

Stop and goes of traffic signals

A traffic signal auditor's perspective



 Land Transport NZ
Ikiiki Whenua Aotearoa

 VIASTRADA

Stops and goes of traffic signals

*Looking backwards
and forwards*

Axel Downard-Wilke

Aug 2023

2004 SNUG presentation

<h3>Stops and Goes of Traffic Signals</h3> <p>Arel Wilks Christchurch City Council</p>	<h3>Introduction</h3> <ul style="list-style-type: none"> Commissioned by Transfund Objective <ul style="list-style-type: none"> Contribute to improving the efficiency and safety of the network Purpose <ul style="list-style-type: none"> Assist and advise practitioners 	<h3>Overview</h3> <ul style="list-style-type: none"> Background LTSA crash analysis for signals Photos showing good and bad practice Recommendations for each major issue Conclusions 	<h3>Disclaimer</h3> <ul style="list-style-type: none"> You may recognise some photos! Some might be from your "patch" You may have designed/implemented the features in question You may have had good reasons to do so Some might have been fixed/modified since The aim is to learn from all of them <p>Discussion phase!</p>	<h3>Background</h3> <ul style="list-style-type: none"> Representative number of existing traffic signals has been audited Covering some 12 TLAs Including Transit installations "Stops and Goes" summarises common trends and themes 	<h3>Content of "Stops & Goes"</h3> <ul style="list-style-type: none"> Draws attention to items frequently compromising safety and efficiency Presents ways how these deficiencies could be addressed Includes photos and illustrations showing <ul style="list-style-type: none"> Good practice Not so good practice 	<h3>Crashes at Traffic Signals</h3> <ul style="list-style-type: none"> Based on Tim Hughes' analysis Presented at previous SNUG meeting Main safety issues <ul style="list-style-type: none"> Right-turn-against crashes 32% Failed to stop for red 30% Pedestrians 14% Cyclists 8% 	<h3>Crashes at Traffic Signals cont.</h3> <ul style="list-style-type: none"> Factors contributing to RT against red light running crashes listed Different turn philosophies have different crash rates <ul style="list-style-type: none"> See next slide Observations on pedestrian and cycle crashes offered A simplification of Give Way rules would help both groups 	<h3>Typical crash rate reductions</h3> <ul style="list-style-type: none"> Compared to full filtering <ul style="list-style-type: none"> 30% for lag right turns 68% for lead RT, then filtering 90% for lead RT w/o filtering 	<h3>Common deficiencies</h3> <ul style="list-style-type: none"> Right turn lanes Captive turn lanes Slip lane design Signal conspicuity Sufficient number of displays Turn arrow operation Turn arrow logic Push button location Cyclist issues
<p>Right turn lanes</p>	<h3>Right turn lanes</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Ensure RT bays line up (back to back design) Reduce RT lane width Where opposed RT lanes are not possible, consider different phasing operation or RT bay 	<p>Right turn lanes</p>	<p>Right turn lanes</p>	<h3>Captive turn lanes</h3>	<h3>Captive turn lanes</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Channel drivers into through lanes whenever possible Engineering plans to show turn into mid-block layout Have sufficient pre-warning when captive lanes cannot be avoided 	<p>Captive turn lanes</p>	<p>Slip lane design</p>	<h3>Slip lane design</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Appropriate size of islands High-entry angle type Location of ped crossing point should provide sufficient intervisibility Ped priority issues can be addressed using signalized slip lanes or a zebra crossing 	<p>Slip lane design</p>
