$70 / m^2	10 years	$162 / m^2	High
Vistagrip resin [2]	$50 / m^2	10+ years		High
Synthite epoxy and resin[3]	$50 / m^2			High
Resin[4]	$100 / m^2			High

1. Skilton, 2007
2. http://www.resinsurfaces.co.nz/#
3. NZ industry estimate
4. http://www.pavingexpert.com/resin.htm

NZ TRANSPORT AGENCY Module 3, Section 4 58

RRPMs

- RRPMs – Reflective Raised Pavement Markers
  - Reflective studs
  - "Catseyes" (UK, 1993) depress when driven over
  - Height 6-8 mm
  - Appropriate gaps
- Improve lane discipline / unintended incursions into cycling space
- High speed roads where there is adequate shoulder space or shared lane width
- Mixed response from cyclists

MOTSAM 4.06; TNZ M/12; RTS 5: 6.1.3; RR 322 , 365

NZ TRANSPORT AGENCY Module 3, Section 4 59

ATPM

- Intended to reduce driver inattention due to fatigue
- ATPM – Audio Tactile Profiled Marking
  - MOTSAM: "Profiled Edge Lines"
  - Perceived higher security for some cyclists
  - Thermoplastic
  - 100 -150 mm wide in NZ
- "Raised ribs" (UK)
- "Rumble strips" (USA)
  - 400 - 600 mm wide transverse channels
  - inexpensive, no maintenance
  - primarily rural applications
  - minimum 1.2 m of smooth shoulder

MOTSAM 4.08.02 (e); TNZ M/24; RR 322 ,365

NZ TRANSPORT AGENCY Module 3, Section 4 60

Broken Yellow Lines

- Since 2005, cycle lanes are "special vehicle lanes" and therefore do not require broken yellow lines (BYLs)
- However, many motorists still park in cycle lanes that do not have BYLs
  - Many localities have a mixture of kerbside cycle lanes with and without BYLs
  - Low levels of enforcement
- Therefore, advisable to mark all kerbside cycle lanes with BYLs

Wilke & Ferigo, 2009

NZ TRANSPORT AGENCY Module 3, Section 4 61

Vehicular cycling

Module 3, Section 4 62

Vehicular cycling

Vehicular cycling

- Primary position
  - The centre of the traffic lane
- Secondary position
  - Just to the left of motor vehicle traffic, but:
  - Well clear of parked cars and opening doors
  - At least 0.5 m from the kerb, and if it is safe
- In a busy road environment this is only suitable for experienced cyclists
  - Cannot expect Interested but Concerned cyclists to be comfortable with this principle

Module 3, Section 4 64

Section 4 Summary

- Cyclists face a number of issues in the midblock
  - safety, space, turning right, crossing
- There are different ways of making space for cyclists, generally involving changes for other road users.
- Coloured surfacing, RRPMs, ATPMs and electronic warning systems can be used to enhance awareness of cyclists and cycle facilities

NZ TRANSPORT AGENCY Module 3, Section 4 65

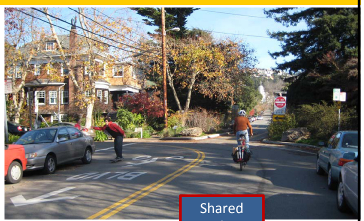
Advanced Planning and Design for Cycling

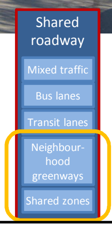
Module 3 Midblock and Path Design

Section 5 Neighbourhood Greenways & Traffic Management

Section 5 Outline

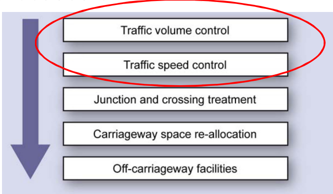
- Introduction
- Definitions
- LATM Process
  - GTM process
  - consultation
  - monitoring
- Speed-based design
  - vertical deflection
  - horizontal deflection
- Flow restrictions
- Shared streets





Introduction

- Remember that providing for cyclists is not just about providing cycle facilities.
  - *Interested but concerned* cyclists may be comfortable with neighbourhood greenways
    - i.e. low-volume, low-speed shared streets
    - may be achieved by traffic management
- Traffic management focuses on first two IHT hierarchy measures



Definitions

- Neighbourhood greenways
  - a.k.a. quiet streets / slow streets / bicycle boulevards
  - Streets with low traffic volumes and speeds
- Local Area Traffic Management (LATM) is the planning and management of the usage of road space within a local traffic area
  - modified street designs may be considered inappropriate to the needs of residents and users
  - may use physical devices, streetscape treatments and regulations
- to influence vehicle operation, in order to create safer and more pleasant streets in local areas.

