

Design of Multi-Lane Turns

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10 Year Alliance to June 2018



Auckland Motorways

New Zealand Government

Auckland Motorways Alliance

Why a maintenance alliance?

- Not a big network in terms of length (230 centreline km)
- But very busy (900,000 vehicles per day)
- Congestion effects over much of the day, impacts on freight
- Complexities – constrained between urban land uses
- NZTA wished to bring together the best team, working cohesively to manage the network
- Maximise opportunities to identify innovations, efficiencies

Advantages of Multi Lane Turns

- provides greater intersection capacity, particularly for right turns (400 vph or more)
- reduces delays, particularly at start up
- reduces the required stacking length for right turns, reducing short lane effects and disruption to upstream network
- shortens the green time for right turns, liberating more time for other phases

Multi Lane Turns

- **some issues arise with the addition of another turning lane**
- **this remit reviews some of the issues that can arise, and possible treatments**

Multi Lane Turns – Design Checks

Multi lane turns should be signalised

Double left turns require signalisation

- Pedestrian routes across a double left turn **MUST** be controlled

Double right turns require positive control at all times.

- Double right turns cannot filter safely – vehicles in central lane cannot see around right turners in adjacent lane to their left

Multi Lane Turns – Design Checks

- multiple lane turns lend themselves to split diamond phasing, but...
- skewed or slightly staggered junctions may prevent split full diamond operation
- partial split phasing may be required – one RT has lead, the opposing lags
- order of lead/lag phases may vary by time of day to suit tidal flows
- example: Fanshawe Street / Halsey Street, Auckland City

Multi Lane Turns – Design Checks

Lane utilisation

- cannot always assume the same length of queue in both turning lanes
- up and downstream conditions influence lane utilisation
- wider model needed to assess lane usage
- SIDRA does not provide this level of complexity

Multi Lane Turns – Design Checks

Lane utilisation

- SIDRA also assumes that up and downstream lanes are continuous
 - does not model the effects of upstream lane development or downstream lane merges well
- Paramix can provide a better model
- Saturn can be made to work

Multi Lane Turns – Design Checks

Geometry

- adequate width for vehicles to turn right two abreast, including the downstream exit from the intersection
- generally the exit lane width is much more critical than the entry lane width
- where right turn exit lane width is constrained the adjacent limit lines may need to be set back

Multi Lane Turns – Design Checks

Geometry

- continuity lines give guidance through the turn to prevent lane confusion
 - mark continuity line between turning lanes
 - avoid excessive use of lines – check need
- ensure lane continuity at the exit from the intersection
 - no sudden lane end (parking, intersection or major access, bus stop)
 - no sudden lateral movement of lanes at exit
- avoid vehicle weaving downstream such as to driveways or side roads

Multi Lane Turns – Design Checks

Geometry

- separate opposing RT vehicles during concurrent right-turn movements
- Austroads recommends 2m minimum separation
- mark outside of opposing turns where split diamond operation brings opposing turns into proximity

Multi Lane Turns – Design Checks

Geometry

- permanent all weather markings to accommodate design vehicle tracking
- keep arcs circular
 - avoid tightening through the turn
 - may need to set side road limit line back
- accurate setting out details required
- very large or complex intersections may need survey control

Multi Lane Turns – Design Checks

Geometry

- right turn limit lines may need to be staggered from those of through lanes to accommodate the right turns from side roads
- additional width for double right turns may put pressure on adjacent exit width
 - can make RT from side road more onerous
 - in turn pushes major road right turn limit lines back
- minimise stagger between adjacent lanes' limit lines
 - Austroads recommends the primary signal be no more than 3m from the limit line

Multi Lane Turns – Design Checks

Geometry

- multi lane turns increase pedestrian-vehicle conflict potential
- review roadway width and its resulting impacts upon pedestrian crossings and signal timings.
- increase pedestrian-vehicle clearance times and intersection phasing to suit
- check bicycle clearance time before bringing up side road or opposing green

Multi Lane Turns – Design Checks

Geometry – with the increased intersection footprint

- intersection may need the lighting layout redesigned to ensure correct coverage
- review stormwater drainage needs
- beware of drainage issues when widening into a wide median if superelevated
- check space requirements for the multi-lane turn intersection geometry

Multi Lane Turns – Design Checks

Geometry – always check tracking

- new design vehicle is the 17.9m semi trailer
- absolute minimum design is an 11m large rigid truck
- consider likely combinations:
 - car plus parallel semi trailer is minimum
 - semi trailer can be in either lane – check both
- may have bus plus semi if on a bus route
- usually parallel semis too onerous, but can occur on very busy truck routes (example: Wiri Station Rd / Roscommon Rd, Manukau City)