<p>Signal conspicuity</p>	<h3>Signal conspicuity</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Should have upgrading programme for conversion to tall posts Locate posts close to kerb, and close to tangent point (minimize corner radii) Use level extensions wherever possible Make your signals visible (under-ground aerial services, use joint-use poles, don't point trees in front of posts/points trees) 	<p>Signal conspicuity</p>	<h3>Sufficient number of displays</h3>	<h3>Sufficient number of displays</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> All displays in primary or dual primary location (including arrows) Minimum number of displays for major movements is three Minimum number of displays for minor movements is two One display is sufficient for two approach lanes only At least one aspect must be illuminated in any one signal face at any one time 	<p>Sufficient number of displays</p>	<p>Turn arrow operation</p>	<h3>Turn arrow operation</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Where present, use arrow displays for (at least) partial pedestrian protection Control programmed so that unintentional left turn is prevented, not possible Ensure turning traffic doesn't call side street phases 	<p>Turn arrow operation</p>	<p>Turn arrow logic</p>
<h3>Turn arrow logic</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Correct sequence for transition from protected RT to filter lanes leading the red arrow for S lane Green LT arrows should be operated whenever their movement is unopposed LT loop should call an associated RT movement (see next slide) Use standard operating sequences Seek expert help and insist on peer reviews 	<p>Turn arrow logic</p>	<p>Pedestrian phase issues</p>	<h3>Pedestrian phase issues</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Base clearance time settings on crossing geometry and user profile Where present, use arrow displays for (at least) partial pedestrian protection An alternative to arrow protection is a late start of the vehicle phase (generally 3 sec) RT from stem of T should not face a ped crosswalk (unless signal protection is used) Don't have late ped introduction or re-introduction with conflicting vehicle movements 	<p>Pedestrian phase issues</p>	<p>Push button location</p>	<h3>Push button location</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Install push buttons at the cut-down Make use of curb posts if required Ensure embossed arrow and tactile paving are orientated correctly Avoid safety risks obscuring push buttons Ensure any minimum spacing of audio-tactile equipment Comply with RTS 14 	<p>Push button location</p>	<p>Cyclist issues</p>	<h3>Cyclist issues</h3> <ul style="list-style-type: none"> Consider the following factors <ul style="list-style-type: none"> How safe is intersection for cyclists What is the existing demand by cyclists Are there reasonably alternative routes Are there planned projects that could include improvements for cyclists Factors should determine the priority order Ultimately, all intersections should work for cyclists
	<h3>Cyclist issues</h3> <ul style="list-style-type: none"> Recommendations <ul style="list-style-type: none"> Aim for a treatment that is as far as possible suitable for cyclists with basic competence All normal manoeuvres should be possible Manage conflict between LT, motorcycle and straight through cyclists (consider slip lanes) Achieve a layout intuitive to all road users Use coloured surfaces 	<p>Cyclist issues</p>	<p>Cyclist issues</p>	<p>Cyclist issues</p>	<p>Cyclist issues</p>	<p>Cyclist issues</p>	<h3>Conclusions</h3> <ul style="list-style-type: none"> Engage competent signal engineer for the peer review of new designs <ul style="list-style-type: none"> Road safety audit process is not sufficient Signal peer review is separate Engage suitably experienced specialists for the auditing of SCATS set-ups 	<h3>Conclusions cont.</h3> <ul style="list-style-type: none"> Suitably qualified engineers ask SNUG committee members for a list <ul style="list-style-type: none"> www.penz.org.nz/sng Commission audits of your existing traffic signals Engage competent signal engineer for the peer review of new designs 	<h3>Availability of "Stops and Goes"</h3> <ul style="list-style-type: none"> Get your copy here Order more copies from Transfund <ul style="list-style-type: none"> contact Ian Appleton Online soon (LTNZ website) Thank you

