# #4 – Back-in Diagonal Parking with Bike Lanes

**VANCOUVER, WASHINGTON**

*Todd Boulanger, Senior Transportation Planner, MURP, Vancouver, WA*
*Contributions by Ali Goudarz Eghtedari PE; John Manix PE, PTOE*

## Background

McLoughlin Boulevard, a minor arterial laid out at the turn of the century, was no longer serving the surrounding land uses and users well. Along segments, this arterial was wider than its traffic volume necessitated, especially in the area of Clark College. The segments under study had one to two wide lanes in either direction and often no parking or parking limited to parallel stalls (see figure 1). Complaints typically focused on problems with driver speeding, lack of bicycle facilities, strong parking demand in areas with limited supply, and long pedestrian crossing distances to reach transit stops. Complaints about conventional diagonal parking focused on the restricted line of sight parkers had when leaving a stall and the insecurity of bicyclists in cycling along zones with conventional diagonal parking.

Diagonal parking in the City up to the point of this demonstration project was laid out conventionally by staff to allow drivers to enter 45-degree stalls head-in along some of the wider arterials. Research by the City in the 1970s documented the risk of vehicle-to-vehicle collisions when using head-in diagonal parking on an arterial street. To mitigate this concern, City engineers separated diagonal parking lanes from travel lanes with a full 3.7 m (12 ft) buffer lane for vehicle queuing (figure 2).The McLoughlin Boulevard corridor also lacked bike lanes, with the result that some bicyclists chose to ride on the sidewalk along this street (figure 3). Over time, this layout became less opportune as head-in diagonal parking facilities were difficult to combine with bicycle lanes. This demonstration project moved forward because of the desire of our Parks and Recreational Department for both additional on-street parking and enhanced bicyclist access to their facilities along a segment of McLoughlin Boulevard that lacked parking.

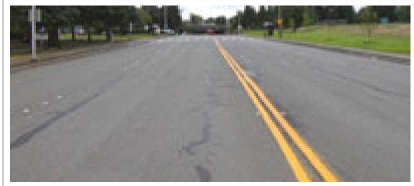


Figure 1. Four lane configuration before back-in parking.

Figure 2. Traditional diagonal parking with buffer lane, no bike lanes and incomplete sidewalks (1 block east of back-in zone).

In the treatment section, McLoughlin Boulevard:

- is a minor arterial,
- had two striped lanes in each direction and no parking,
- was identified as a facility with future bike lanes in the city's bike plan,
- had an ADT of 6,800 in 2000.

In a zone to the east of the demonstration area, McLoughlin Boulevard has head-in diagonal parking with a 3.7 m (12 ft) buffer lane (shown in figure 2).

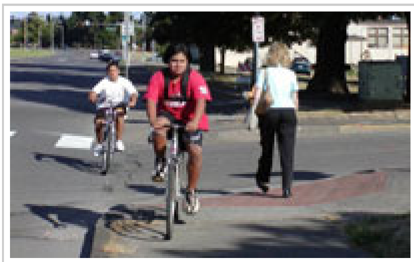


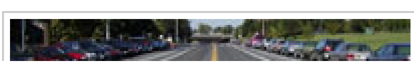
Figure 3. Bicyclist access before bike lanes.

This demonstration project had three objectives, to assess whether:

1. back-in diagonal parking would function as well as head-in diagonal parking in regard to safety and community acceptance,
2. back-in diagonal parking would allow bike lanes to replace vehicle buffer lanes for motorist maneuvering space, thereby improving bicyclist access, and
3. the narrower street cross-section devoted to motor vehicle travel would lower the 85th percentile speeds.

Figure 4. Seattle — Merchants prefer the view.

The existence of back-in diagonal parking in other cities was not widely known in Vancouver at the time of the original proposal in 2000. Staff became aware of this option in 1997 when bicycling in Seattle's Queen Anne district and from other cities (see figures 4–7). Interactions between parkers with motor vehicles, bicyclists and pedestrians were photographed and



videotaped in other locations, although the combination with a bike lane was not observed during several annual observational visits. Other sections of Seattle used back-in parking along streets with very steep grades. Initial proposals were developed using photo simulations in Adobe Photoshop® overlaying photos of Seattle parked cars with Vancouver project sites.

