



Role of Technology & Data in Vision Zero Interventions

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Bellevue, WA: A Vision Zero City



Safe System – Council Resolution (2020)



2020 Vision Zero Strategic Plan



2021 Vision Zero Action Plan



2022 Vision Zero Action Plan

Safe System Principles



Death/Serious Injury is Unacceptable

While no crashes are desirable, the Safe System approach prioritizes crashes that result in death and serious injuries, since no one should experience either when using the transportation system.



Responsibility is Shared

All stakeholders (transportation system users and managers, vehicle manufacturers, etc.) must ensure that crashes don't lead to fatal or serious injuries.



Humans Make Mistakes

People will inevitably make mistakes that can lead to crashes, but the transportation system can be designed and operated to accommodate human mistakes and injury tolerances and avoid death and serious injuries.



Safety is Proactive

Proactive tools should be used to identify and mitigate latent risks in the transportation system, rather than waiting for crashes to occur and reacting afterwards.



Humans Are Vulnerable

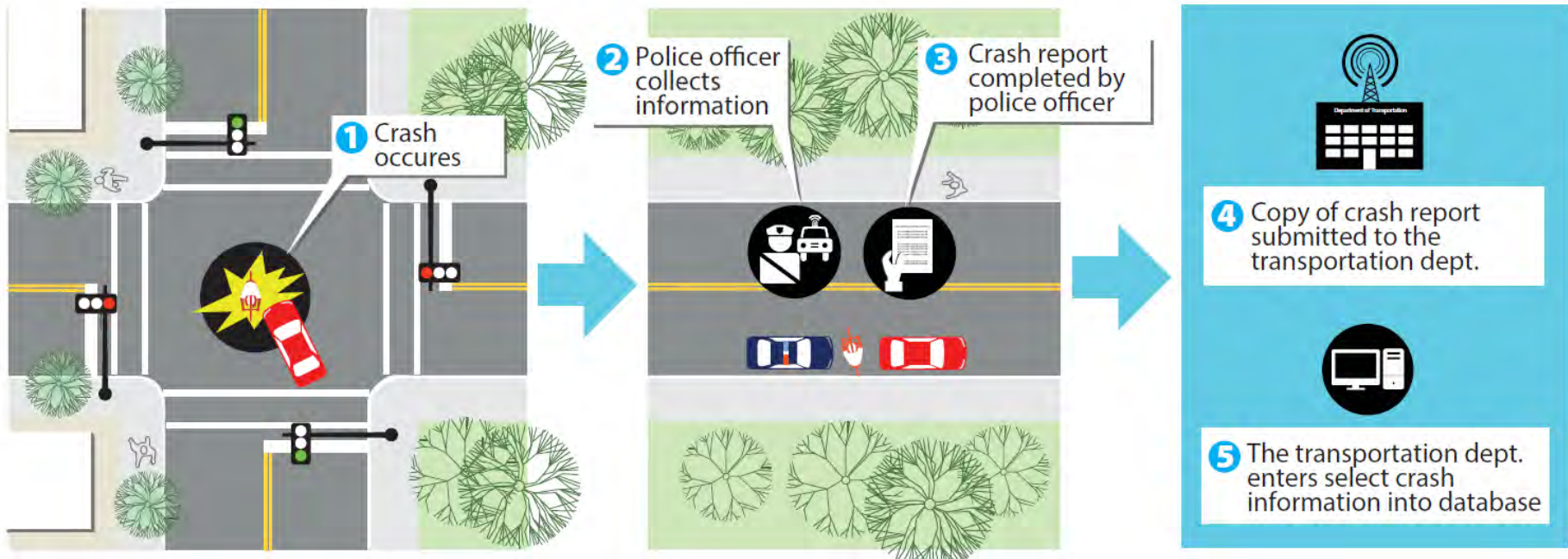
People have limits for tolerating crash forces before death and serious injury occurs; therefore, it is critical to design and operate a transportation system that is human-centric and accommodates human vulnerabilities.



Redundancy is Crucial

Reducing risks requires that all parts of the transportation system are strengthened, so that if one part fails, the other parts still protect people.

Crash-Based (Ad-Hoc) Approach



Conflict-Based (Optimized) Approach



Sean Roulette-Miller

@sean_roulette

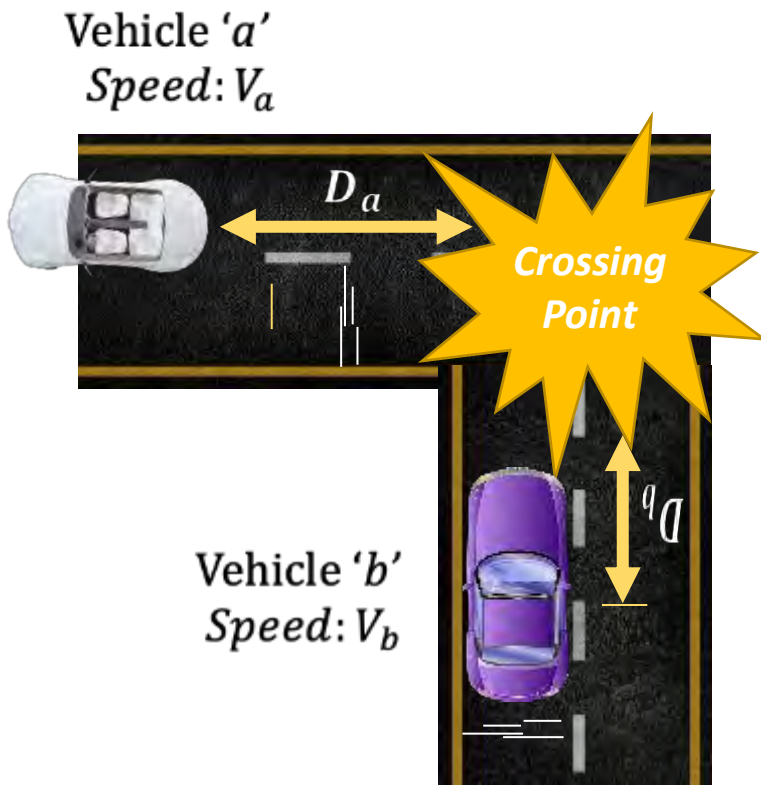
Follow



@BvueTrans someone just got hit by someone driving a car right in front of my office. I see close calls here everyday it was just a matter of time before someone got hurt