2004 SNUG presentation (slide 1)

Stops and Goes of Traffic Signals

Axel Wilke
Christchurch City Council



Turn arrow logic

- Recommendations
- Correct sequence for transition from protected RT to filter lanes leading the red arrow for 3 lanes
- Green LT arrows should be operated whenever their movement is unopposed
- LT loops should call an associated RT movement (see next slide)
- Use standard operating sequences
- Seek expert help and insist on peer reviews



Introduction

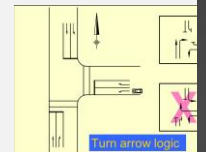
- Commissioned by Transfund
- Objective
 - Contribute to improving the efficiency and safety of the network
- Purpose
 - Assist and advise practitioners

Right turn lanes

- Recommendations
 - Ensure RT bays line up (back to back design)
 - Reduce RT lane width
 - Where opposed RT lanes are not possible, consider different phasing operation or RT ban

Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to tall posts
 - Locate posts close to kerb, and close to tangent point (minimise corner radii)
 - Use kerb extensions wherever possible
 - Make your signals visible (underground aerial services, use joint-use poles, don't point trees in front of posts (point trees))



Axel Wilke
Christchurch City Council

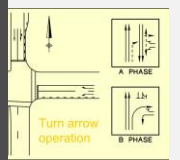


Signal crash rate reductions

- 30% for lag right turns
- 68% for lead RT, then filtering
- 90% for lead RT w/o filtering

Slip lane design

- Recommendations
 - appropriate size of islands
 - entry angle type
 - location of ped crossing point should provide central intervisibility
 - priority issues can be addressed using aligned slip lanes or a zebra crossing



Design considerations

- Designed by qualified engineers
- SNUG committee members for a list: v.penz.org.nz/snug
- Commission audits of your existing signals
- Engage competent signal engineer
- Require peer review of new designs

Common deficiencies

- Right turn lanes
 - Captive turn lanes
 - Slip lane design
 - Signal conspicuity
 - Sufficient number of displays
- Turn arrow operation
 - Turn arrow logic
 - Ped phase issues
 - Push button location
 - Cyclist issues



Cyclist issues

- Consider the following factors
 - How safe is intersection for cyclists
 - What is the existing demand by cyclists
 - Are there reasonably alternative routes
 - Are there planned projects that could include improvements for cyclists
- Factors should determine the priority order
- Ultimately, all intersections should work for cyclists

Availability of "Stops and Goes"

- Get your copy here
 - Order more copies from Transfund
 - Contact Ian Appleton
 - Online soon (LTNZ website)
- Thank you

2004 SNUG presentation (slide 2)

Stops and Goes of Traffic Signals

Arel Wilks
Christchurch City Council



Turn arrow logic

- Recommendations
- Correct sequence for transition from protected RT to filter lanes leading the red arrow for S lane
- Green LT arrows should be operated whenever their movement is unopposed
- LT loop should call an associated RT movement (see next slide)
- Use standard operating sequences
- Seek expert help and insist on peer reviews



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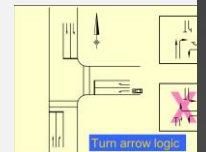
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- Recommendations
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 - Reduce RT lane width
 - Where opposed RT lanes are not possible, consider different phasing operation or RT bay

Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to tall poles
 - Locate poles close to kerb, and close to tangent point (minimise corner radii)
 - Use level extensions wherever possible
 - Make your signals visible (underground aerial services, use joint-use poles, don't point trees in front of poles (green trees))



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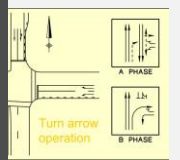


Crash rate reductions

- Compared to full filtering
 - 30% for lag right turns
 - 68% for lead RT, then filtering
 - 20% for lead RT w/o filtering

Slip lane design

- Recommendations
 - Appropriate size of islands
 - Entry angle type
 - Location of ped crossing point should provide good visibility
 - Priority issues can be addressed using raised slip lanes or a zebra crossing



Conclusions

- Designed by qualified engineers
- SNUG committee members for a list
- www.penr.org.nz/snug
- Commission audits of your existing signals
- Engage a competent signal engineer
- Peer review of new designs

Common deficiencies

- Right turn lanes
 - Captive turn lanes
 - Slip lane design
 - Signal conspicuity
 - Sufficient number of displays
- Turn arrow operation
 - Turn arrow logic
 - Ped phase issues
 - Push button location
 - Cyclist issues



Cyclist issues

- Consider the following factors
 - How safe is intersection for cyclists
 - What is the existing demand by cyclists
 - Are there reasonably alternative routes
 - Are there planned projects that could include improvements for cyclists
- Factors should determine the priority order
- Ultimately, all intersections should work for cyclists

Availability of "Stops and Goes"

- Get your copy here
- Order more copies from Transfund
- Contact Ian Appleton
- Online soon (LTNZ website)
- Thank you

2004 SNUG presentation (slide 5)

Stops and Goes of Traffic Signals

Arel Wilks
Christchurch City Council



Turn arrow logic

- Recommendations
- Correct sequence for transition from protected RT to filter lanes leading the red arrow for S lane
- Green LT arrows should be operated whenever their movement is unopposed
- LT loop should call an associated RT movement (see next slide)
- Use standard operating sequences
- Seek expert help and insist on peer reviews



