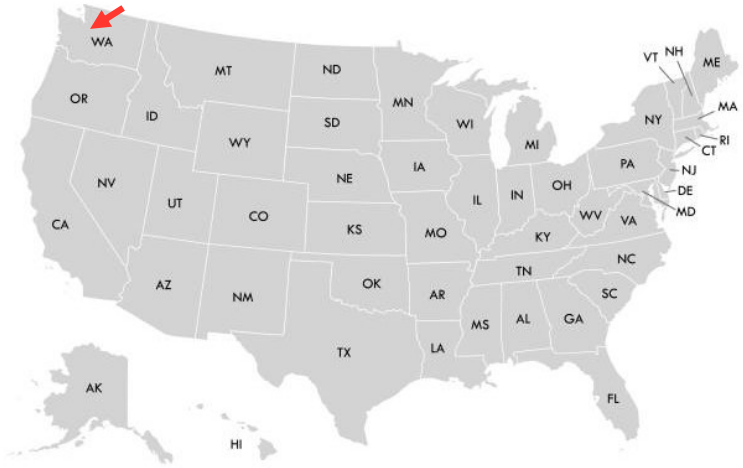
CASE STUDY ON FILTERED TURNS
BELLEVUE, WASHINGTON, USA



SIGNAL NZ USER GROUP 2026

September 24, 2026

Background
Bellevue WA



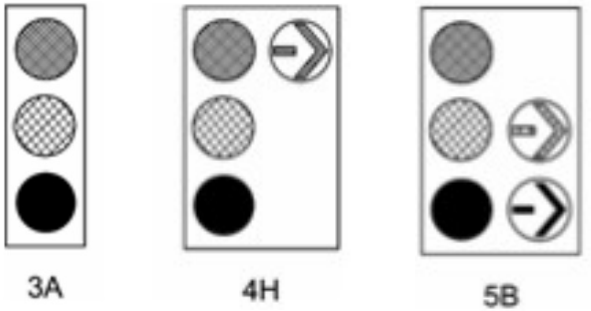


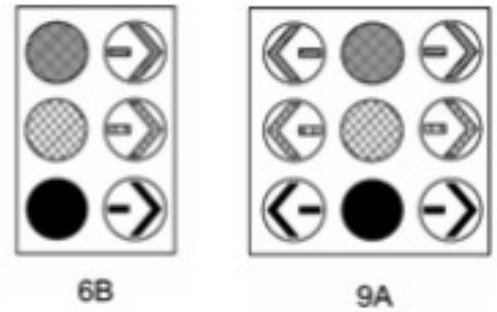




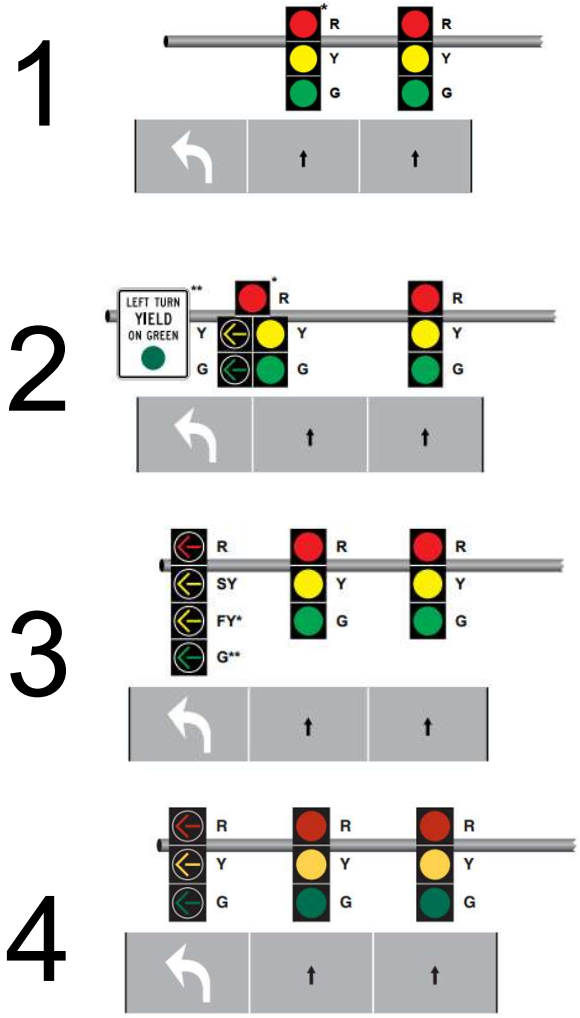
Filtered vs Permissive

New Zealand





United States