Surrogate Indicators of Safety

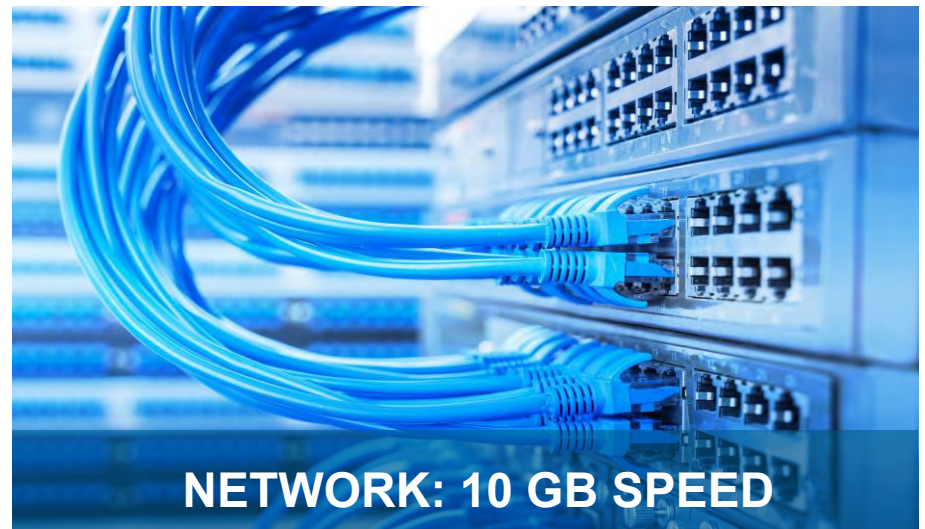
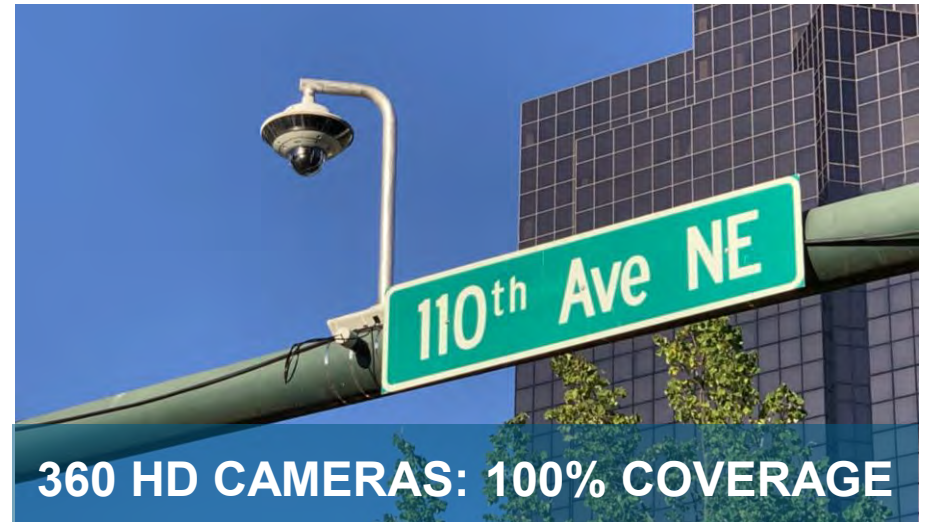
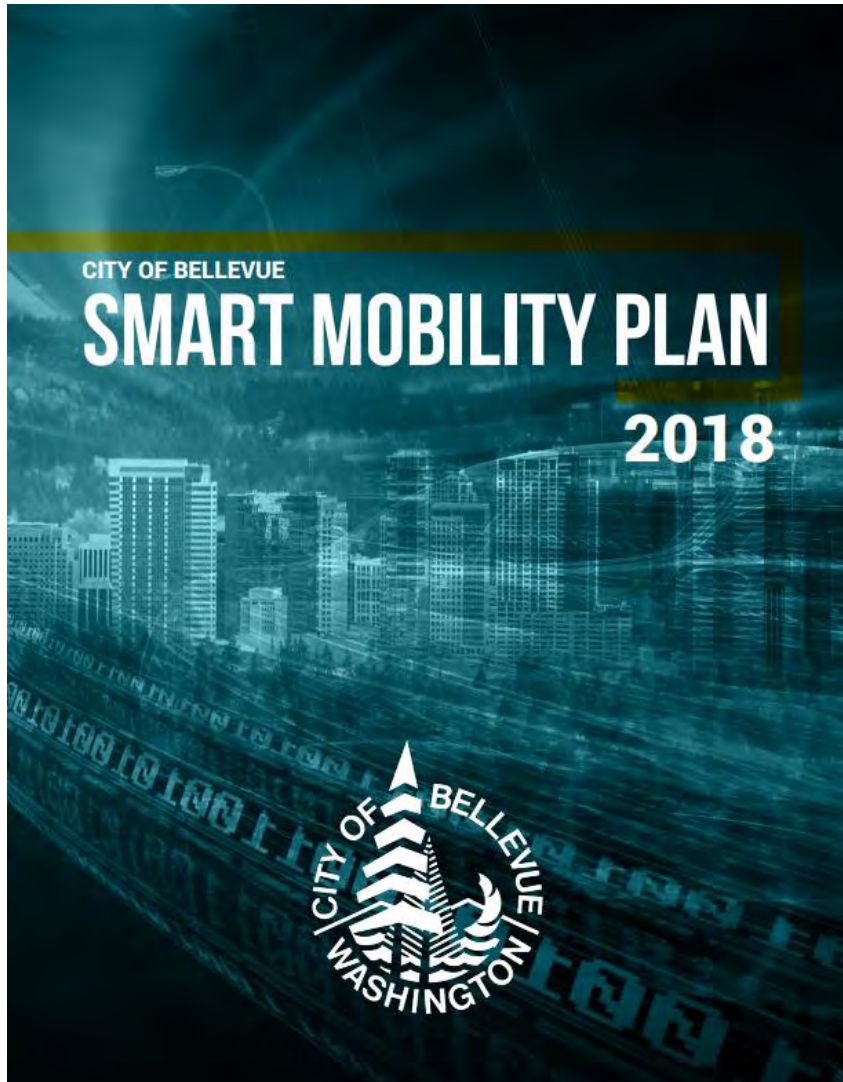


$$T_a = \frac{D_a}{V_a} ; T_b = \frac{D_b}{V_b}$$

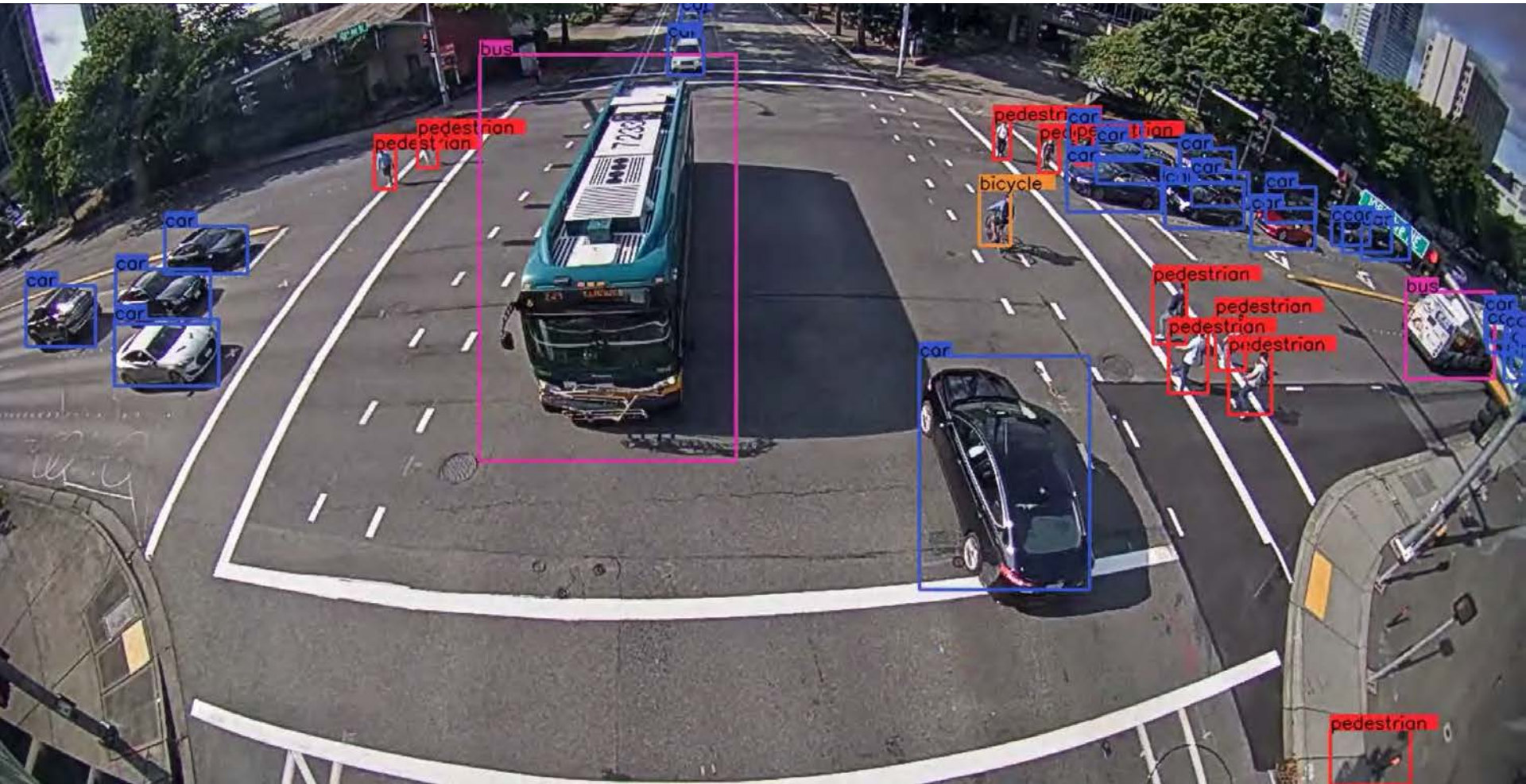
Post-Encroachment Time (PET):
Time elapsed between vehicle 'a' leaving crossing point and vehicle 'b' arriving there