Multi Lane Turns – Design Checks

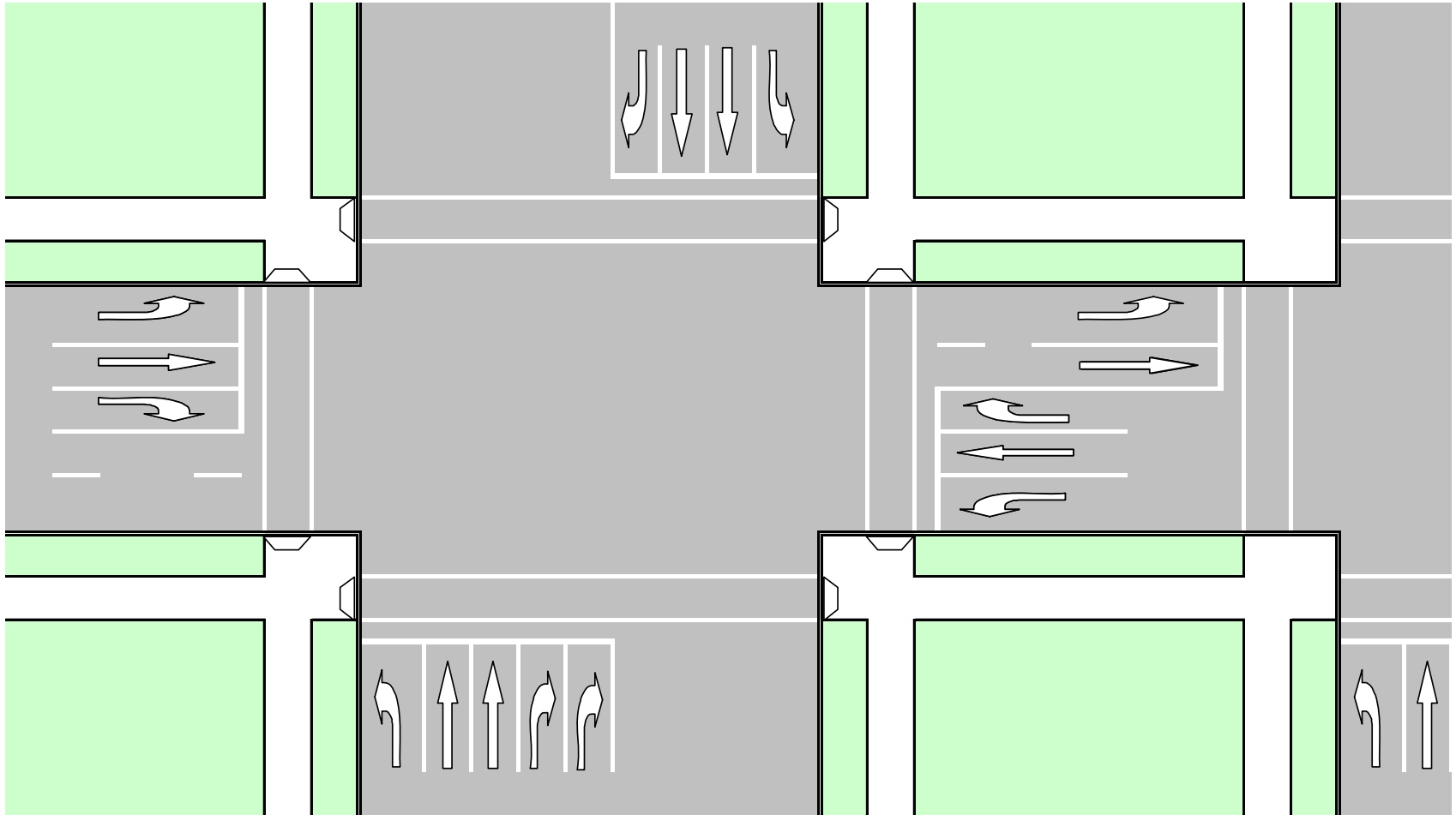
Geometry – side road false calls

- if no median island then a RT vehicle can cross and activate a side road loop
- this can put in a false call for the side road
- usually addressed by putting in a 2sec delayed call (vehicle has to be over loop for 2secs before calls demand)