Figure 5. Washington, DC — Back-in parking used on streets with bike lanes.

Staff primarily relied on Seattle staff's written positive collision experience with this layout of parking,[1] as repeated literature review and research did not find many other examples to evaluate until the project was well underway. Soon after 2002, articles began to appear in the ITE Journal concerning renewed interest in back-in parking (Edwards, 2002) and concern about its rediscovery (Box, 2002). Over the last four years, staff has exchanged information with over 10 jurisdictions with back-in parking and those contemplating it. Through site visits and e-mail discussions, 23 communities in the US have been identified as having some form of back-in diagonal parking, and at least four of those have combined back-in parking with bike lanes as of 2004 (see Appendix).

Figure 6. Seattle — back-in parking with neighborhood commercial land use.

Initial treatment sites along McLoughlin Boulevard were selected during a Neighborhood Traffic Management planning process in 1999–2000. The initial parking concept proposal languished until a facility plan for a public swimming pool proposed tearing down a heritage house for parking lot expansion in Hough. Community support for back-in diagonal parking grew, as it would allow neighborhood associations to improve the surrounding parking supply while providing bicycle access to surrounding public facilities and protecting existing housing stock. The site of this demonstration was relocated one half-mile east of the original site, after a request by the Parks & Recreation Department for more parking in front of another pool guaranteed funding for the striping demonstration project. Additionally, engineering staff considered this site to be less politically risky for a long evaluation period as it had a greater supply of off-street parking, thus allowing drivers uncomfortable with back-in parking other parking options.

## Countermeasures

The demonstration project relied primarily on new bike lane striping, stenciling and signs to create back-in, diagonal parking stalls along a zone that did not have pre-existing parking. The pre-project lane configuration generally was four lanes with a striped center line for an 18.6 m (61 ft)–wide street (shown in figure 1) classified as a 'minor arterial' with 7,000 vehicles per day. The post-project lane configuration has added separate lanes for parking and bike lanes while removing one lane in each travel direction (see figure 8 and table 1).

**Table 1. Lane Configurations Pre- and Post-Project**

| Lane Type | Bike Lane | Parking Lane | Travel Lane | Travel Lane | Parking Lane | Bike Lane |
|---|---|---|---|---|---|---|
| **Before** | None | None | 4.6 m (15 ft)* | 4.6 m (15 ft)* | None | None |
| **After** | 1.8 m (6 ft) | 4.9 m (16 ft) | 3.7 m (12 ft) | 3.7 m (12 ft) | 2.4 m (8 ft) | 1.8 m (6 ft) |
| Notes: Prior to 2002 there were two lanes in each direction. | | | | | | |

The proposed addition of street textures for traffic calming and bulb-outs for reduction in pedestrian crossing distances could not advance until engineering evaluation of the parking demonstration was completed and additional construction funding was found. The project was initiated in the summer of 2002. .

Time and understanding of the opportunities of this type of parking was important for many of the stakeholders in order for trust to develop. Initial interactions among stakeholders could be best summed up by one council member's comment on the idea; "cockamamie." Others suggested that it belonged downtown where more parking supply was needed and the speeds were slower. Support for the demonstration project was developed through repeated dialog with surrounding neighborhood associations and large institutional property owners, and then waiting for them to request project initiation at a later date. The bicycle community had guarded support for the project, as it provided 0.8 km (0.5 mi) of additional bike lanes in an area with many residences and civic facilities (two swimming pools, a college, a high school, and a recreational center). Outreach to other stakeholders (elderly recreation facility clients, students, bicyclists, transit riders, pedestrians, and parkers) was accomplished by posting information on the City Web site, holding neighborhood newsletter discussions and a televised council session, and the posting of flyers on windshields, bus stops, and sidewalk A-boards along the project area. Final institutional support for the project was found after the transportation manager visited Seattle and observed back-in parking in use. The project then advanced to City Council for final, though guarded, approval.