$$PET = T_a - T_b$$

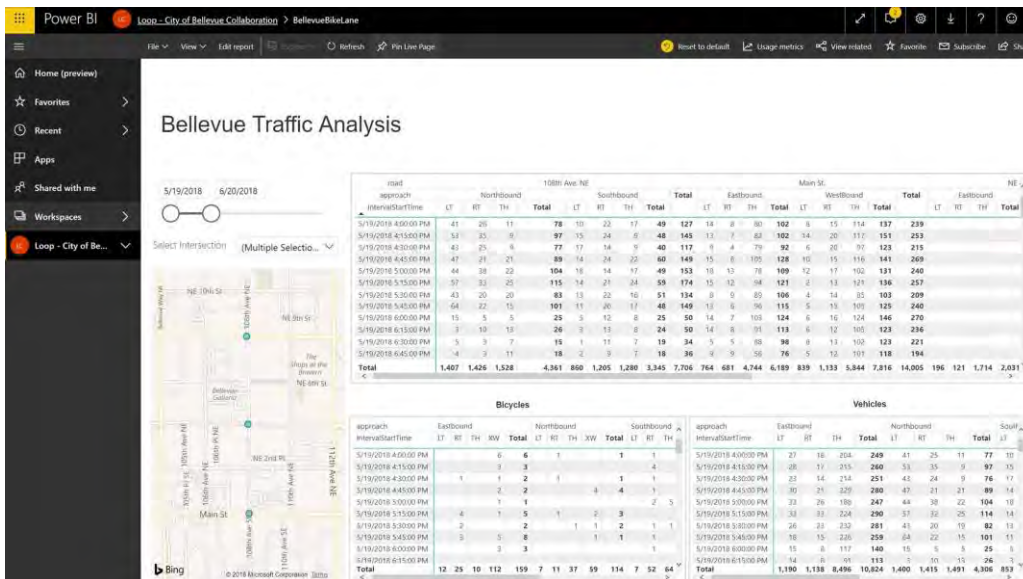
Bellevue Camera & Communications Systems



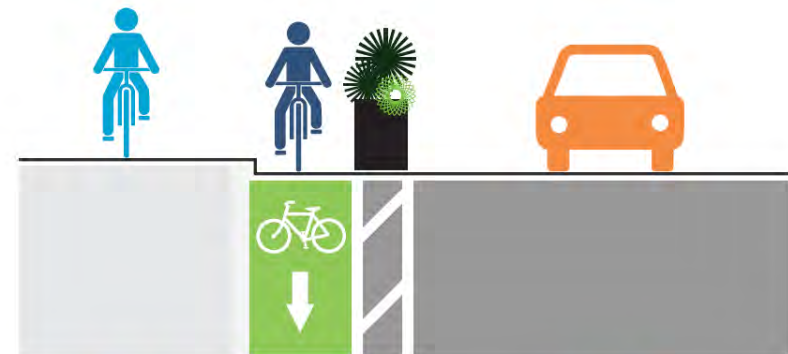
Cloud Computing + AI + Video Analytics



2016-18 Video Analytics Partnership with Microsoft



Results from Demonstration Bikeway Assessment



2019-20 Network-Wide Traffic Safety Partnership



Transoft Solutions (ITS) Safety Dashboard

Safety DASHBOARD floewenherz@bellevuewa.gov

TRANSOFT SOLUTIONS (ITS)
formerly Brisk Synergies

Search roads, landmarks, intersections

Land Use Type | Road Type 1 Selection | Urban Density | [More filters](#)

Map | Satellite

Bel-Red Way & NE 30th St Bellevue LUMINA	95.5 BriskSCORE
NE 4th St. & 112th Ave. NE Bellevue LUMINA	99.4 BriskSCORE
NE 4th Ave. & 110th Ave. NE Bellevue LUMINA	99.3 BriskSCORE
NE 8th Ave. & 108th Ave. NE Bellevue LUMINA	99.4 BriskSCORE
100th Ave NE & Main St	98.5

Transoft Solutions (ITS) Safety Dashboard

NE 8th Ave. & 110th Ave. NE



Overview

Scenarios

Traffic

Trajectories

Heatmaps



Trajectories

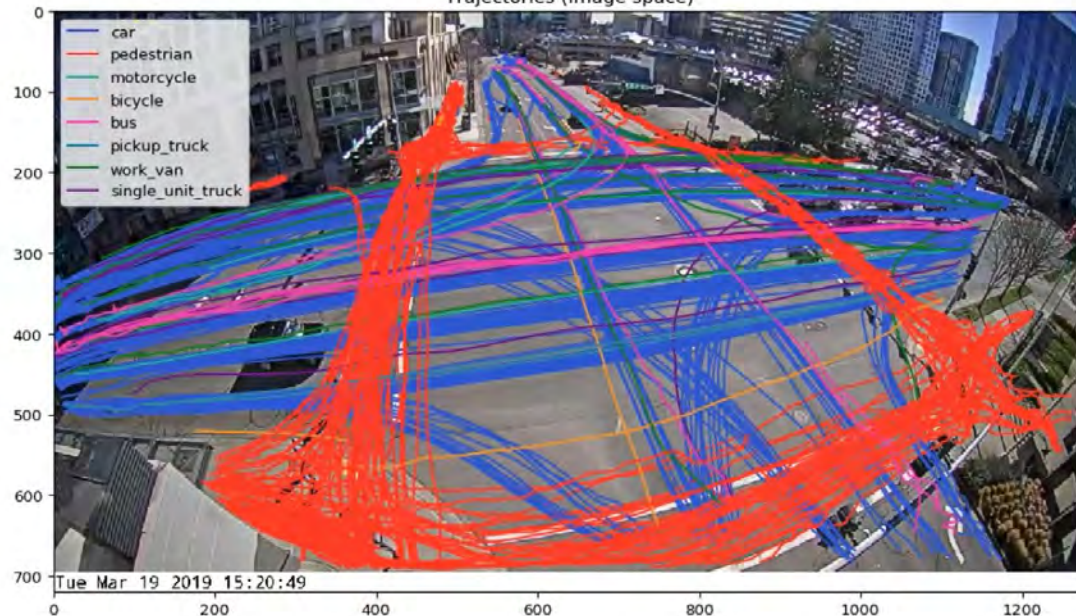
This page displays core trajectory data. Note: These figures are not generated dynamically. Also note that the trajectories by user type are sampled are NOT shown proportionally to their counts.

Display Options:

Show trajectories by user type (Image Space)

Change Location

Trajectories (Image space)



Transoft Solutions (ITS) Safety Dashboard



NE 8th Ave. & 110th Ave. NE



Overview Scenarios Traffic Trajectories Heatmaps

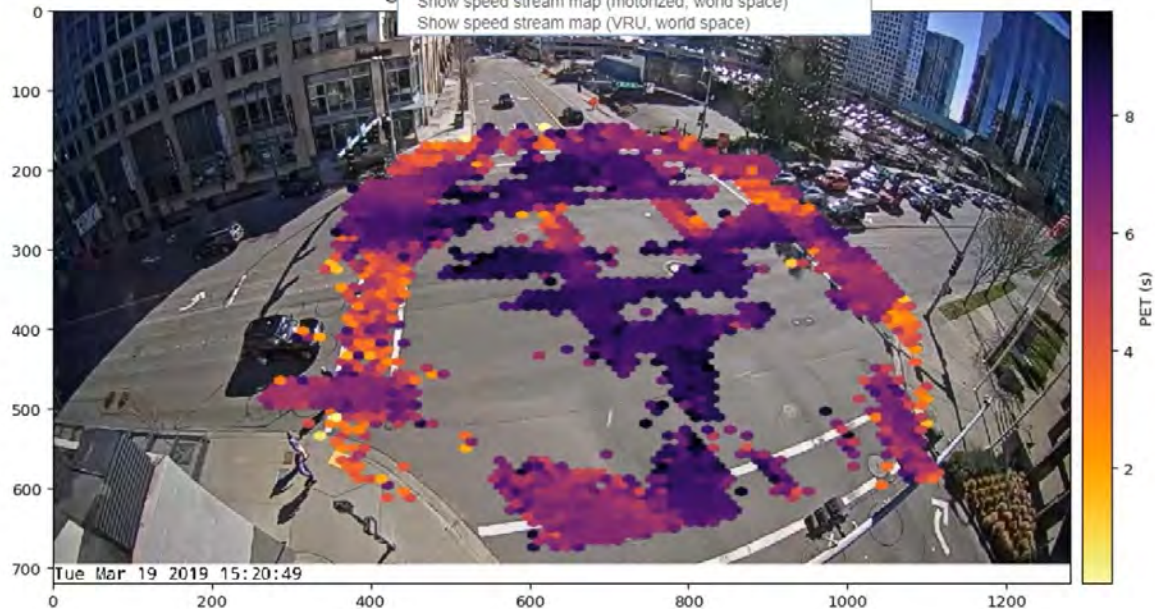
Change Location



This page displays core heatmaps. Note: These figures are not generated dynamically.

