CASE STUDY

C-Curb Your Enthusiasm:

By Chris Comeau, AICP-CTP and Chris Breiland

In November 2015, the City of Bellingham, WA, USA completed $4.3 million in safety improvements on Alabama Street using the principals of Complete Streets and Bellingham's "Complete Networks" approach to multimodal transportation planning.[1,2] This complex 1.75-mile-long project wove together a partial road diet, six new pedestrian hybrid beacon ("HAWK") signal crossings, a transit bus queue jump, relocation of five transit bus shelters, 114 curb ramp upgrades to Americans with Disabilities Act (ADA) standards, 38 total driveways/alleyways reconstructed to meet ADA sidewalk standards, bike lanes, bike boulevards, bike boxes, center turn lanes, asphalt resurfacing, a reduced speed limit, and a c-curb median for access management to make Alabama Street safer for all users and to reconnect residential neighborhoods that had been bisected by this busy roadway. The transportation planning for these improvements took more than three years and, despite all of the safety benefits, the project was extremely controversial in the community.

SHUTTERSTOCK/ SEITA

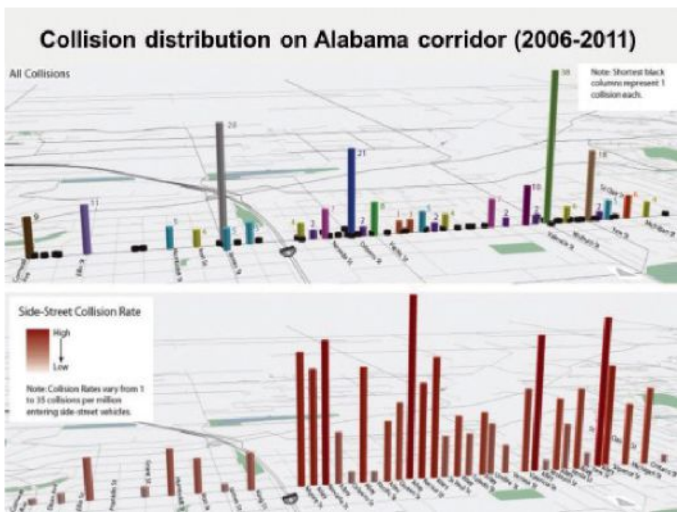
A Road Diet, Safety Improvements, and Public Controversy in the U.S. Pacific Northwest

CHRIS BEHEE, BELLINGHAM PLANNING GIS

Geographic Location of Bellingham, WA, USA

In 2011, Alabama Street, which carries more than 19,000 vehicles per day, was identified as having the second highest vehicle collision rate in Whatcom County behind Guide-Meridian (State Route 539), which carries more than 45,000 vehicles per day between Bellingham and the U.S.–Canada border. From 2006 through 2011, there were 262 vehicle collisions on Alabama Street, 93 (35.5 percent) of which were injury-related.[3] In addition to driving hazards, residents of neighborhoods bisected by Alabama Street had consistently identified the corridor as a mobility barrier for pedestrians, bicyclists, and transit riders, which was a negative influence on their quality of life.

This led city staff working on Bellingham's Pedestrian Master Plan in 2011 to recommend a "Feasibility Study for a Road Diet and Safety Improvements" along the entire Alabama Street corridor.[4] A feasibility study was needed due to high traffic volumes on Alabama Street, several cross arterials, many side streets and local access alleyways, closely spaced traffic signals, heavy traffic congestion, lengthy vehicle queues, and high-frequency transit bus service provided by Whatcom Transportation Authority (WTA).



TIKI RYSEN, FEHR & PEERS

Collision Distribution and Rates 2006–2011 on Alabama Street, Bellingham, WA, USA.

Coincidentally in 2011, the Washington State Department of Transportation (WSDOT) invited Bellingham to apply for federal Highway Safety Improvement Program (HSIP) funds through Washington's Target Zero safety campaign to reduce the high vehicle collision rate on Alabama Street. Bellingham staff convinced WSDOT to allow transportation planners to conduct a Phase 1 Feasibility Study, consistent with the Pedestrian Master Plan, and then construct Phase 2 improvements based on the preferred alternative identified in the study. In 2012, WSDOT awarded Bellingham $1.4 million in HSIP funds and Bellingham hired Fehr & Peers transportation consultants to help City staff with the road diet feasibility study.

One of the first tasks that Fehr & Peers completed for the Alabama Street road diet analysis was to evaluate the effectiveness of road diet projects on other corridors in the United States with similar traffic volumes. The literature review indicated that road diets on streets with daily traffic volumes of 18,000–19,000 are possible, but that intersection operations are key. Fehr & Peers analysis of Alabama Street confirmed these earlier findings. The main challenge with Alabama Street is that two cross-streets (James and Woburn) also have high intersecting traffic volumes (16,000 and 19,000).