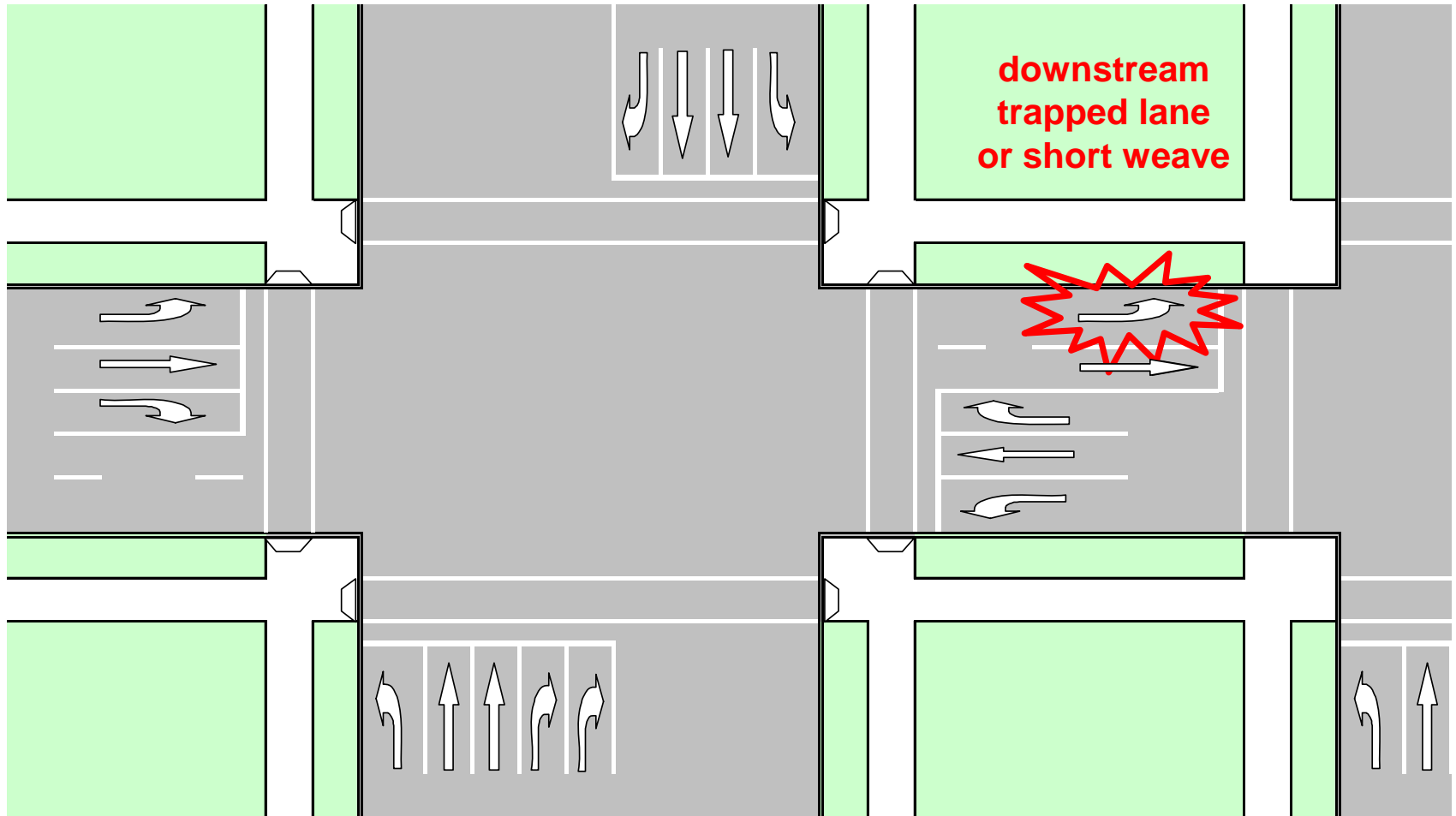
Multi Lane Turns – Conclusions

- multi lane turns provide greater intersection capacity, reduce delays, and shorten stacking requirements
- they can work safely
- some design expertise is needed to ensure that they work as intended