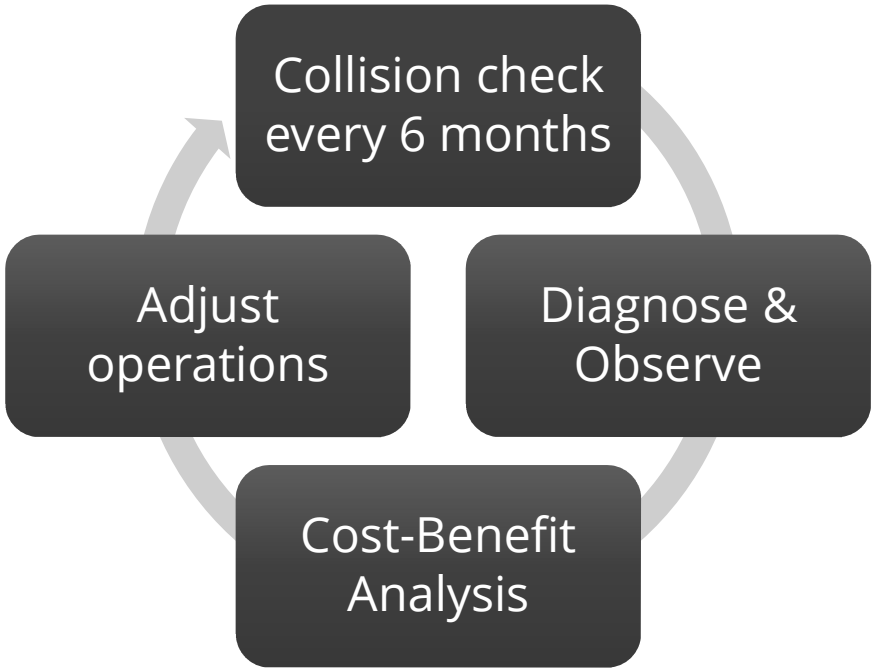
Sources: New Zealand TCD Manual, FHWA MUTCD 11th edition

PPLT Programme (Filtered Turns Monitoring)

New Locations → Ongoing Monitoring

Evaluate using guidelines

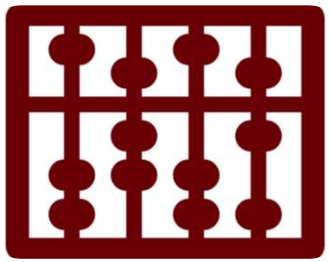
- Volume Cross-product
- Speed Limit
- Number of Lanes
- Sight Distance
- Collision History
- Pedestrian activity
- Engineering Judgement