Introduction

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Right turn lanes

- Recommendations
 - Ensure RT bays line up (back to back design)
 - Reduce RT lane width
 - Where opposed RT lanes are not possible consider different phasing operation or RT bay

Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to tall poles
 - Locate poles close to kerb, and close to tangent point (minimise corner radii)
 - Use kerb extensions wherever possible
 - Make your signals visible (under-ground aerial services, use joint-use poles, don't point trees in front of poles, pruned trees)



Background

- Representative number of existing traffic signals has been audited
 - Covering some 12 TLAs
 - Including Transit installations
- “Stops and Goes” summarises common trends and themes



Typical crash rate reductions

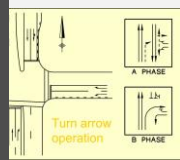
Compared to full filtering

- 30% for lag right turns
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- 90% for lead RT w/o filtering

Slip lane design

Recommendations

- Appropriate size of islands
- Right-entry angle type
- Location of pedestrian crossing point should provide sufficient intervisibility
- Key priority issues can be addressed using signalised slip lanes or a zebra crossing



Conclusions

- Highly qualified engineers
- Ask SNUG committee members for a list www.pnz.org.nz/snug
- Commission audits of your existing traffic signals
- Engage competent signal engineer for the peer review of new designs

Common deficiencies

- Right turn lanes
- Captive turn lanes
- Slip lane design
- Signal conspicuity
- Sufficient number of displays
- Turn arrow operation
- Turn arrow logic
- Ped phase issues
- Push button location
- Cyclist issues



Cyclist issues

- Consider the following factors
 - How safe is intersection for cyclists
 - What is the existing demand by cyclists
 - Are there reasonably alternative routes
 - Are there planned projects that could include improvements for cyclists
- Factors should determine the priority order
- Ultimately, all intersections should work for cyclists

Availability of “Stops and Goes”

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2004 SNUG presentation (slide 6)



Introduction

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Right turn lanes

- Recommendations
 - Ensure RT bays line up (back to back design)
 - Reduce RT lane width
 - Where opposed RT lanes are not possible consider different phasing operation or RT ban

Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to tall posts
 - Locate posts close to kerb, and close to tangent point (minimise corner radii)
 - Use kerb extensions wherever possible
 - Make your signals visible (underground aerial services, use joint-use poles, don't point trees in front of posts, point trees)



Content of "Stops & Goes"

- Draws attention to items frequently compromising safety and efficiency
- Presents ways how these deficiencies could be addressed
- Includes photos and illustrations showing
 - Good practice
 - Not so good practice



Typical crash rate reductions

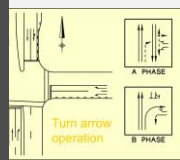
Compared to full filtering

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- 68% for lead RT, then filtering
- 90% for lead RT w/o filtering

Slip lane design

Recommendations

- Appropriate size of islands
- Right-entry angle type
- Location of lead crossing point should provide sufficient intervisibility
- Not priority issues can be addressed using signalized slip lanes or a zebra crossing



Conclusions

- Only qualified engineers
- Ask SNUG committee members for a list www.nzta.govt.nz/snug
- Commission audits of your existing traffic signals
- Engage competent signal engineer for the peer review of new designs

Common deficiencies

- Right turn lanes
- Slip lane design
- Signal conspicuity
- Sufficient number of displays
- Turn arrow operation
- Turn arrow logic
- Ped phase issues
- Push button location
- Cyclist issues



Cyclist issues

- Consider the following factors
 - How safe is intersection for cyclists
 - What is the existing demand by cyclists
 - Are there reasonably alternative routes
 - Are there planned projects that could include improvements for cyclists
- Factors should determine the priority order
- Ultimately, all intersections should work for cyclists

Availability of "Stops and Goes"

- Get your copy here
 - Order more copies from Transfund
 - contact Ian Appleton
 - Online soon (LTNZ website)
- Thank you