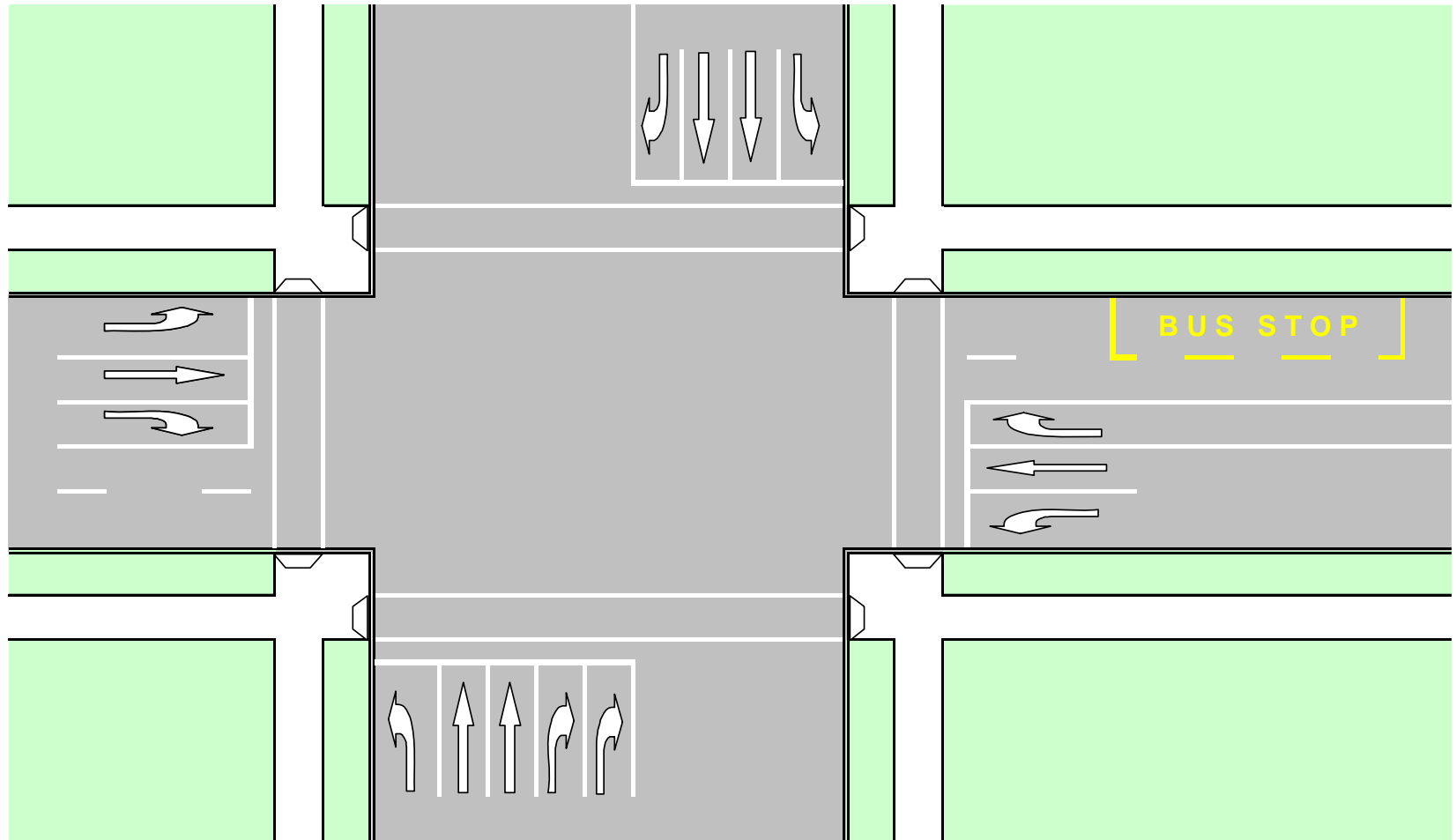
Multi Lane Turns – Examples



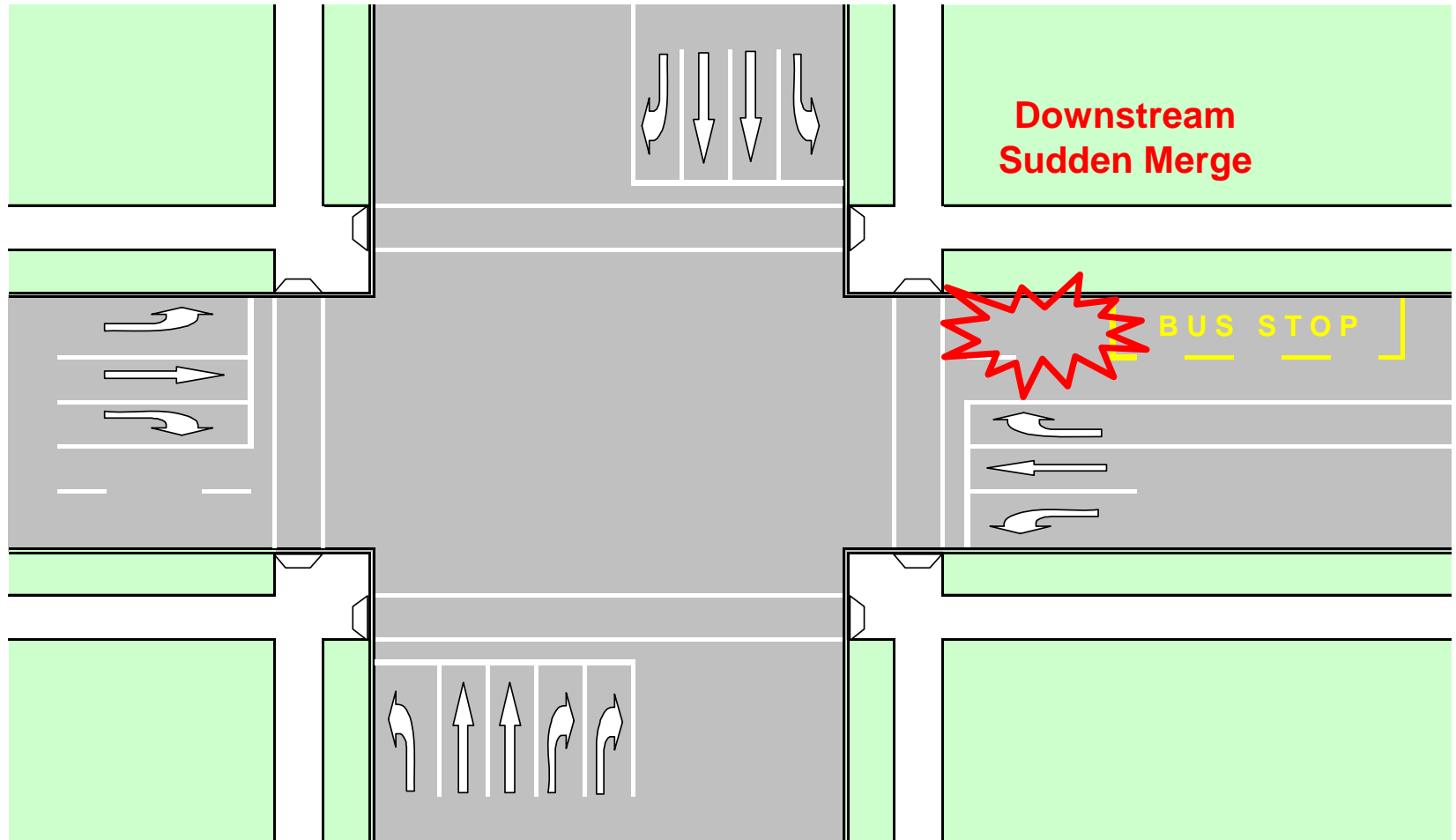
Multi Lane Turns – Examples