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 Austroads 2009:GTM part 8 4

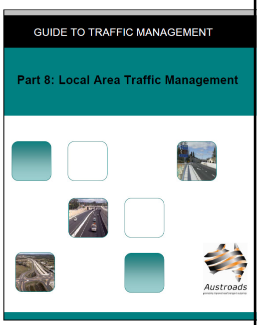
Neighbourhood Greenways

- Useful guidance in NACTO
  - Reduce motor vehicle volumes to 1,500 or 3,000 vehicles/day (depending on road characteristics)
  - Reduce vehicle speeds, preferably to 20 mph (32 km/h)
  - Traffic management treatments to achieve these recommendations

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 Nacto.org

LATM – Austroads GTM 8

- GTEP Part 10: LATM (2004) replaced by...
- GTM Part 8: LATM (2008)



NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 6

LATM – Austroads GTM 8 (2)

- Pedestrian and cycle planning involves:
  - the creation of compact mixed use accessible centres around public transport stops
  - the use of walking and cycling catchment mapping, accessibility zoning and integration of regional walking and cycling networks.
- Cyclists and pedestrians considered at all stages of LATM planning and design

GTM part 8

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 7

LATM process

- LATM is a planning issue
  - not just engineering!
- Neighbourhoods are systems
- Systematic process is needed...

GTM part 8

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 8

LATM process (2)

- The GTM suggests this process:
  - identify and quantify the "real" problem
  - conduct a study on area-wide basis
  - consider area-wide implications of access restrictions
  - use self-enforcing measures, not enforcement
  - facilitate non-motorised movement
  - provide for emergency and utility services
  - monitor and follow up
- We will briefly explore some planning issues...

GTM part 8

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 9

Process – prioritisation

- community requests logged in register
- investigation bi-annually
  - can see wider picture
  - reduces temptation to "whack a mole"
- if result of a crash, may be pressure to investigate immediately
  - best to have template answers to maintain consistency and integrity

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 10

Process – consultation

- set a benchmark (e.g. 75% of *respondents* must agree to some form of LATM intervention)
- must also have a quorum (e.g. 50% of residents responding)
- note that during process people may move
  - best to include these projects on LIM reports!

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 11

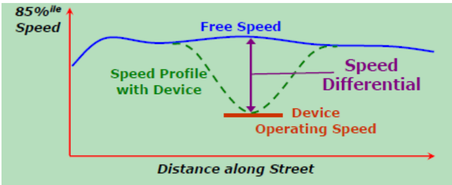
Process – monitoring

- Important to quantify effects of LATM for:
  - funding assessment
  - community support (or criticism…)
- Speed reduction effects:
  - travel time
  - safety benefits
- Volume reduction:
  - redistribution of network flows
  - livability of streets (could be the hardest to quantify)

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 12

Speed based design

- Differential between free and desired speed profiles
- Determine device effectiveness
- Determine device spacing

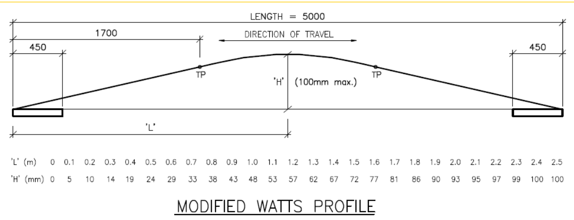


Brindle 2008)

NZ TRANSPORT AGENCY WAKA KOTAHI   Module 3, Section 5   13

Vertical deflection – humps

- Typical speed hump is “round topped”
- “Watts Profile” speed hump
  - still not comfortable at speed or with trailer / cargo
  - consider longitudinal channels or cycle bypasses



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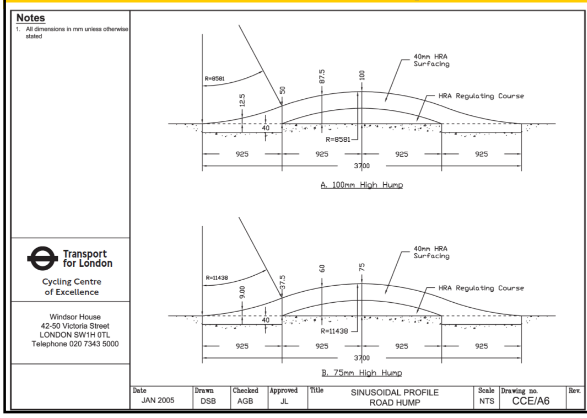
Sinusoidal hump