Filtered Turn Adjustment to Operations



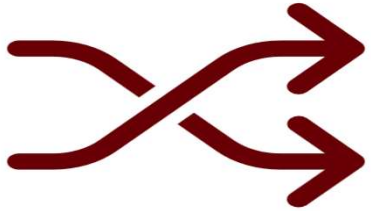
Time of Day
Protected Only



Adaptive Protected
Only

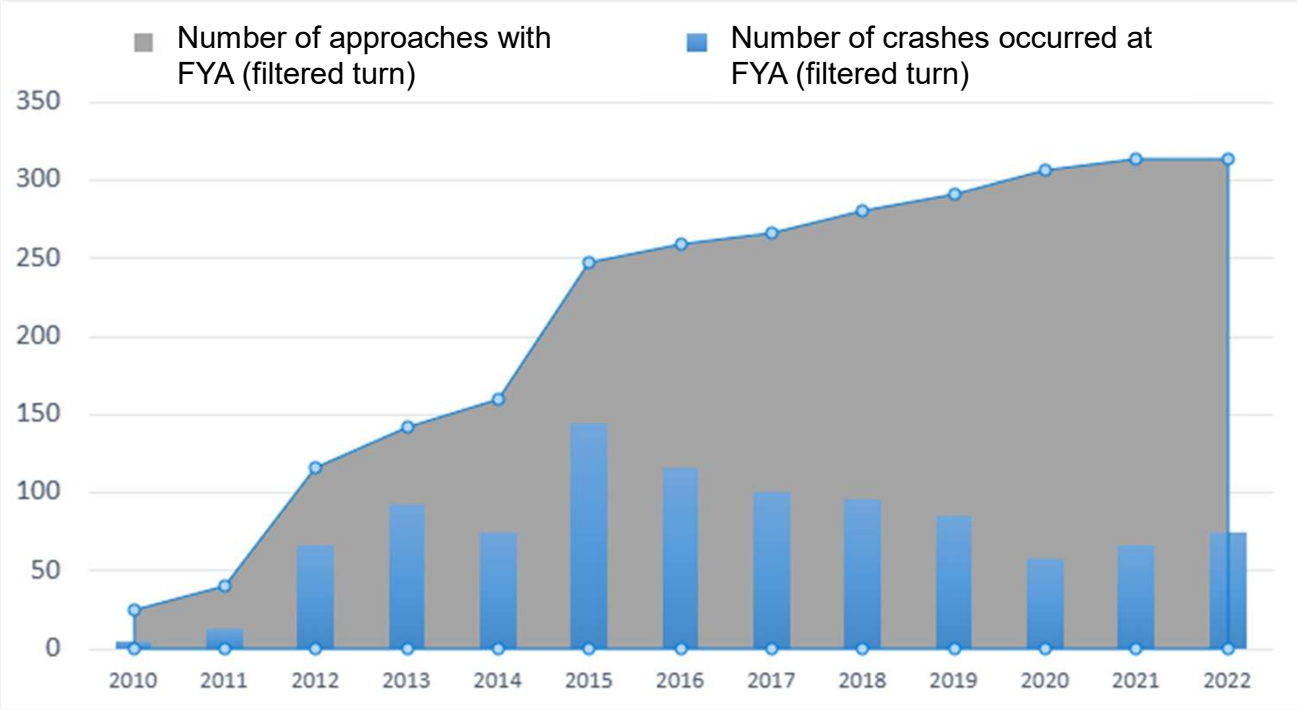


Protected
Pedestrian Phasing



Lead-Lag

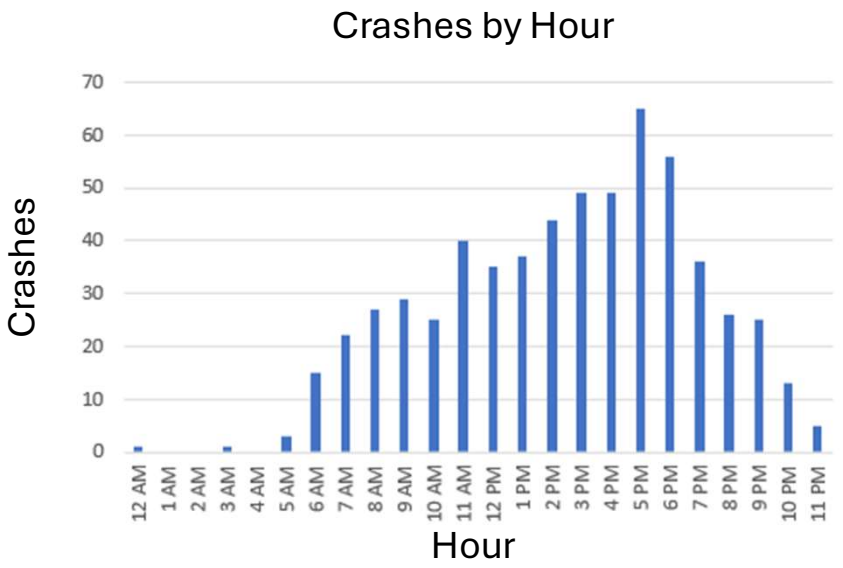
Case Study: Crash Trends in Bellevue



Based on City of Bellevue, WA, USA crash data collected between 2010-2018 specific to crashes occurring when a flashing yellow arrow (filtered turn) was active

Time of day

- Time of Day or Adaptive Protected Only: 64% reduction in PPLT collisions compared to continuous operation
- Adaptively restrict filtered turns when turning through a gap in traffic