## Evaluation and Results

This demonstration project has been evaluated using video analysis of vehicular interaction with parking (30 hours over six weekdays while college was in session), observational studies, feedback from users, review of collision rates and speed surveys, and review of citizen complaint files.

### Diagonal Back-in Parking (figure 9)

- Some drivers had difficulty backing into spaces when few cars were parked versus when stalls surrounded by other parked cars, as there was less spatial reference as to where the stalls were located while executing the turn unto a stall.
- A few drivers preferred to pull into a back-in space by looping in through empty adjacent stalls versus stopping in the bike lane and backing up into a stall — this behavior was not forecast before design.
- The 1.8 m (6 ft) bicycle lane was adequate to provide drivers space for reversing into the parking stall with traffic.
- Drivers that violated (drove through them without parking) the bike lanes and parking zones were typically leaving or entering the driveways nearest the parking zone versus drivers that were just driving through the zone.
- No drivers were observed violating the parking zone when cars were parked in it or when bicyclists were using the bicycle lane.
- Loading and unloading from parked vehicles is easier from the curb area (figure 10).

Figure 9. Driver backing into stall.

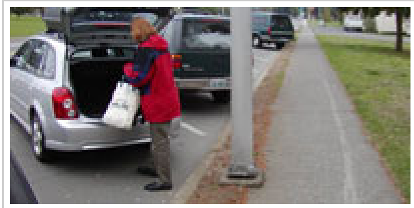


Figure 10. Easier unloading at the curb with back-in parking.

### Vehicle to Parker Conflict (figures 11 and 12)

- No bike to parking or exiting parking vehicle conflict was observed on the video footage, but there were too few joint actions to judge this interaction between these street users.
- No vehicle to parking or exiting parking vehicle conflict was observed on the video footage.

### Bicycle Traffic Flows

- Bicycle traffic increased from 1 to 6 percent of all eastbound vehicular traffic along the project area (tube counts pre- and post-project — 10h00 to 11h00) during an average hour of use.
- Total bicycle traffic increased 235 percent from 17 bicycles (hose count — April 24, 2002) to as many as 44 bicyclists (video analysis — Oct. 16, 2002, 10h00 to 14h00, clear warm weather) after the bike lanes were added.
- Bikeway facilities provided more direct benefit than on-street parking facilities at this location (44 bicyclists versus eight drivers who parked during period with highest parking utilization — Oct. 15, 2002 video analysis).
- No recognized avoidance of back-in parking zone versus conventional parallel parking zone by either advanced (A type) or experienced (B type) bicyclists riding next to parked cars — and both zones had similar traffic flows (19 versus 25 riders on Oct. 15, and 19 versus 21 riders on Oct. 16).

Figure 11. Bicyclist's view along back-in parking zone.

Figure 12. Exiting driver's view of approaching traffic along back-in parking zone.

### Lane Configuration Effect on Speeds

The secondary objective of adding bike lanes and parking lanes was to reduce the traffic speeds along this corridor. The travel speeds along this section of McLoughlin Boulevard are historically higher than posted, causing concern among neighborhood leaders and other street users such as pedestrians and bicyclists, as identified during the Neighborhood Traffic Management planning process.

- The post-project travel speeds were not calmed. They increased slightly (see table 2). There is a visual break between the section west of the project area, which is a much more pedestrian-scaled, shared-use neighborhood. The project area, by contrast, is bordered by open-space land uses (sports fields) with few driveways and long blocks. In the next phase, enhanced pedestrian crossings with calming measures will be implemented.

**Table 2. Eighty-Fifth Percentile Speed Pre- and Post-Project**

| | East Bound Traffic | West Bound Traffic |
|---|---|---|
| **Before** | 35.1 mph | 36.7 mph |
| **After** | 38.5 mph | 38.3 mph |
| Notes: This street is posted as a 25 mph zone. | | |

### Collision History

- There were few collisions in both the pre- and post-time periods, so the project's influence on the collision rate along the parking zone is inconclusive. During 2000-2002 there were two collisions versus three collisions in the 2002-2004.
- All except one of the collisions in both periods involved two vehicles, where one vehicle turning left into a driveway failed to yield to oncoming traffic.
- Both periods had one injury reported closest to the parking zone. The entire bike lane zone (which extends beyond the parking project area) had a total of six injuries before the addition of the bike lanes and one injury after.
- None of the reported collisions or injuries involved a bicyclist or driver undertaking a parking or exiting parking maneuver.