15

Vertical deflection platforms

- Also called ‘flat top humps’
- More cycle-friendly than speed humps
- Better for longer buses

NZ TRANSPORT AGENCY WAKA KOTAHI 16

Vertical deflection bypasses (1)

- Insufficient width
- Bypass may not be accessible due to parking

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 17

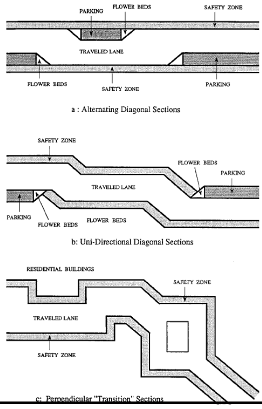
Vertical deflection bypasses (2)

- Raised central median, hump and bypass
- Hotmix surface, colour would be ideal to show

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 18

Horizontal deflection

- May be complete street treatment
  - 'Home zone"
- Sharp deflection slows traffic
  - provides planting room
- Decreases differential between motor vehicle and cycle speeds



Polus and Craus 1996

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, 19

Horizontal deflection

- Home zone with access restriction
- Appropriate on low volume streets

Pt England, Auckland

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 20

Horizontal deflection

- Reduced width, two-way
  - cyclist may remain on carriageway or take the bypass provided on both sides
  - Note the smooth kerb cut down transition

21

Horizontal deflection

- Reduced width, one way
- Cycle or shared use bypasses both sides
  - Smooth transitions with minimal lip, gentle radius
  - Hot-mix is better than chip seal
  - Consider use of coloured surfacing at entry / exit points

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 22

Horizontal deflection

- Give way ‘neck down’

23

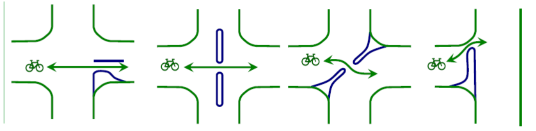
Access restrictions

- Former high speed corner now appears to be cul-de-sac

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 24

Access restrictions

- Access restrictions can achieve LATM objectives and a “**bicycle boulevard**”
- Must be direct
- Under-utilised in NZ



Walker, et al (2009)

Access restrictions

- One way access
  - network permeability for non-motorised users
  - access possible by car, less convenient
  - provides traffic calming benefits

Eugene, OR (G. Koorey)

Access restrictions

- No through access (for cars)
- Cul-de-sac on former through street
- Another example on next slide

Access restrictions

- Direct link, bypassing traffic signals, on shared path through park to a major supermarket

Angus / Forbes Street, Christchurch

NZ TRANSPORT AGENCY WAKA KOTAHI 28

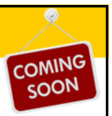
Access restrictions

- No Entry – except for buses and cycles

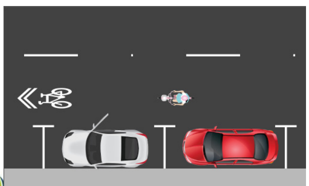
Wellesley St. Auckland

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 29

Sharrows



- Tool to encourage vehicular cycling
  - Indicates to cyclists where to ride on road, and informs motorists that cyclists are expected (allowed) to be there
- Best practice note currently being drafted
  - Will hopefully be included in first tranche of next rule changes for cycling, due in July 2016



NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 30

Contra-flow cycle facilities

- Allow cyclists to go against one-way traffic
  - Can be part of separated two-way cycle path

Tuam St contra flow Christchurch

- Design principles
  - Physically separated by barrier/kerb/median
  - Good end treatments needed at intersections
  - Highlight wrong-way flow to all road users

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 31

Shared streets

- Include pedestrians
- Legal basis is RUR 10.2 (Shared Zone)

(1) A driver of a vehicle entering or proceeding along or through a shared zone must give way to a pedestrian who is in the shared zone.
(2) A pedestrian in a shared zone must not unduly impede the passage of any vehicle in the shared zone.

- LAs can pass bylaws
  - AT Traffic Bylaw 2012

Except where Auckland Transport has by resolution specified otherwise, no person may stand or park a vehicle in a road specified as a shared zone.