2004 SNUG presentation (slide 45)

Stops and Goes of Traffic Signals

Arel Wilks
Christchurch City Council



Turn arrow logic

- Recommendations
 - Correct sequence for transition from protected RT to filter (reverse leading the red arrow for 3 lanes)
 - Green LT arrows should be operated whenever their movement is unopposed
 - LT loop should call an associated RT movement (see next slide)
 - Use standard operating sequences
 - Seek expert help and insist on peer reviews



Introduction

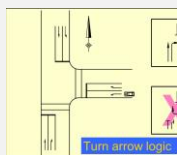
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Right turn lanes

- Recommendations
 - Ensure RT bays line up (back to back design)
 - Reduce RT lane width
 - Where opposed RT lanes are not possible consider different phasing operation or RT ban

Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to 3rd post
 - Locate posts close to kerb, and close to tangent point (minimise corner radii)
 - Use kerb extensions wherever possible
 - Make your signals visible (under-ground aerial services, use joint-use poles, don't point trees in front of posts (point trees))



Conclusions

- Engage competent signal engineer for the peer review of new designs
 - Road safety audit process is not sufficient
 - Signal peer review is separate
- Engage suitably experienced specialists for the auditing of SCATS set-ups



Typical crash rate reductions

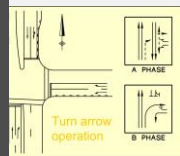
Compared to full filtering

- 30% for lag right turns
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- 90% for lead RT w/o filtering

Slip lane design

Recommendations

- Appropriate size of islands
- 45° entry angle type
- Location of ped crossing point should provide sufficient intervisibility
- Not priority issues can be addressed using signalized slip lanes or a zebra crossing



Conclusions

- Suitably qualified engineers
- Ask SNUG committee members for a list www.transfund.org.nz/snug
- Commission audits of your existing traffic signals
- Engage competent signal engineer for the peer review of new designs

Common deficiencies

- Right turn lanes
 - Captive turn lanes
 - Slip lane design
 - Signal conspicuity
 - Sufficient number of displays
- Turn arrow operation
 - Turn arrow logic
 - Ped phase issues
 - Push button location
 - Cyclist issues



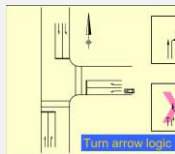
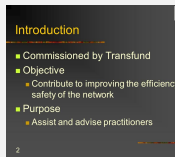
Cyclist issues

- Consider the following factors
 - How safe is intersection for cyclists
 - What is the existing demand by cyclists
 - Are there reasonably alternative routes
 - Are there planned projects that could include improvements for cyclists
- Factors should determine the priority order
- Ultimately, all intersections should work for cyclists

Availability of "Stops and Goes"

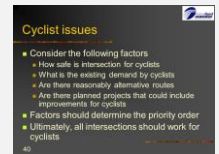
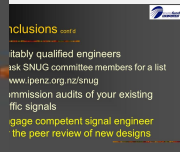
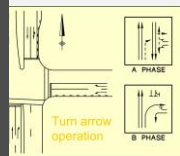
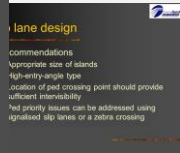
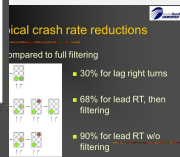
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 - Online soon (LTNZ website)
- Thank you

2004 SNUG presentation (slide 46)

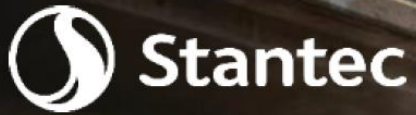


Conclusions cont'd

- Suitably qualified engineers
 - ask SNUG committee members for a list
 - www.ipenz.org.nz/snug
- Commission audits of your existing traffic signals
- Engage competent signal engineer for the peer review of new designs



2022 SNUG presentation (Martin Huang)



1

Traffic Signal Safety

Recap for Stops and goes
of traffic signals booklet



Next steps

Rewrite/update the document to reflect the following:

- Crash search / patterns refinement
- Cyclists / pedestrian best practice at signalised intersections
- Bus priority at signalised intersections
- A checklist for future traffic signal review / audit