Another major consideration in the road diet feasibility study was WTA Route 331, the Gold GO Line, with high-frequency bus service available every 15 minutes in both directions on Alabama Street. Route 331 is the most productive transit route in WTA's entire countywide system, and many neighborhood residents rely on this bus route to get to work, shopping, education, and entertainment destinations throughout the city. WTA staff understood the benefits that a road diet could provide for transit riders who must cross the street to access the bus stops—and WTA partially funded the study. However, a major concern from WTA was the potential for added delay to transit busses on Alabama Street, which were already experiencing decreased on-time performance on this critical bus route.

Ten alternatives were identified to make Alabama Street safer, and input was gathered from neighborhood residents and business owners along the corridor at multiple neighborhood meetings, public open house events, and City Council public hearings. A multidisciplinary project team was created to analyze existing and future forecast conditions on the Alabama corridor. This team included City of Bellingham Fire and Emergency Medical Services, Police, Transportation Planning, and Traffic Operations staff, WTA transit, the School District, the garbage and recycling collection company, the Whatcom Council of Governments, and consultants from Fehr & Peers with expertise on traffic simulation modeling.

While many neighborhood residents were in favor of studying a road diet to reduce the negative traffic impacts through their neighborhoods, many business owners and drivers were vehemently opposed to even considering it. Local media articles and talk shows about the project highlighted this controversy, and, unfortunately, the public focus of the project became less about reducing collisions and improving safety and more about a battle over traffic congestion versus bike lanes. Public misunderstanding was further fueled by misinformation posted on social media and personal blogs. Some neighborhood residents claimed that the vehicle collision data was bogus because they had never personally witnessed any vehicle collisions on Alabama Street. Other citizens said that the City should widen Alabama Street for automobile commuters and re-route WTA transit busses onto side streets rather than reduce vehicle travel lanes.

Close examination of the collision data revealed that Alabama Street experienced a high proportion of sideswipe, rear-end, and side-impact collisions. This collision profile is typical of 4-lane undivided roadways where left-turning vehicles can unexpectedly stop in the inner lane to wait for a gap in traffic (which can result in rear-end and sideswipe collisions) or be hit from the side when they are executing their turn and fail to yield to a vehicle that may be in the outside oncoming lane. Alabama Street had also experienced a relatively high number of pedestrian and bicycle collisions, particularly at busy crossing areas near bus stops, businesses, or apartments. Four-lane roadways are notoriously difficult to cross on foot or bicycle since the person crossing the street must keep track of both directions of traffic, and if they find they have misjudged the speed of approaching vehicles, it may be impossible to avoid a collision.

According to Federal Highway Administration data, a 4-to-3 lane road diet is considered a proven safety countermeasure to reduce vehicle collisions. By removing a travel lane in each direction and providing a center turn lane, left-turning vehicles have a location to pull out of the main traffic stream and have only one lane of opposing traffic to cross.[5] Similarly, pedestrians and bicyclists have an easier time crossing a 3-lane street. While there are many safety benefits of road diets, they must be evaluated in the context of the traffic volume on the corridor. If a road diet is implemented on a corridor with too much traffic, this can result in increased congestion, driver frustration, cut-through traffic on local streets, and increased impatience/risk taking at intersections—all of which can result in increased collisions, eroding the other safety benefits of a road diet. Because Alabama Street carries more than 19,000 vehicles per day and is a major transit route, a careful analysis of existing and future traffic congestion and transit reliability under various road diet scenarios was conducted using a traffic simulation model.

Existing Conditions

To define a baseline to which the road diet alternatives could be compared, existing conditions were evaluated using a traffic simulation model developed by the Whatcom Council of Governments (WCOG), which is the Bellingham area's metropolitan planning organization. The traffic simulation model was calibrated to 14 intersection traffic counts collected in 2012 as well as observed PM peak hour travel times and vehicle queue lengths. The primary focus of the analysis was to document how the road diet would impact intersection delays, vehicle queues, and transit operations along the corridor.

Table 1 shows the PM peak hour delay and level of service (LOS) results for 3 scenarios: 1.) Existing conditions; 2.) A comprehensive 1.75-mile road diet; and 3.) A "hybrid" road diet converting the east and west ends from 4-to-3 vehicle travel lanes.

Comprehensive Road Diet

With the simulation model calibrated and validated to observed conditions, the lane channelization was updated to evaluate a full road diet (three-lane cross-section) along the 1.75-mile corridor between Cornwall Avenue and St. Clair Street. As part of the analysis, the traffic signal timings, offsets, and phasing were iteratively adjusted to optimize the vehicle throughput of the corridor. Maximizing throughput was balanced against the need to maintain adequate pedestrian and bicycle crossing times; as a result the traffic signal cycle length was limited to 120 seconds.