Fort St, Auckland

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 32

Shared streets – local

- Residential street traffic calming / LATM treatments – the "Woonerf"
- No footpath – street for all road users and play

Ely St. Christchurch

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 33

Shared Streets – corridor

- Kensington High Street, West London
- 40,000 vpd
- Pedestrian barriers and crosswalks removed
- Bike parking in central median
- Many signs and markings removed
- Shared street features may include
  - threshold entry
  - central island
  - landscaping
  - “kerb-less” pavement

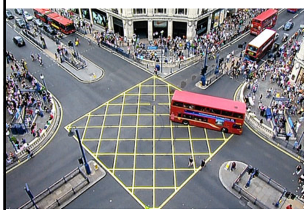
Hamilton-Baillie (2008)

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 34

Shared streets – intersection

- Oxford Circus, London

Before



After

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 35

Shared spaces

- Further Reading:

  Project for Public Spaces
  http://blog.pps.org/shared-space/

  Shared Spaces Institute
  http://www.sharedspace.eu/en

The Netherlands

NZ TRANSPORT AGENCY WAKA KOTAHI Module 3, Section 5 36

Section 5 summary

- Local Area Traffic Management (LATM)
  - useful in reducing motor vehicle volumes and speeds
  - therefore key in developing neighbourhood greenways
- Traffic Control Devices (TCDs)
  - access and speed controls
  - should be designed with cyclists in mind, may give some advantage to cyclists over motor vehicles
  - sharrows (coming soon) to guide cyclist positioning
- Contra-flow cycle lanes
  - give permeability advantages to cyclists
- Shared streets / spaces
  - make cyclists and pedestrians more equal with motorists.

Advanced Planning and Design for Cycling

Module 3 Midblock and Path Design

Section 6
Module 3 wrap-up

NZ TRANSPORT AGENCY
WAKA KOTAHI

VIASTRADA

Protected cycleways

- Likely to encourage *Interested but Concerned* people to cycle
- Different forms available
- Perceived to be safer
  - Separation from moving traffic
- Actual safety highly dependent on context and design
  - Driveways are critical elements
    - Especially where there is contra-flow cycling
    - Essentially intersections

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WAKA KOTAHI

Module 3, Section 6 2

Paths for cycling

- Safety
  - Consider interactions with pedestrians
  - As for protected cycleways, conflicts at driveways are critical, especially for contra-flow cycling
- Planning
  - Segregate users or directions?
- Design
  - Widths, horizontal and vertical curves, drainage, surface type, lighting
- Traffic Management
  - Bollards, signs and markings
  - Allowing cyclists in pedestrian areas

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Module 3, Section 6 3

On-road midblock design A

- Shared roadway facilities mainly for enthused & confident cyclists
- Cycle lane widths
  - new research suggests mixed traffic lane preferable to narrow cycle lanes
- Cycle lane separation
  - Painted line, kerb, vertical poles etc...
- Finding space
- Bus lanes, transit lanes
- Vehicular cycling

NZ TRANSPORT AGENCY Module 3, Section 6 4

Neighbourhood Greenways & Traffic management

- Neighbourhood greenways
  - low vehicle speeds and volumes
  - Appropriate for *interested but concerned*
- Traffic management includes
  - traffic control devices (TCDs) for speed reduction
  - access restrictions which improve relative travel time for cycles versus cars

NZ TRANSPORT AGENCY 5

The end

- We hope you found this course useful
  - And enjoyed it!
- Course evaluations, please…

<table>
<tr><th>Module</th><th>Level</th><th>Duration</th><th>Topic</th></tr>
<tr><td>1</td><td>Fundamentals</td><td>1 day</td><td>Planning and Design for Cycling</td></tr>
<tr><td>2</td><td rowspan="3">Advanced</td><td>½ day</td><td>Planning and Funding
• Policy and legislation
• Data Collection and analysis
• Evaluation and funding
• Auditing</td></tr>
<tr><td>3</td><td>½ day</td><td>Mid-block and Path Design
• General midblock issues
• Protected cycleways
• Cycle Lanes and Parking
• Cycle Paths and Shared Paths
• Neighbourhood greenways & Traffic Mgmt</td></tr>
<tr><td>4</td><td>1 day</td><td>Intersection Design</td></tr>
</table>

Module 3, Section 6 6