Display Options:

- Show conflict heatmap (PET, image space)
- Show conflict heatmap (PET, image space)
- Show conflict heatmap (PET, world space)
- Show speed heatmap (motorized, image space)
- Show speed heatmap (motorized, world space)
- Show speed stream map (motorized, world space)
- Show speed stream map (VRU, world space)



Transoft Solutions (ITS) Safety Dashboard



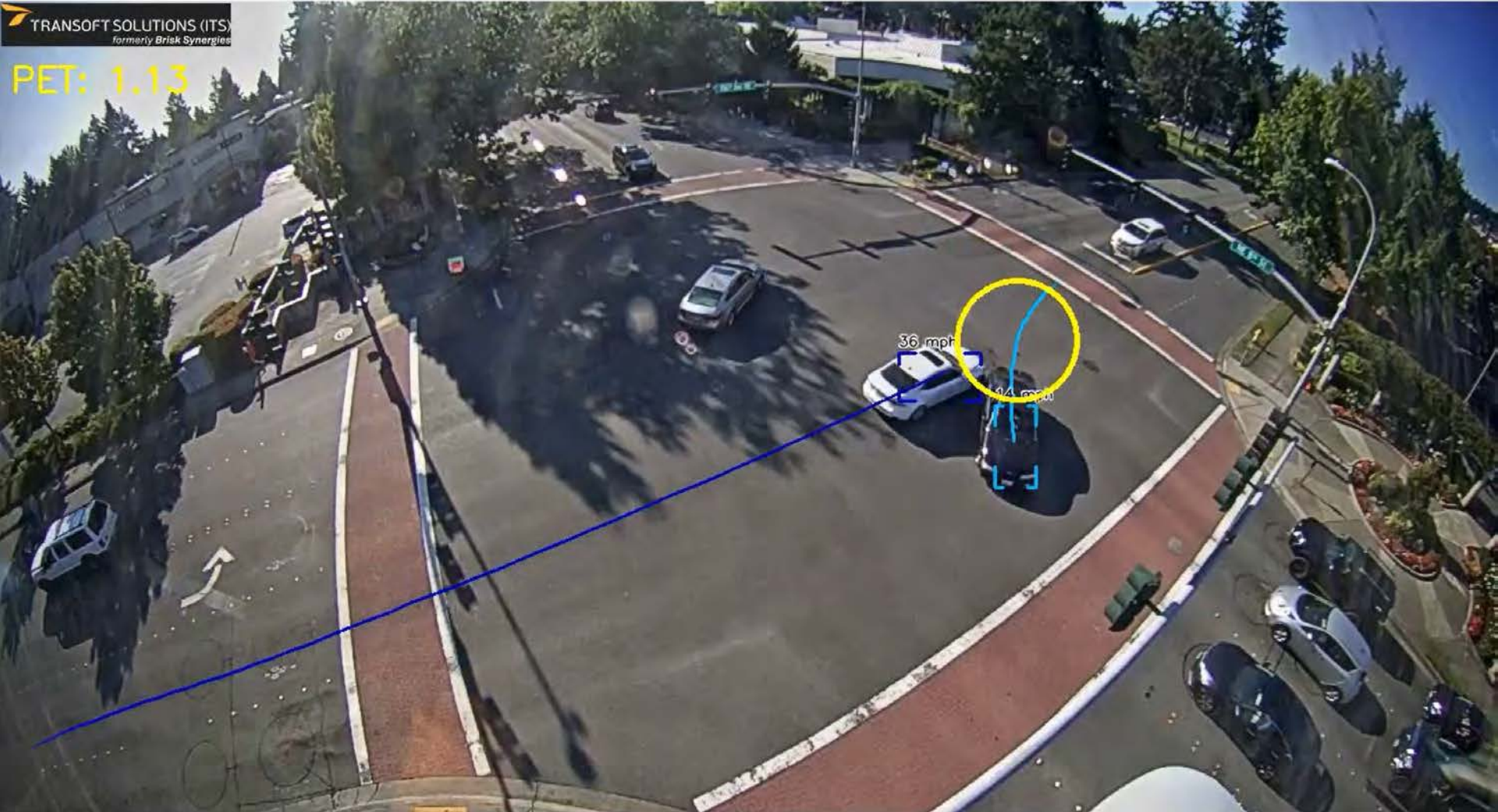
Conflict (Motorists)



Conflict (Motorists)

TRANSOFT SOLUTIONS (ITS)
formerly Brisk Synergies

PET: 1.13



Speeding

TRANSOFT SOLUTIONS (ITS)
formerly Brisk Synergies

Limit 35 mph



Speeding

TRANSOFT SOLUTIONS (ITS)
formerly Brisk Synergies

Limit 35 mph



Partnership Reports

Video-based Network-wide Conflict Analysis to Support Vision Zero in Bellevue (WA) United States

Conflict Analysis Report | June 2020



Video-based Network-wide Speed and Speeding Analysis to Support Vision Zero in Bellevue (WA) United States

Speeding Report

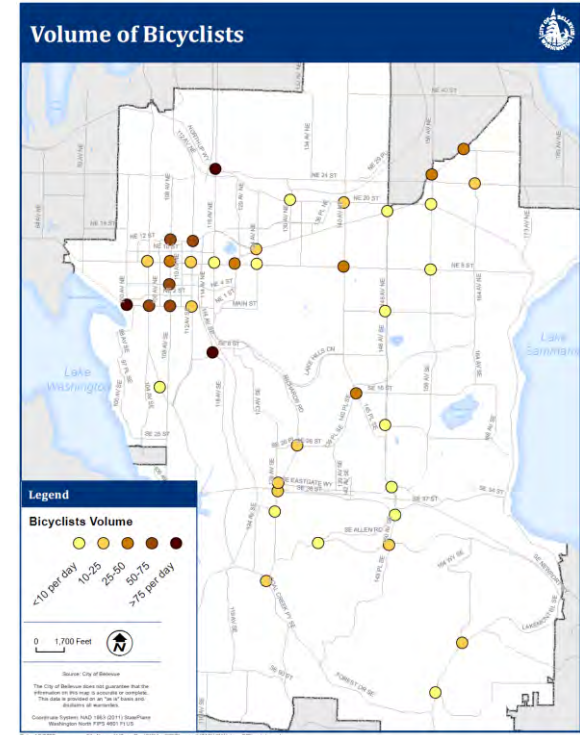
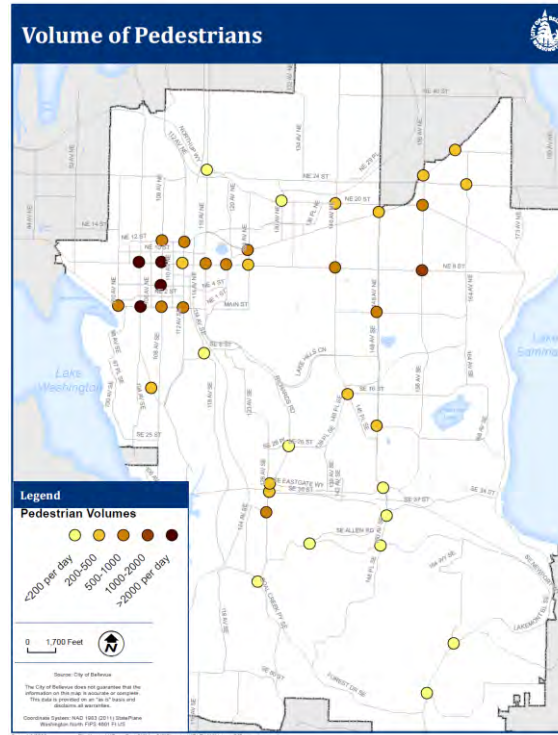
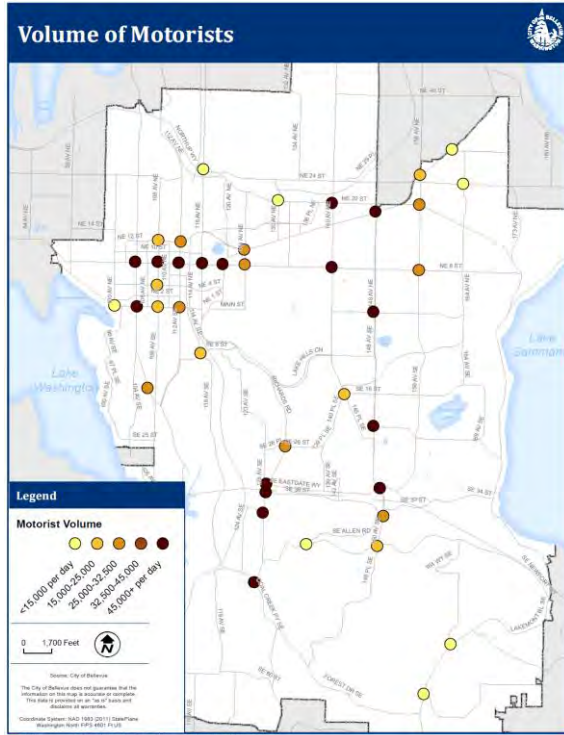