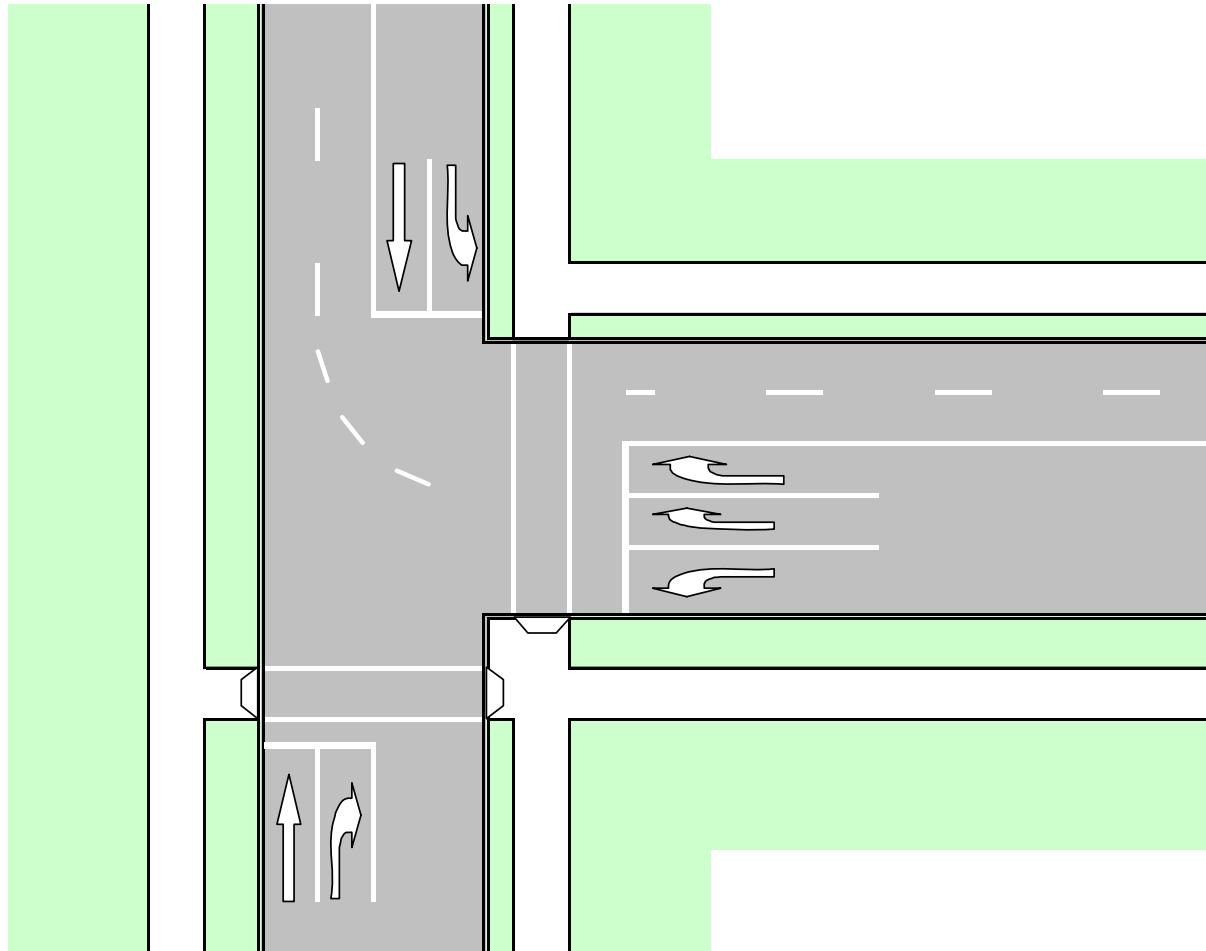
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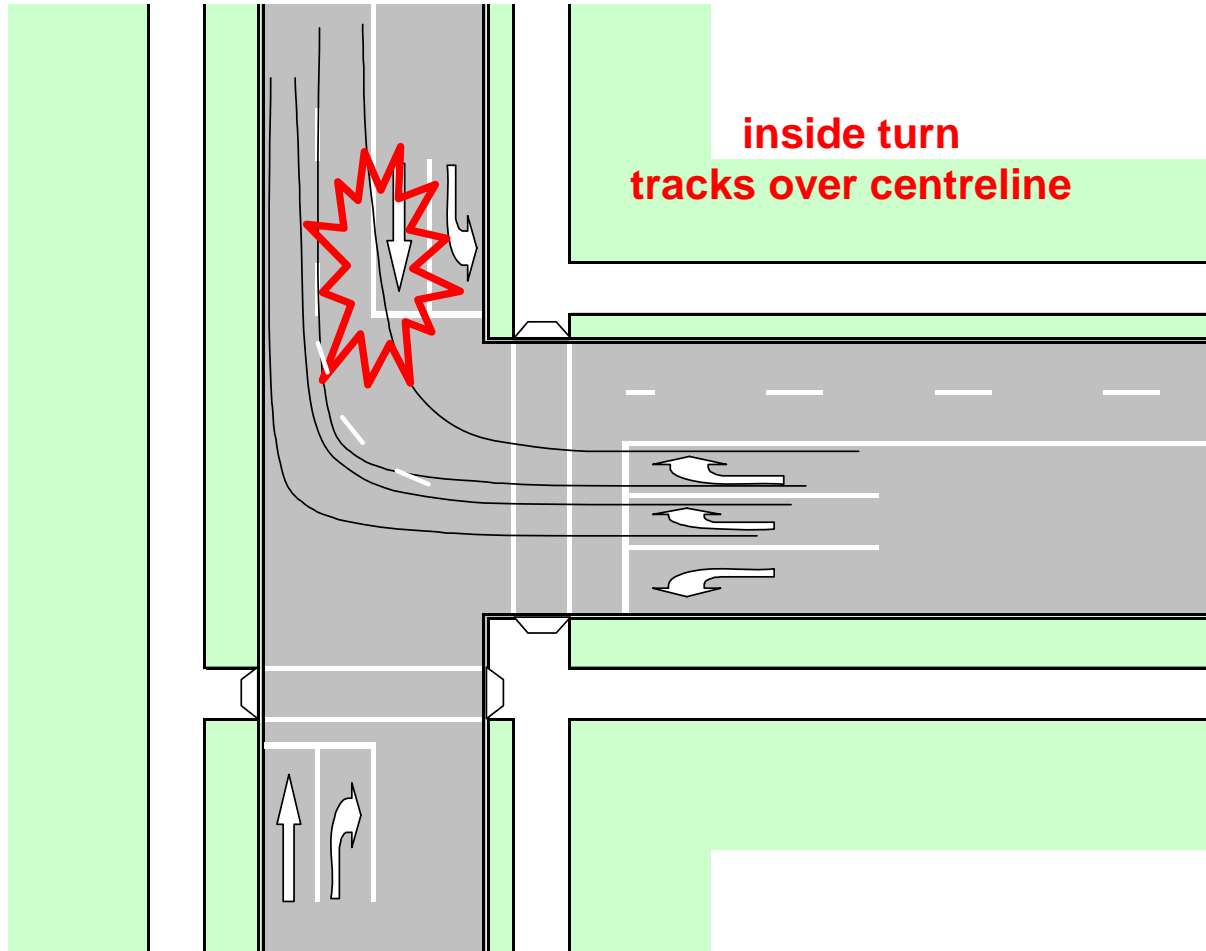
Multi Lane Turns – Examples