As shown in Table 1, a comprehensive road diet scenario would experience much higher traffic congestion, intersection delays, and longer queues than existing conditions for the following reasons:

- High cross-street volumes: The intersections James Street and Woburn Street have cross-street volumes that are comparable to the volumes on Alabama Street. These high cross-street volumes are problematic since a substantial amount of traffic signal time is required to accommodate the heavy through and left-turn traffic. This time requirement, coupled with fewer through lanes on Alabama Street, results in long queues and increased delays on Alabama Street.
- High directional volume: Traffic on Alabama Street is highly directional, with about two-thirds of the traffic in the PM peak hour heading eastbound and one-third heading west. Given the high cross-street volumes mentioned above, there is not enough green signal time that can be devoted to clearing eastbound traffic at James Street and Woburn Street This results in cycle failures and queues that build through the peak hour.

An analysis of travel times between Cornwall Avenue and St. Clair Street showed that eastbound travel times increased from about 5 minutes under existing conditions to more than 7 minutes under the road diet scenario. While this increase in travel time represented some inconvenience for vehicle drivers, it also created a major negative impact to transit operations for WTA. A close examination of the results revealed that the majority of the delays and congestion resulted from traffic signal cycle failures at the intersections in the central portion of the corridor (between James Street and Woburn Street). The reduction of one through lane for the entire 1.75-mile length of Alabama Street resulted in untenable traffic signal operations. In order to provide adequate throughput for Alabama Street, there was inadequate time to clear traffic on the cross streets, resulting in high intersection delays for any of the traffic signal timing plans that were evaluated, as well as significant negative impacts to transit on-time performance, reliability, and operations.

Hybrid Road Diet

Based on the results above, the team developed a second "hybrid" scenario that limited the road diet to the east and west ends of the corridor—east of Superior Street to St. Clair Street and west of Iron Street to Cornwall Avenue. As shown in Table 1, the LOS and queuing results of the hybrid road diet project were very similar to the existing conditions results. A corridor travel time analysis from the simulation model indicated that eastbound travel times were similar at about 5 minutes for existing conditions and for the hybrid road diet scenario. These findings confirmed that removing a vehicle travel lane on the east and west ends of Alabama Street would not substantially impact traffic or transit operations and that the additional capacity (particularly in the peak direction of travel) was necessary to maintain acceptable levels of traffic congestion between James Street and Woburn Street.

Another major consideration of the project was increasing bicycle connectivity and use as recommended in Bellingham's 2014 Bicycle Master Plan.[6] Bike lanes could only be installed if a 4-to-3-lane road diet was implemented, but many citizens stated that they would not ride in bike lanes on Alabama Street, preferring lower volume, lower speed, and lower stress residential streets

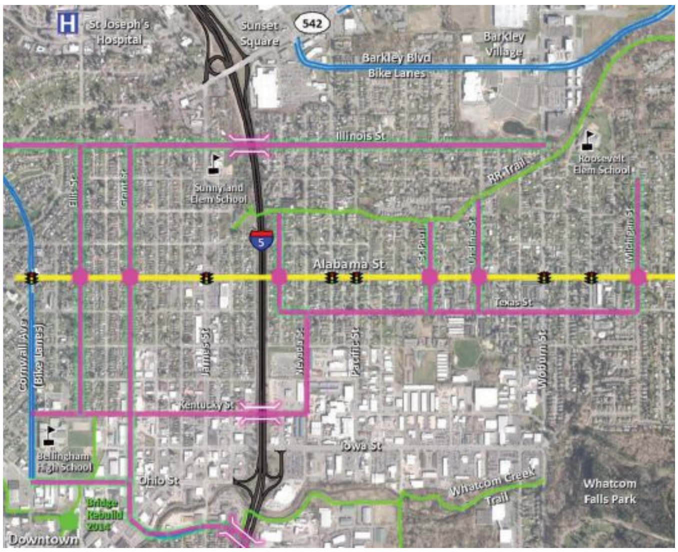
Table 1. Three Road Diet Scenarios Analyzed (Existing; Comprehensive; and Hybrid) Alabama Street Multimodal Safety Improvements - Bellingham, WA

Road Diet Feasibility Study	Major Signalized intersections on Alabama Street							
	Cornwall		James		Orleans		Woburn	
Road Diet Scenarios	LOS	Seconds of Delay	LOS	Seconds of Delay	LOS	Seconds of Delay	LOS	Seconds of Delay
No Action - Existing Conditions	B	19	D	37	C	16	D	27
Comprehensive Road Diet (1.75-miles)	F	130	F	195	F	80	F	84
Hybrid Road Diet (East & West ends only)	C	28	D	37	C	24	C	23

CHRIS BREILAND, FEHR & PEERS

parallel to Alabama Street improved as "bicycle boulevards." East of Interstate 5, bicycle boulevard options existed on Texas Street, one block south of Alabama, a major regional multiuse trail two blocks north of Alabama Street, and on Illinois Street four blocks north of Alabama Street.