Video-based Conflict, Speeding, and Crash Correlation in Bellevue (WA) United States

Correlation Report | June 2020



Report 1: Volume Data



Motorists

97.3% of total road users
8 million observed

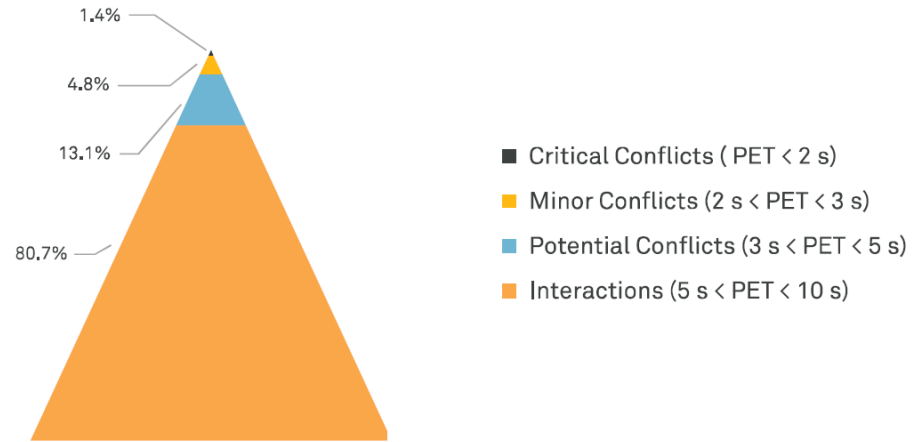
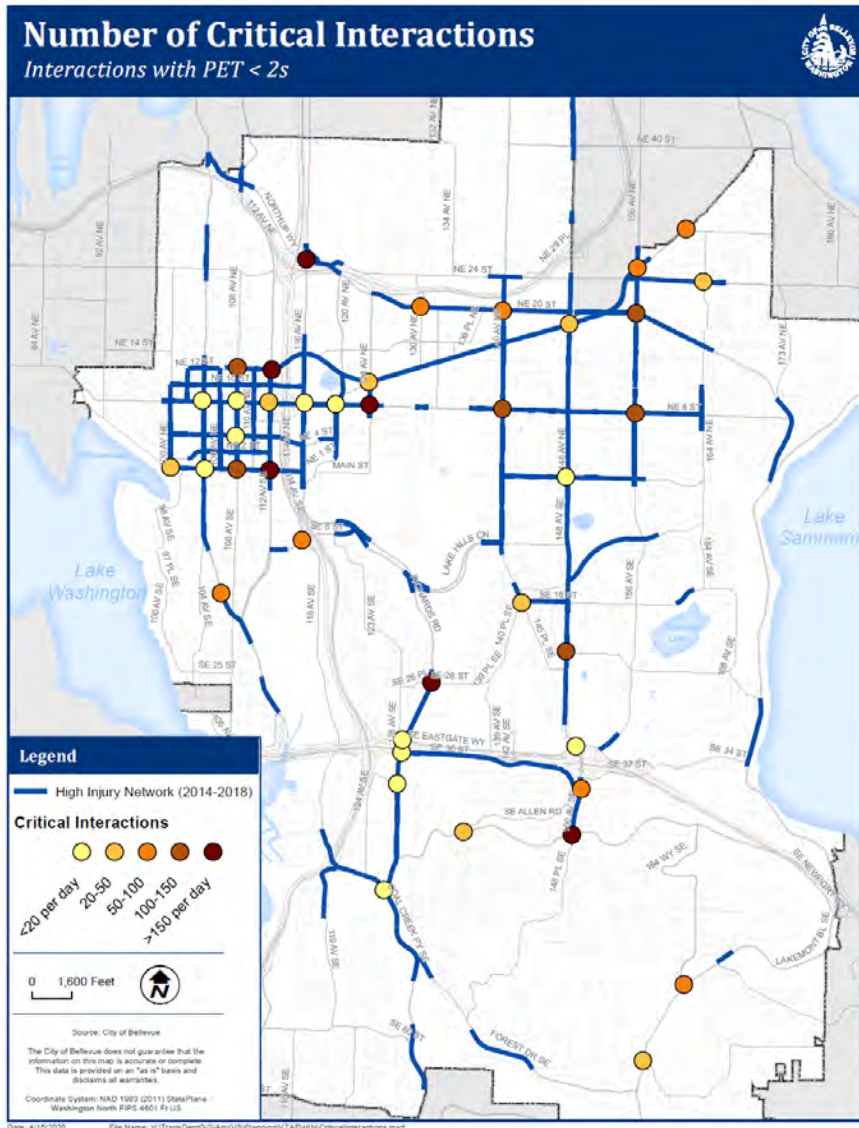
Pedestrians

2.6% of total road users
0.2 million observed

Bicyclists

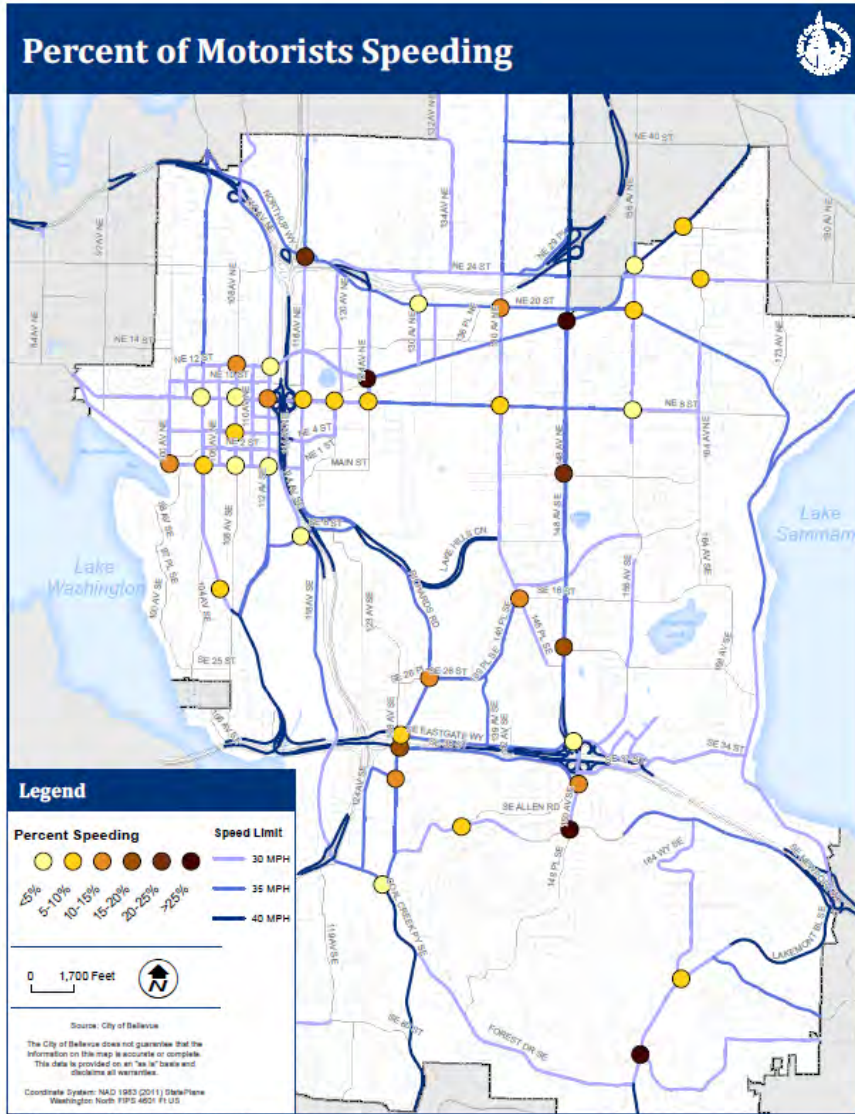
0.1% of total road users
8,000 observed

Report 1: Conflict Analysis



20K critical conflict events were observed (PET < 2 seconds) during one week at the 40 intersections.