2004 SNUG presentation (slide 46)

Stops and Goes of Traffic Signals

Aural Wilke
Christchurch City Council



Turn arrow logic

- Recommendations
- Correct sequence for transition from protected RT to filter (vehicle leading the red arrow for 3 lanes)
- Green LT arrows should be operated whenever that movement is unopposed
- LT loop should call an associated RT movement (see next slide)
- Use standard operating sequences
- Seek expert help and insist on peer reviews



Introduction

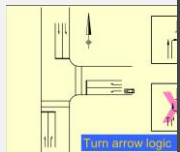
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Right turn lanes

- Recommendations
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 - Reduce RT lane width
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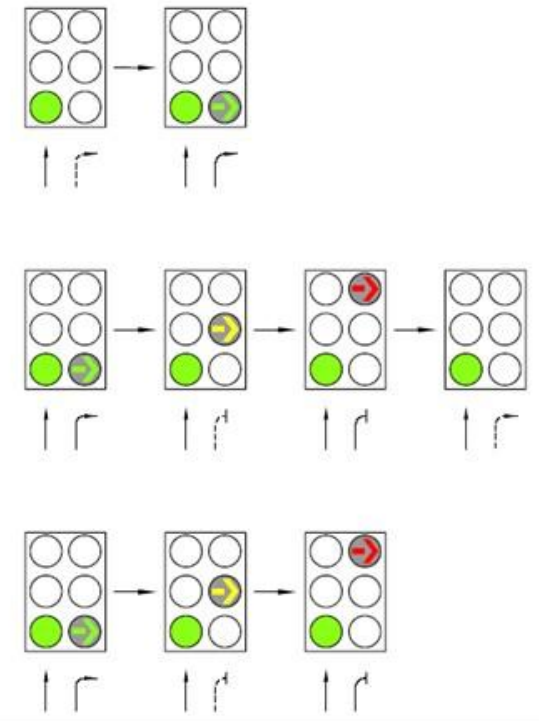
Signal conspicuity

- Recommendations
 - Should have upgrading programme for conversion to 3rd posts
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 - Use kerb extensions wherever possible
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 - Make your signals visible (underground aerial services, use joint-use poles, don't point trees in front of posts (green trees))



Typical crash rate reductions

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- 30% for lag right turns
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Typical crash rate reductions

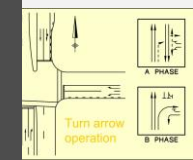
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Slip lane design

Recommendations

- Appropriate size of islands
- Right-entry angle type
- Location of pedestrian crossing point should provide sufficient intervisibility
- Key priority issues can be addressed using signalised slip lanes or a zebra crossing



Conclusions

- Only qualified engineers
- Ask SNUG committee members for a list
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Common deficiencies

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Cyclist issues

- Consider the following factors
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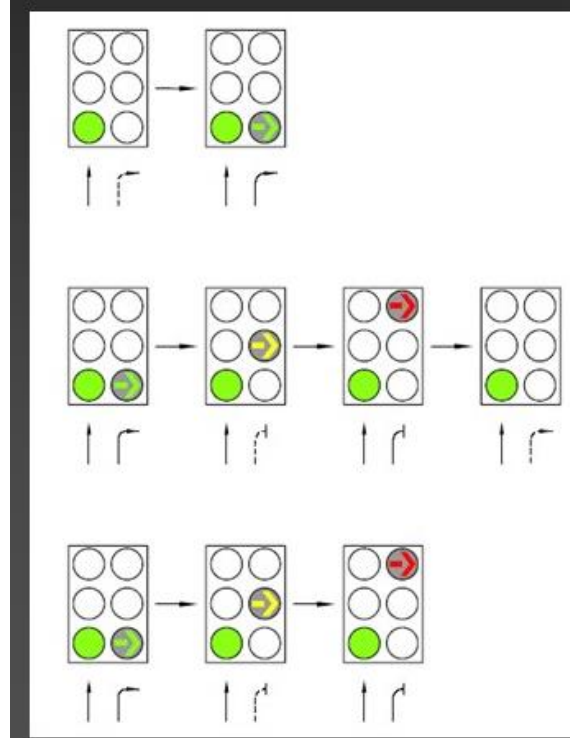
Availability of "Stops and Goes"

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Crash search / patterns refinement (2)

My thoughts

- This can be done
- Will be time-consuming
- What will we learn from it?
- Hence – is it worth it?