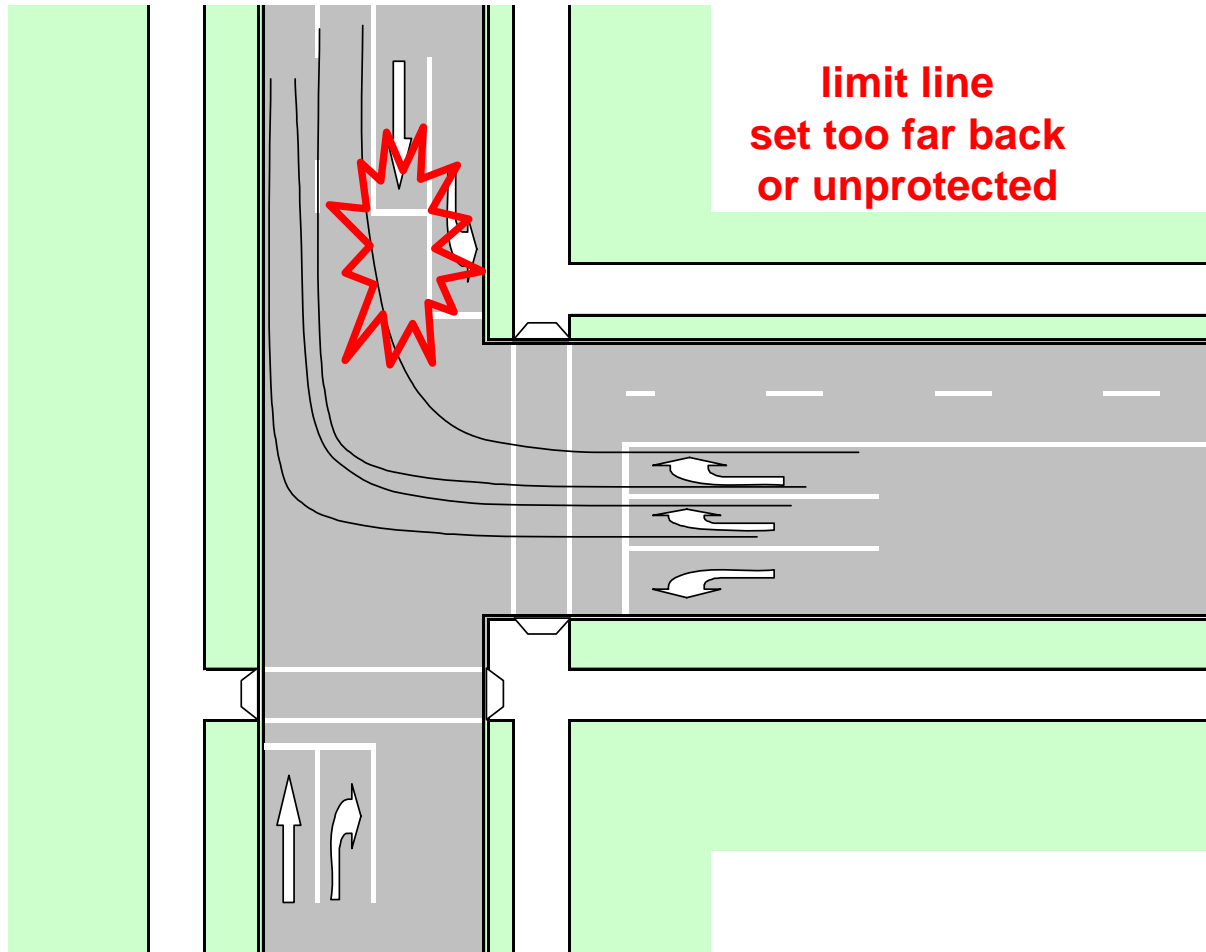
Multi Lane Turns – Examples



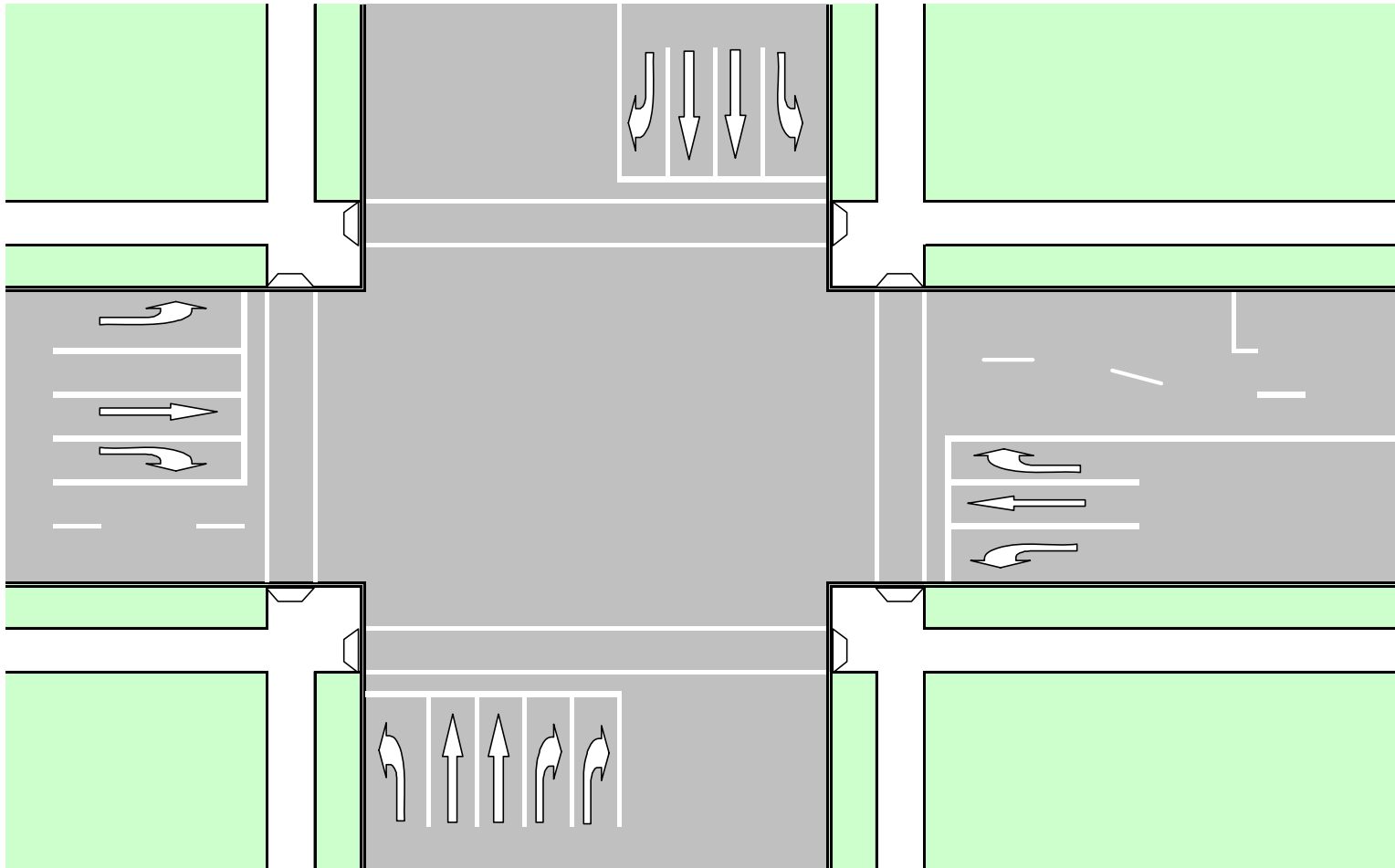
Multi Lane Turns – Examples