Our office is currently working on extending this back-in parking and bike lane zone further to the west and the east for 2440 m (8000 ft) total, as requests for work are generated by property owners and neighborhood associations. Two projects are currently in the design stages. Both should be constructed during the summer of 2005.

## Conclusions and Recommendations

Recommendations for future Vancouver projects included the following:

1. Widen the standard parking stalls from 2.7 m to 2.9 m (9 ft to 9.5 ft) or provide other stall position guidance (raised markers, etc.).
2. Adopt a supplemental back-in parking sign adapted from Salt Lake City (figure 13).
3. Adjust striping layout to add turn lane for west bound traffic into western entrance of parking lot (site specific).

This treatment has been very effective at balancing bicyclist access (increase in trips) while providing for growing parking demand. The adoption of recommendations #1 and #2 has met resistance from our maintenance crews (‘another sign to stock’ and ‘if the drivers need the pavement markers, then there must be a problem with this type of parking…’). The proposed projects will be using the wider stall (2.9 m (9.5 ft)).


Figure 13. Salt Lake City sign adapted for use in Vancouver.

The use of photo simulations of the planned parking scenario was very helpful during the staff and public process stages, as few if any stakeholders had experienced this type of parking before or remembered doing so while visiting Seattle in the past (figures 14 and 15). This type of parking demands a lot of public discussion and process, more so than any other striping project we have typically undertaken, especially since we were adding parking and not removing it. It would be ideal if a stakeholder group (business, engineers, residents, etc.) were able to visit a city with this type of parking before adopting it on a district-wide basis.

Figure 14. Simulation before back-in parking.

Figure 15. Simulation after back-in parking.

Vancouver plans to adopt the back-in form of diagonal parking along wider arterials where bike lanes are desirable and the surrounding land uses support pedestrian trips and shared uses. The use of conventional diagonal parking with bike lanes is not acceptable. Where bike lanes are required and back-in parking is not adopted, (low resident and business support) parallel parking shall be used. Back-in parking with bike lanes might be thought of as a kind of "road diet plus" — having parking and bike lanes but still keeping a narrower cross section to constrain car traffic. Road diets usually involve choosing between parking or bike lanes with the extra space going to center turn lanes.

## Costs and Funding

An original budget of $5,520 for signs, striping and traffic control was established. This cost was split between the Transportation Services and the Parks and Recreation departments (the parking was located in front of their recreation facilities and at their request). We are applying for the second portion of $100,000 Community Development Block Grant (Federal funds) money to fund pedestrian crossings. These funds join $80,000 funded for the striping and refuge islands.

## References


John Edwards, Angle Parking Issues Revisited, 2001 *ITE Journal*, February 2002

Paul Box, Changing On-Street Parallel Parking to Angle Parking, *ITE Journal*, March 2002


## Contacts


Todd Boulanger, MURP
Senior Transportation Planner
City of Vancouver
360.696.8290 x8657

Ali Eghtedari, PE
Traffic Engineering Manager
City of Vancouver
(360) 696-8290 ext. 8661


[1] "It is my understanding, the last research on accident history in the 1970s indicated a 3-1 ratio of more reported accidents occurring in relation to head-in parking spaces as distinct from back-in," wrote Billy Jack, City of Seattle to Todd Boulanger in 2001.

## Appendix

Cities With Back-In Diagonal Parking

- Seattle, WA*
- Olympia, WA
- Tacoma, WA
- Vancouver, WA *
- Everett, WA
- Portland, OR
- Salem, OR

- Ventura, CA
- San Francisco, CA
- Tucson, AZ
- Salt Lake City, UT
- Honolulu, HI
- Charlotte, NC
- Indianapolis, IN
- Montreal, QC
- Pottstown, PA*
- Plattsburgh, NY
- Knoxville, TN
- Birmingham, MI
- Marquette, MI
- Washington, DC*
- Arlington, VA
- Wilmington, DE