Bellingham's Bicycle Master Plan promotes the construction of bikeways that are safe, comfortable, and likely to induce the "interested, but concerned" crowd to choose riding a bike for transportation purposes more often. Bike boulevards are low-volume residential streets optimized for bicycles, are a major component (30 percent) of the Primary Bicycle Network, and six bike boulevards were planned across the busy Alabama Street corridor (see illustration). These six crossing locations also coincided with pedestrian crossing improvements and WTA transit bus stop locations. Breaking the north-south mobility barrier of the busy roadway with safe crossing treatments for pedestrians, transit riders, and bicyclists, which would also have the effect of reconnecting the neighborhoods severed by Alabama Street became just as important as reducing the high number of vehicle collisions on the street.



Chris Behee, Bellingham Planning GIS

Six new Bicycle Boulevard and Pedestrian Hybrid Beacon crossings on Alabama Street

Ultimately, due to heavy traffic congestion and negative impacts to WTA transit service, the road diet was feasible on the western and eastern portions of the corridor, but not in the center. To reduce vehicle collisions, which was the basis of the project, access management and restriction of left-turns using a "type c" curb (commonly called c-curb) median was proposed in the center portion of the corridor. [7] To mitigate the inconvenience of the access restriction, the City offered to improve a public right-of-way (North Street) one block north of Alabama Street as a local access alleyway connecting five blocks of dead-end residential streets and install a new 4-way traffic signal at Alabama/St. Paul. This proposal would have improved local circulation, minimized access inconvenience, and maximized vehicle collision reduction with the c-curb median, but it was met with outcry from neighborhood residents, claims that City staff wanted to route cut-through traffic through the neighborhood, and more misinformation on social media, personal blogs, and the local media. In May 2014, many neighborhood residents organized and stood on the corners of the five blocks of dead-end streets during the evening rush hour on Alabama Street holding protest signs against the installation of c-curb median.

Chris Comeau, Bellingham Public Works

Local residents protested a proposed raised c-curb median on Alabama Street

During the two years (2012–2013) of technical analysis for safety improvement options, there were an additional 52 vehicle collisions on Alabama Street, 19 (36.5 percent) of which were injury-related. In total, from 2006–2013, there were 314 vehicle collisions on Alabama Street, 112 (35.7 percent) of which were injury-related.[3] Despite the demonstrated collision reduction benefits proposed by City staff, vocal neighborhood opposition swayed the City Council to remove the c-curb median from the 5-block center of the project. All other recommended safety improvements to the corridor were approved and construction was completed in November 2015.

Bellingham's Complete Networks approach to transportation planning and the Alabama Street Multimodal Safety Improvements were featured in the ITE Complete Streets Council's June 2015 webinar.[2] For more complete documentation of the Alabama Street Multimodal Safety Improvements, please visit the project web page www.cob.org/services/planning/transportation/Pages/alabama-corridor-study.aspx. **itej**

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City of Bellingham

4-to-3-lane road diet with center turn lane and HAWK crossing signals for pedestrians, transit riders, bicyclists, and vehicle safety.

City of Bellingham

C-curb median access management at side streets and alleyways to reduce vehicle collisions while adding safe crossings.

Chris Comeau, AICP-CTP, *is the transportation planner for the City of Bellingham, WA, USA and has more than 22 years of professional land use and transportation planning experience in Washington, Arizona, and Alaska. During the past 15 years, Chris has been instrumental in transforming Bellingham's transportation policy approach from predominantly auto-oriented to a focus on completing multimodal networks. Chris has served on the American Planning Association's (APA) Washington Board of Directors and is currently serving as President of the Northwest Section of APA Washington. Chris is a member of ITE. More about Chris' education and work experience can be viewed by searching for Chris Comeau, AICP CTP at www.linkedin.com.*

Chris Breiland, P.E. *is a principal with Fehr & Peers in Seattle and has more than 12 years of transportation planning and engineering experience. Complex multimodal corridor analysis is a key area of interest for Chris. These corridors demand that a variety of mobility needs be balanced against each other to optimize safe access for all. To facilitate this type of corridor planning, Chris has led the development of a number of innovative analysis techniques and unique performance measures. Chris has a bachelor of science in transportation and environmental planning and a master of science in civil engineering. He is a member of ITE.*