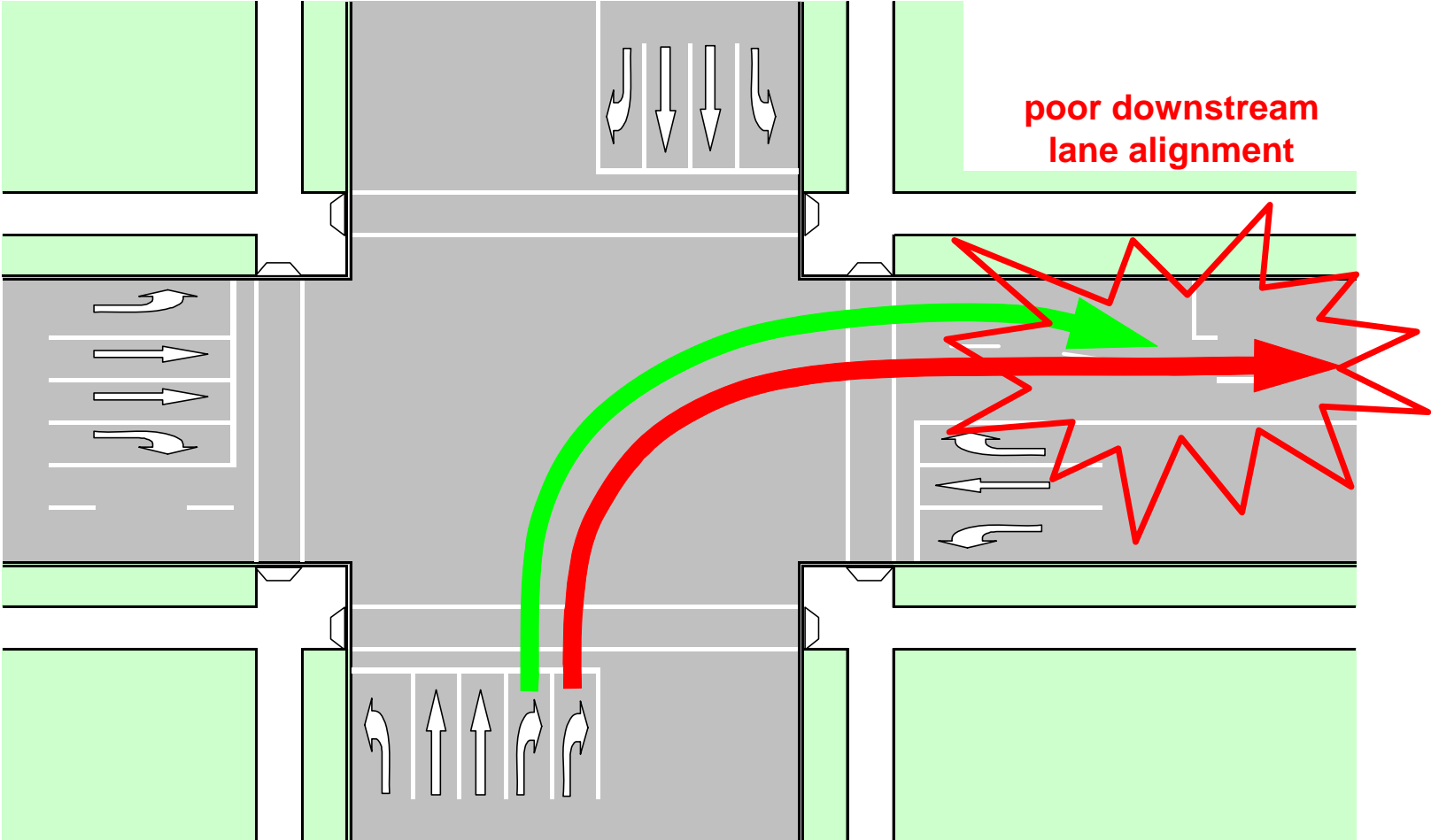
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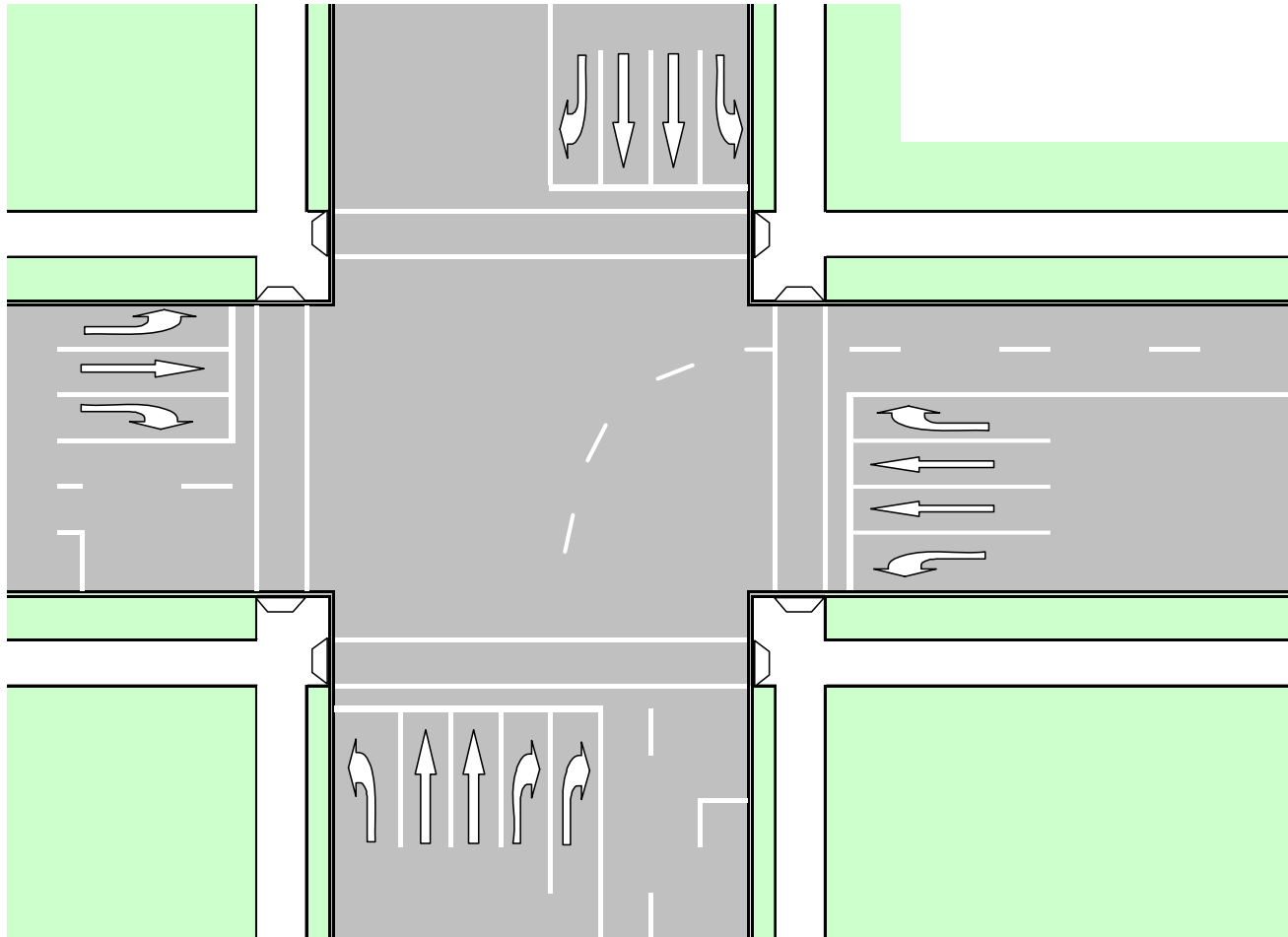
Multi Lane Turns – Examples