Based on City of Bellevue, WA, USA crash data collected between 2010-2018 specific to crashes occurring when a flashing yellow arrow (filtered turn) was active

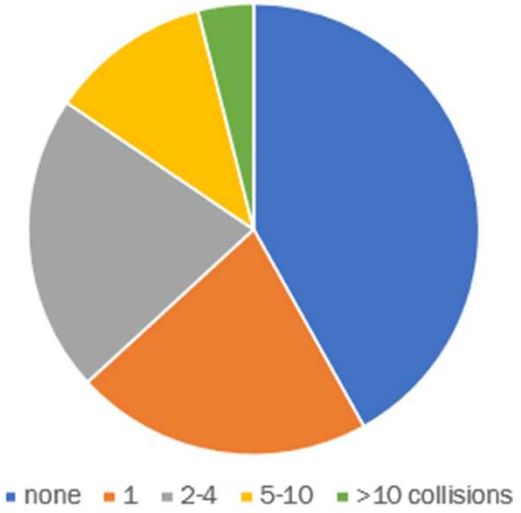
Other trends

Number of crashes by year since turn on



For Locations with 5+ years of Operation

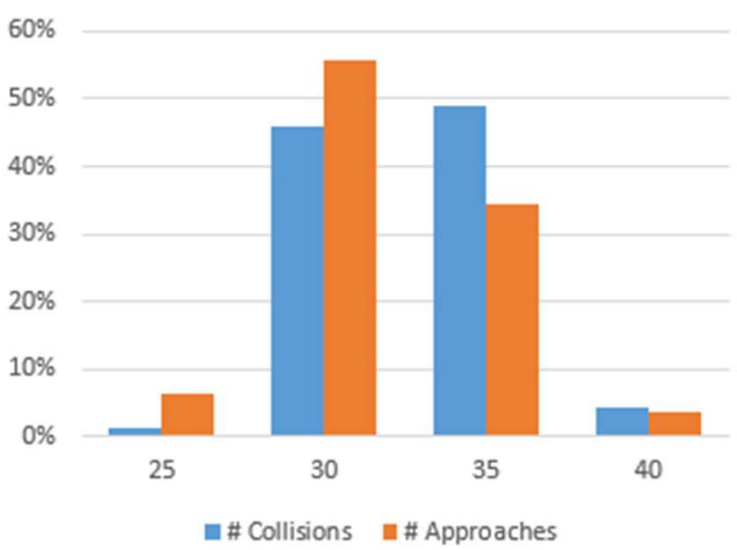
Number of crashes per location



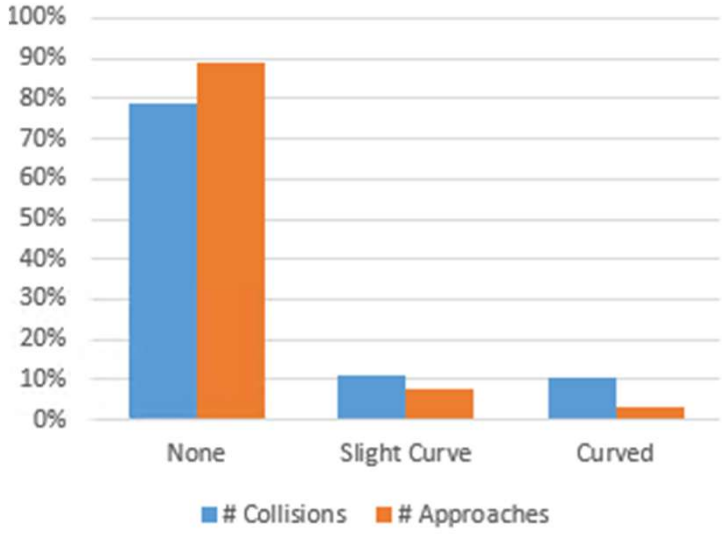
Based on City of Bellevue, WA, USA crash data collected between 2010-2018 specific to crashes occurring when a flashing yellow arrow (filtered turn) was active

Other trends

Percent of Crashes vs
Percent of Approaches
by Opposing Speed Limit



Percent of Crashes vs
Percent of Approaches
by Roadway Curve



Based on City of Bellevue, WA, USA crash data collected between 2010-2018 specific to crashes occurring when a flashing yellow arrow (filtered turn) was active