Report 2: Speeding Analysis



Percentile	mph Above Speed Limit
5th	1.1
15th	3.1
50th	11.4
85th	23.8
95th	26.9

870K speeding events were observed (indicating 10.8% of drivers were speeding) during one week at the 40 intersections.

Report 3: Conflict and Crash Correlation

$$C = \alpha_0 V^{0.4} PET^{0.3}$$

C = Expected crashes

V = Observed traffic volume

PET = Observed conflicts (PET < 3sec)

- An increase in either volume or conflicts with PET < 3s correlates to an increase in crashes.
- This relationship is statistically significant and has a R-square of 38 percent.
- The strong association between crashes and conflicts show the promising capability of the surrogate safety approaches.
- These preliminary results (with only 10 intersections) are in the process to be improved with more data (more intersections).

Case Study: 124th Ave NE & NE 8th Street



Figure 5.1 Aerial image of intersection



Figure 5.2 Aerial image with aerial trajectories

Table 5.1 – Average Hourly Weekday Driver Volumes

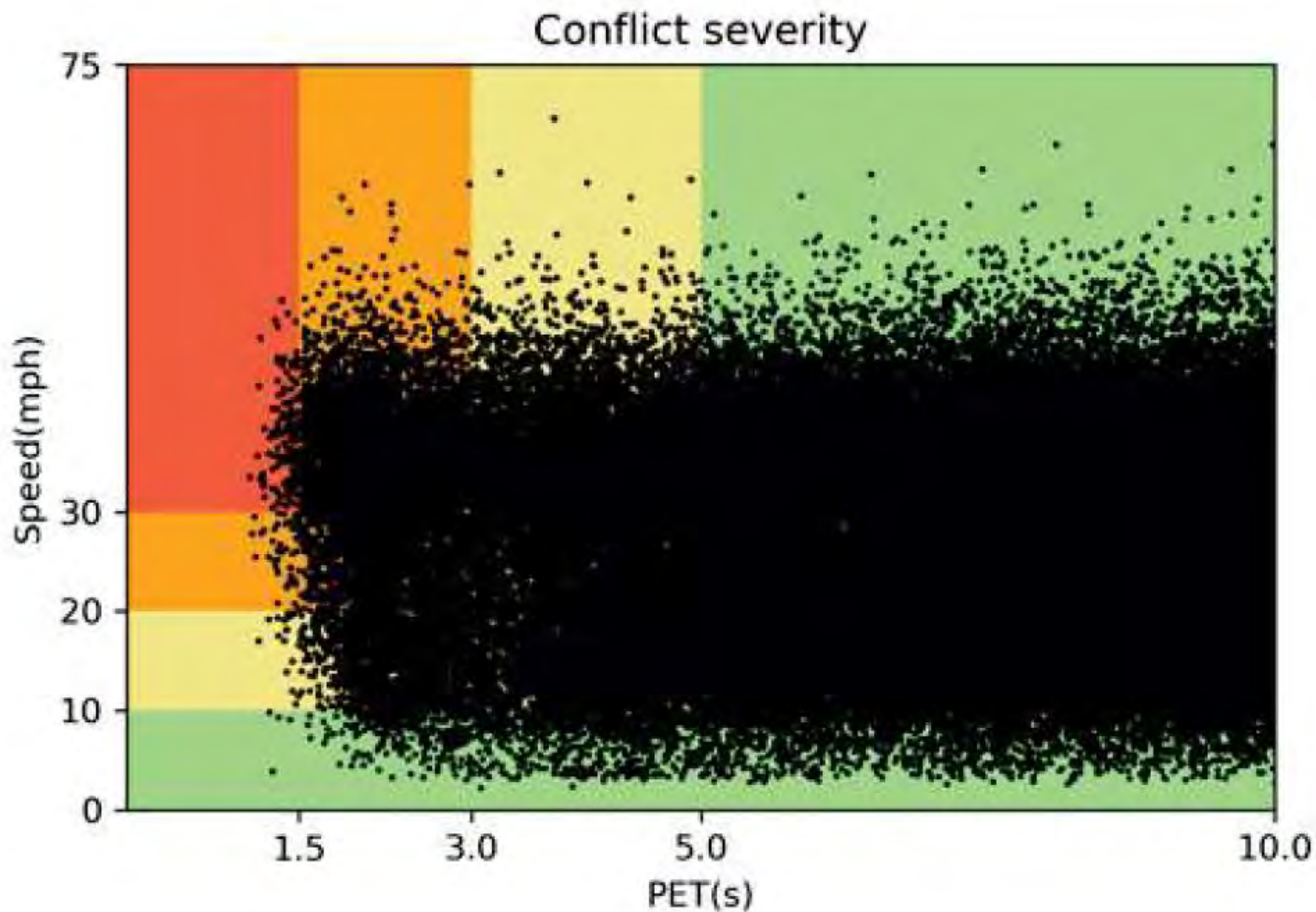
Northbound			Eastbound			Southbound			Westbound		
LT	Thru	RT	LT	Thru	RT	LT	Thru	RT	LT	Thru	RT
26	106	51	203	564	15	91	129	204	50	620	64

Before: 124th Ave NE & NE 8th Street



“Currently there is no green left turn arrow phase for cars on 124th so the left-turning traffic has to make a best effort to choose a safe time to cross the intersection but this is very difficult (and I often feel like I made a dangerous turn just to get through the intersection time).”