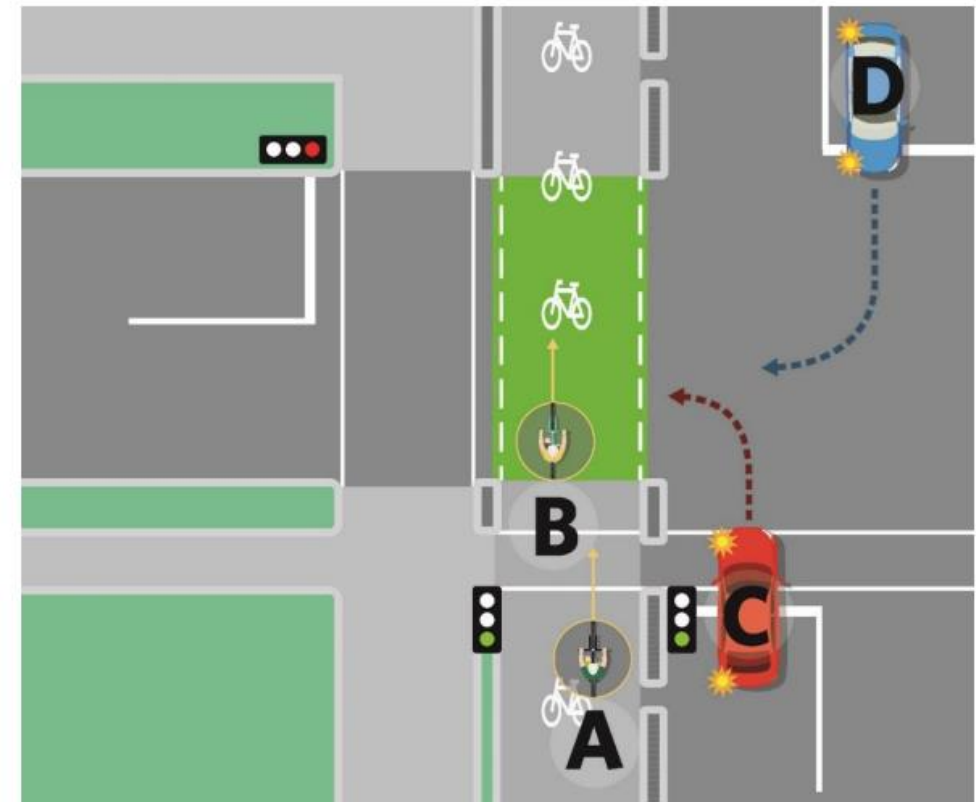
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Cyclists / pedestrian best practice

My thoughts

- Cycle best practice is useful
 - Will change completely when *Accessible Streets* package is passed
 - When will that happen?
 - [CNG info](#) is not comprehensive
- Pedestrian best practice is useful
 - Good guidance in the PNG, though
 - [Signalised crossings](#)
 - [Signalised intersections](#)

Proposal 6C). Give cycles and buses priority over turning traffic when they're travelling through an intersection in a separated lane




Accessible Streets consultation (Mar 2020)

Bus best practice

My thoughts

- Bus priority is super-useful
- What will be included in the upcoming PTDG?
 - Not useful to duplicate efforts



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Public transport priority and optimisation

[Public transport design guidance](#) [Overview](#) [Bus dimensions for design](#)

Content in development, expected later in 2022.

My thoughts

- Checklist for future traffic signal review / audit
- Should we be doing those audits?
 - Yes
 - It needs to be centrally organised, like it was 20 years ago
 - I don't expect TLAs to do that on their own
 - If there's no desire for central coordination, this is not needed

Discussion

- Crash search / patterns refinement
- Cyclists / pedestrian best practice at signalised intersections
- Bus priority at signalised intersections
- A checklist for future traffic signal review/audit

We share more knowledge on
www.viastrada.nz



TRANSPORT PLANNING AND DESIGN