Cost Benefit – Delay reduction vs crash

Year	Savings
2011	$770,000
2012	$1,500,000
2013	$2,250,000
2014	$2,550,000
2015	$3,550,000
2016	$4,250,000
2017	$4,450,000
2018	$4,950,000

Flashing Yellow Arrow Before-After Evaluation — Last updated 12/31/2018

See notes tab for description of columns

Location	Turn-On Date	Annual Delay Reduction Savings (based on $15/hr)	Annual Before Collision Cost (5 yr period)	Annual After Collision Cost	Net Annual Collision Cost	Total Annual Savings	Total Cumulative Savings
[redacted]	10/18/2010	$43,500	$0	$20,116	$20,116	$23,384	$191,813
[redacted]	10/20/2010	$90,000	$2,280	$36,476	$34,196	$55,804	$457,433
[redacted]	10/21/2010	$21,000	$0	$0	$0	$21,000	$172,082
[redacted]	10/25/2010	$22,500	$2,280	$9,580	$7,300	$15,200	$124,388
[redacted]	10/28/2010	$82,500	$2,280	$5,578	$3,298	$79,202	$647,498
[redacted]	10/28/2010	$204,000	$0	$27,082	$27,082	$176,918	$1,446,345
[redacted]	10/29/2010	$90,000	$0	$18,012	$18,012	$71,988	$588,324
[redacted]	10/21/2010	$114,000	$0	$26,506	$26,506	$87,494	$716,960
[redacted]	5/18/2011	$37,500	$0	$77,904	$77,904	($40,404)	($307,968)
[redacted]	12/7/2011	$63,000	$0	$1,613	$1,613	$61,387	$433,783
[redacted]	12/12/2011	$43,500	$0	$13,952	$13,952	$29,548	$208,393
[redacted]	12/21/2011	$316,500	$15,602	$44,365	$28,763	$287,737	$2,022,235
[redacted]	12/22/2011	$10,500	$0	$0	$0	$10,500	$73,766
[redacted]	1/24/2012	$67,500	$0	$17,275	$17,275	$50,225	$348,311
[redacted]	1/11/2012	$100,500	$0	$46,079	$46,079	$54,421	$379,342
[redacted]	1/17/2012	$223,500	$16,322	$20,189	$3,867	$219,633	$1,527,358
[redacted]	1/26/2012	$54,000	$2,280	$33,567	$31,286	$22,714	$157,394
[redacted]	7/19/2012	$123,000	$0	$50,292	$50,292	$72,708	$468,996
[redacted]	8/7/2012	$153,000	$2,279	$63,329	$61,050	$91,950	$588,331
[redacted]	10/15/2012	$93,000	$0	$33,175	$33,175	$59,825	$371,478
[redacted]	10/15/2012	$124,500	$4,558	$65,062	$60,504	$63,996	$397,379
[redacted]	10/15/2012	$105,000	$2,279	$40,293	$38,014	$66,986	$415,944
[redacted]	10/15/2012	$160,500	$2,279	$50,375	$48,096	$112,404	$697,968
[redacted]	10/16/2012	$162,000	$0	$22,395	$22,395	$139,605	$866,487
[redacted]	10/19/2012	$70,500	$2,279	$11,099	$8,820	$61,680	$382,321
[redacted]	11/5/2012	$61,500	$0	$25,780	$25,780	$35,720	$219,745
[redacted]	11/5/2012	$81,000	$6,557	$43,889	$37,331	$43,669	$268,648
[redacted]	11/6/2012	$103,500	$0	$35,582	$35,582	$67,918	$417,644

Page

Based on City of Bellevue, WA, USA crash data collected between 2010-2018 specific to crashes occurring when a flashing yellow arrow (filtered turn) was active

Trade offs

Benefits



Reduced driver delay



Fewer signal phases changes may result in reduction in rear-end crash risk



Flexible response to traffic demand and time of day trends

Drawbacks



Reliance on driver compliance and correct yielding behaviour



Non-yielding behaviour may result in turn-vs-through crashes



Non-yielding behaviour may result in opposing turn-vs-pedestrian crashes (*if no protected ped phasing*)

Questions?

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