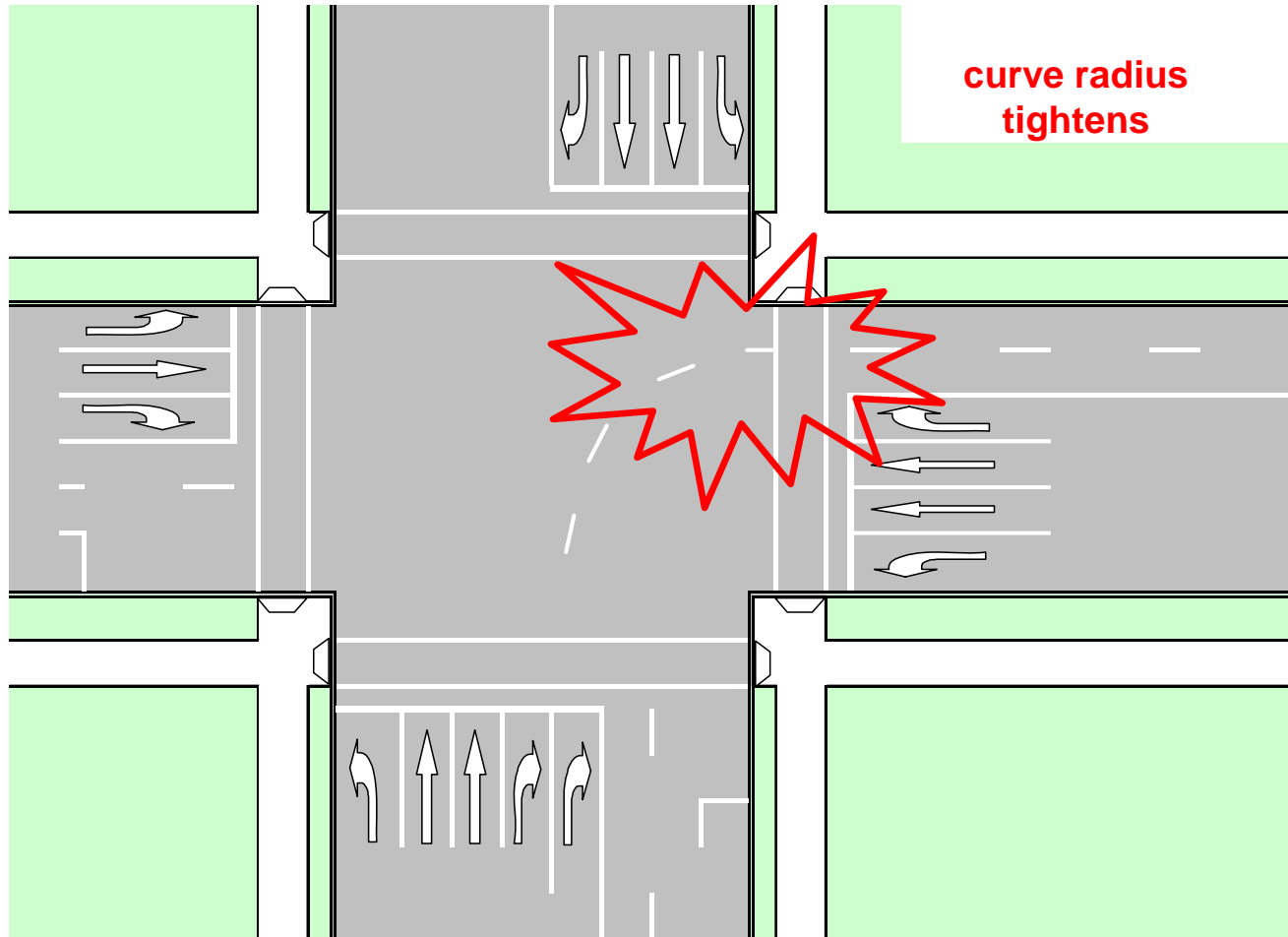
Multi Lane Turns – Examples



Multi Lane Turns – Examples



Multi Lane Turns – Examples



Multi Lane Turns – Credits

Thank you to:

Nathan Harper, Opus Auckland (modelling)

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Multi Lane Turns

Any questions?