Case Study: 124th Ave NE & NE 8th Street



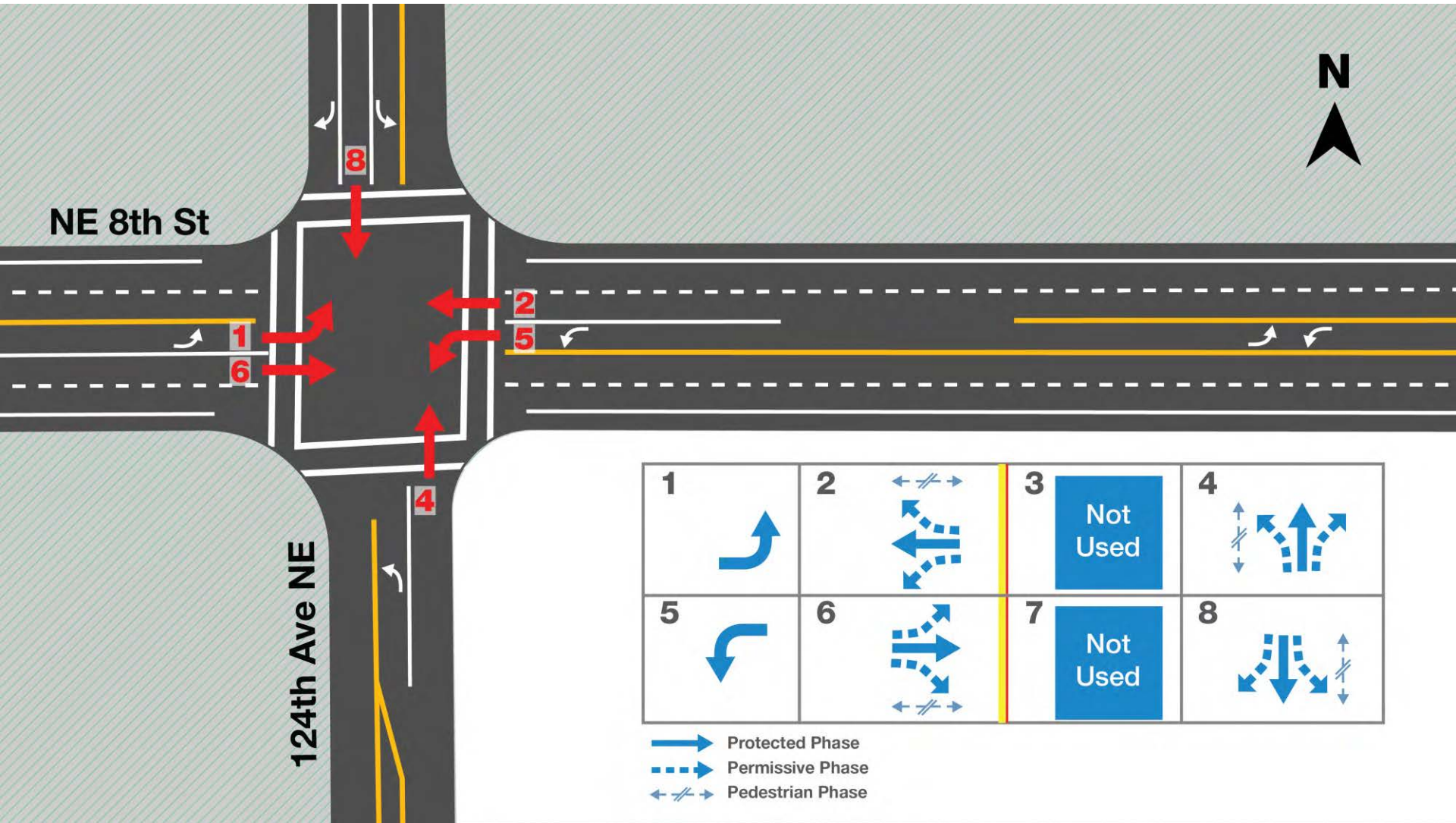
Before: 124th Ave NE & NE 8th Street



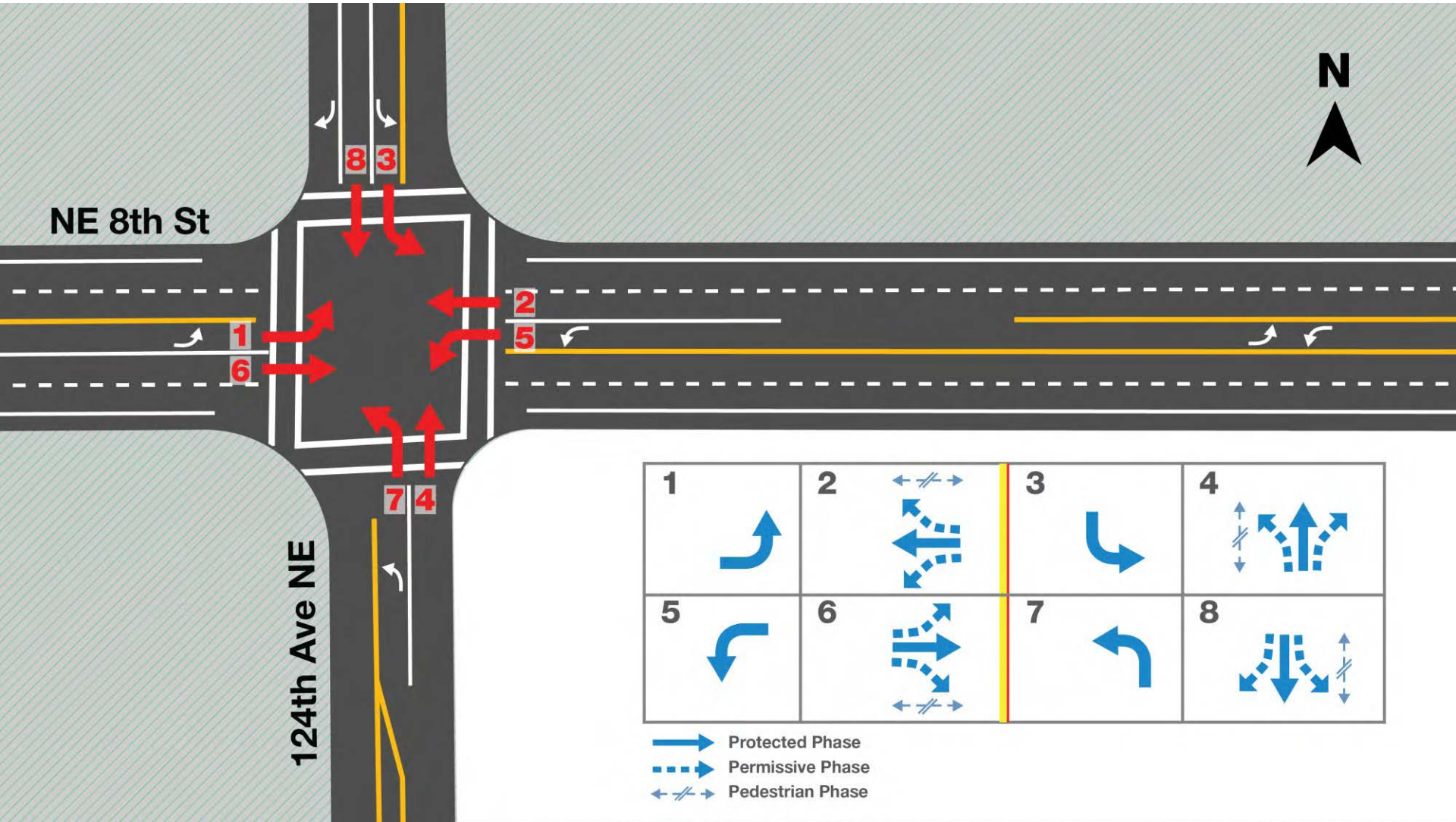
Before: 124th Ave NE & NE 8th Street



Before: 124th Ave NE & NE 8th Street

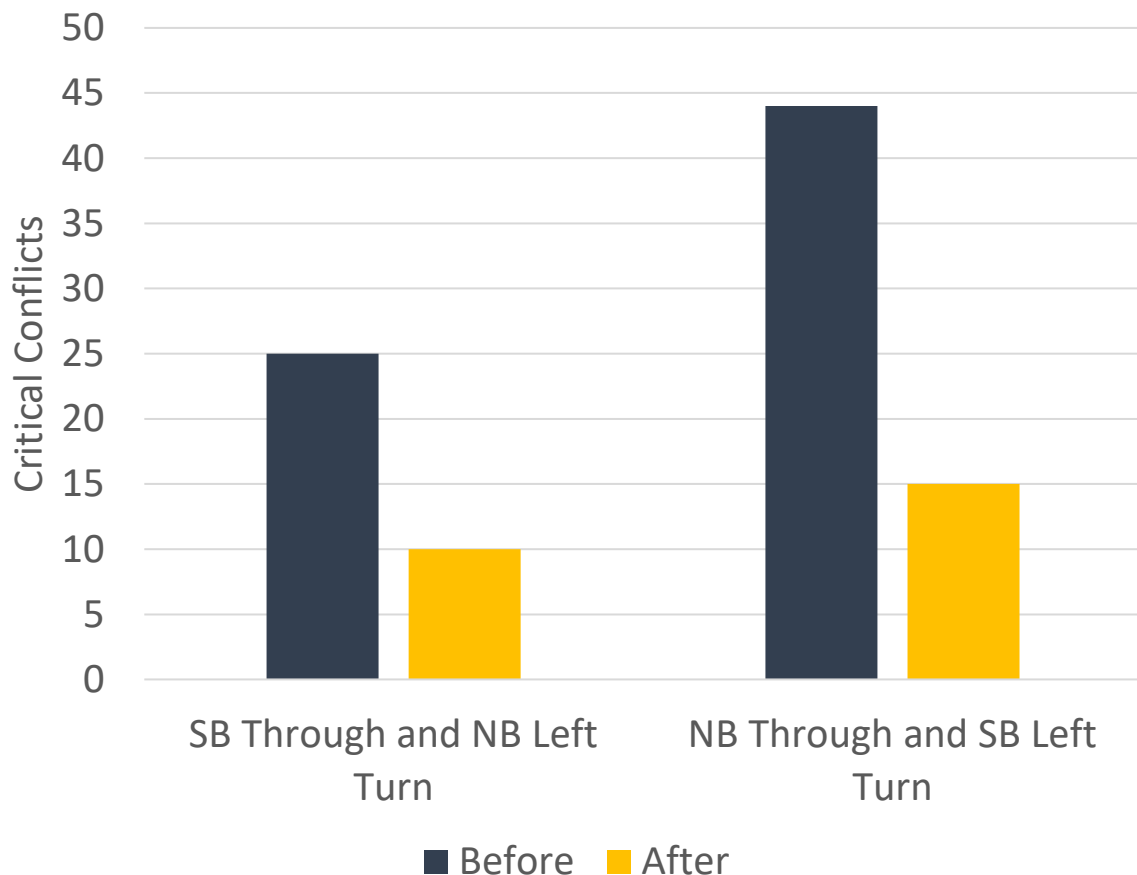


After: 124th Ave NE & NE 8th Street



Before/After Analysis: 124th Ave NE & NE 8th Street

Critical Conflicts at 124th Ave & NE 8th Street



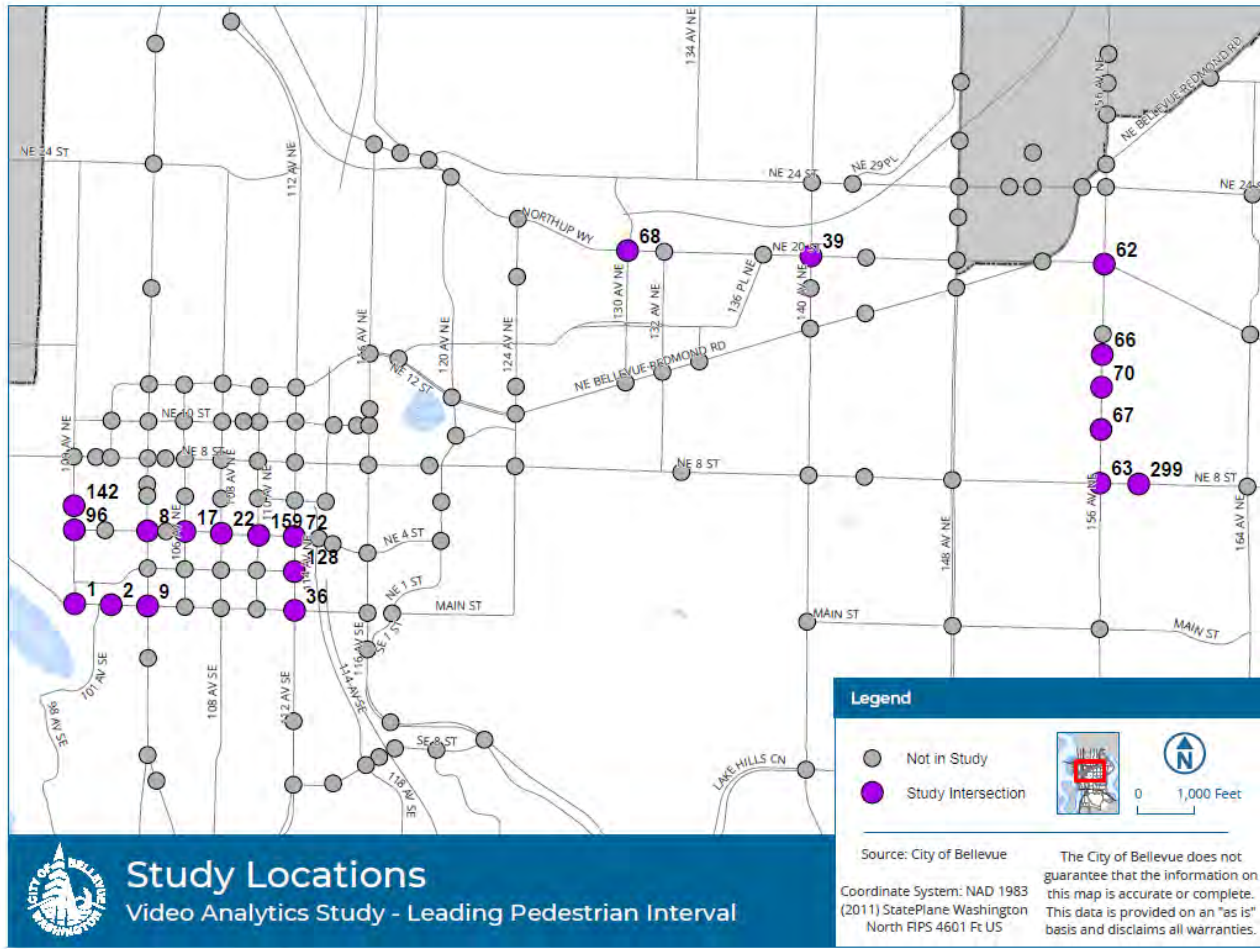
Critical Conflict Reductions:
60% between SBT & NBL
65% between SBL & NBT

After: 124th Ave NE & NE 8th Street



“I would like to say a BIG THANK YOU for installing the left turn light from 124th Ave NE to NE 8th Street. This is a big relief for many Wilburton residents who regularly get out of neighborhood via 124th Ave. They expressed great appreciation to this effort and they want me to let you know. Thank you for always listening to us and work hard on it. Together we will achieve the Vision Zero mission.”

2020-21 Leading Pedestrian Interval Partnership



Study Locations

Video Analytics Study - Leading Pedestrian Interval

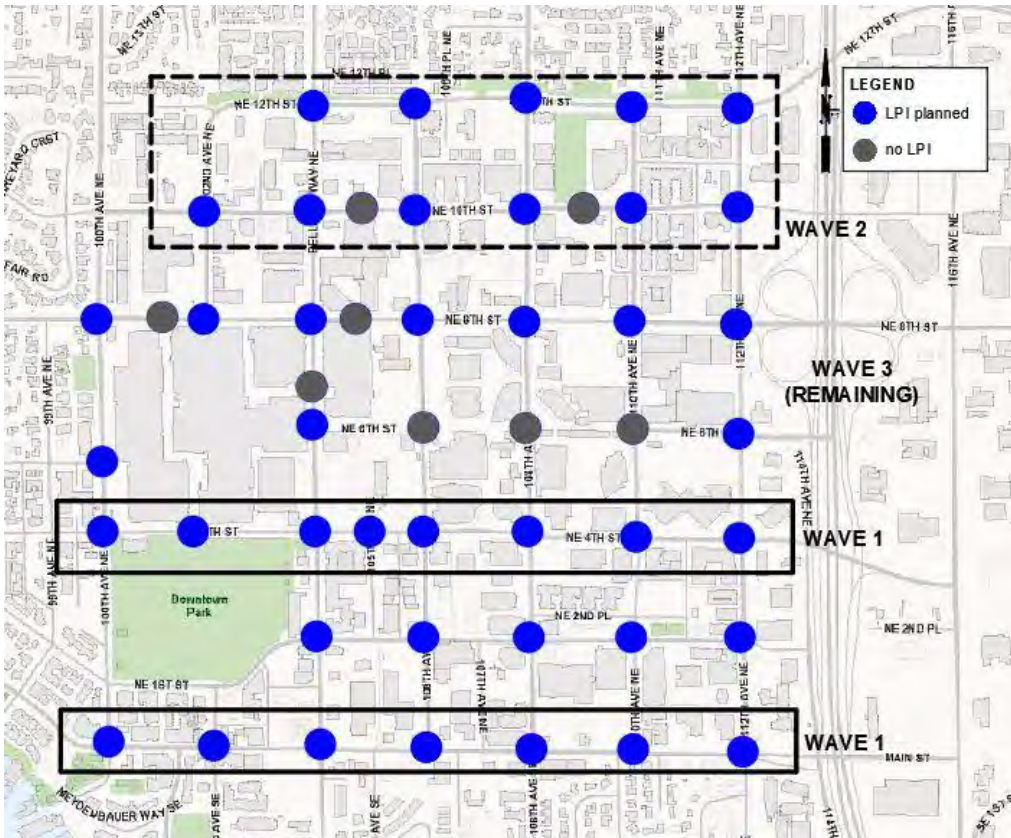


LPI Study Results



LPI results:
42%
reduction in
vehicle-
pedestrian
conflicts

2022 LPI Deployment



GET AHEAD OF TRAFFIC

When you push this button the WALK comes on first, before people driving get a green light.

Bellevue is piloting this pedestrian safety feature at selected intersections. Please cross with care.

Keeping Bellevue Moving Forward

SAFE

<https://bellevuewa.gov/visionzero>

WHAT IS A LEADING PEDESTRIAN INTERVAL?

A leading pedestrian interval, or LPI, is when people crossing the street are given the WALK sign before the adjacent vehicles are given a green light. This adjustment to traffic signal timing allows people walking an opportunity to better establish their presence in the crosswalk before people driving are allowed to turn left or right.

Bellevue is piloting this feature at selected intersections. The goal of this LPI program is to improve pedestrian safety and reduce crashes at these intersections.

City of Bellevue, Washington



2022-2023 Edge Compute Partnership



2023-2024 Cellular Vehicle-to-Everything Partnership



Bellevue blazes trail in technology to make roads safer for cars, bikes, pedestrians



For More Information



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