

UC Berkeley

Research Reports

Title

Pedestrian and Bicycle Safety Evaluation for the City of Emeryville at Four Intersections

Permalink

<https://escholarship.org/uc/item/89r2j4p5>

Authors

Johnson, Emily S.
Ragland, David R
Cooper, Jill F
et al.

Publication Date

2005-08-01

Pedestrian and Bicycle Safety Evaluation for the City of Emeryville at Four Intersections:

Powell and Frontage, Powell and Route I-80, Powell and Christie, and Christie and Shellmound

August 2005





Traffic Safety Center

Setting New Directions in Traffic Safety

The mission of the UC Berkeley Traffic Safety Center is to reduce traffic fatalities and injuries through multi-disciplinary collaboration in education, research, and outreach. Our aim is to strengthen the capability of state, county, and local governments, academic institutions, and local community organizations to enhance traffic safety through research, curriculum and material development, outreach, and training for professionals and students.

Prepared for

The City of Emeryville

Prepared by

**Emily S. Johnson
David R. Ragland
Jill F. Cooper
Terri O'Connor**

**Traffic Safety Center
University of California
Berkeley, CA 94720
Tel: 510/642-0655
Fax: 510/643-9922**

Emeryville Contact:

Maurice Kaufman, Senior Civil Engineer
City of Emeryville Department of Public Works
1333 Park Avenue, Emeryville, CA 94608
(510) 596-4334 mkaufman@ci.emeryville.ca.us

TABLE OF CONTENTS

1. ACKNOWLEDGEMENTS.....	4
2. EXECUTIVE SUMMARY.....	5
2.1. <i>Background</i>	5
2.2. <i>Methods</i>	6
2.3. <i>Major issues and associated countermeasures</i>	7
2.4. <i>Specific intersections and countermeasures</i>	9
2.5. <i>Project chronology</i>	9
3. INTRODUCTION.....	12
4. METHODS.....	14
4.1. <i>Conceptual Framework</i>	14
4.2. <i>Data Collected</i>	17
4.2.1. <i>Collision Data</i>	17
4.2.2. <i>Vehicle Volume</i>	18
4.2.3. <i>Field Observations</i>	18
4.2.4. <i>Field Inspection of the Intersections</i>	19
4.2.5. <i>Pedestrian and Bicyclist Surveys</i>	19
4.2.6. <i>Community Meetings</i>	19
4.2.7. <i>Presentation to the City of Emeryville</i>	20
5. OVERALL ISSUES AND COUNTERMEASURES.....	21
5.1. <i>Major Issues</i>	21
5.1.1. <i>Right turns across pedestrian crossing</i>	21
5.1.2. <i>Double right-turn lanes</i>	22
5.1.3. <i>Vehicle speed</i>	23
5.1.4. <i>Long crossings</i>	23
5.1.5. <i>Poor crosswalk visibility</i>	24
5.1.6. <i>Poor connectivity</i>	24
5.1.7. <i>Lack of way-finding signage</i>	24
5.2. <i>Countermeasure approach</i>	25
5.2.1. <i>Overall Goals</i>	25
5.2.2. <i>Countermeasures</i>	27
6. POWELL AND FRONTAGE.....	28
6.1. <i>Description</i>	28
6.2. <i>Vehicle patterns</i>	29
6.3. <i>Pedestrian patterns</i>	30
6.4. <i>Bicycle patterns</i>	30
6.5. <i>Individual crossings</i>	32
6.5.1. <i>Crossing #1— Northeast corner to pedestrian island</i>	32
6.5.2. <i>Crossing #2—Pedestrian island to the northwest corner of the intersection</i>	34
6.5.3. <i>Crossing #3— West side of Frontage across Powell</i>	36
6.5.4. <i>Crossing #4— South side of Powell across the southbound I-80 on-ramp</i>	40

7. POWELL AND 1-80	42
7.1. <i>Description</i>	42
7.2. <i>Vehicle patterns</i>	43
7.3. <i>Pedestrian patterns</i>	43
7.4. <i>Bicycle patterns</i>	44
7.5. <i>Individual Crossings</i>	45
7.5.1. Crossing # 5— North side of Powell across the northbound I-80 on-ramp	45
7.5.2. Crossing #6— South side of Powell across the northbound I-80 exit ramp	47
8. POWELL AND CHRISTIE	50
8.1. <i>Description</i>	50
8.2. <i>Vehicle patterns</i>	51
8.3. <i>Pedestrian Patterns</i>	51
8.4. <i>Bicycle patterns</i>	52
8.5. <i>Individual Crossings</i>	54
8.5.1. Crossing #7— Unmarked (blocked) crossing across north leg of Christie	54
8.5.2. Crossing #8— West side of Christie across Powell	56
8.5.3. Crossing #9— South side of Powell across Christie	59
9. CHRISTIE AND SHELLMOUND	62
9.1. <i>Description</i>	63
9.2. <i>Vehicle patterns</i>	63
9.3. <i>Pedestrian patterns</i>	64
9.4. <i>Bicycle patterns</i>	64
9.5. <i>Individual crossings</i>	66
9.5.1. Crossing #10— North side of Christie and Shellmound	66
9.5.2. Crossing #11— West side of Shellmound and Christie	68
9.5.3. Crossing #12— South side of Christie and Shellmound	70
9.5.4. Crossing #13— East side of Shellmound and Christie	72
10. INDIVIDUAL CONNECTORS	74
10.1. <i>Connector A—North Sidewalk Along Powell Under 1-80</i>	74
10.2. <i>Connector B—South Sidewalk Along Powell Under 1-80</i>	76
10.3. <i>Connector C—Pedestrian/Bicycle Path Under 1-80 (Parallel to South Sidewalk Along Powell)</i>	77
10.4. <i>Connector D—North Sidewalk Along Powell (East of Denny’s)</i>	78
10.5. <i>Connector E—South Sidewalk/Bicycle Path Between 1-80 and Christie</i>	79
11. APPENDICES	80
11.1. <i>Appendix A: Recommendations and Consultant Responses</i>	81
11.2. <i>Appendix B: Vehicle Volumes</i>	98
11.3. <i>Appendix C: Pedestrian/Bicycle/Vehicle Observations</i>	100
11.4. <i>Appendix D: Infrastructure Observations</i>	127
11.5. <i>Appendix E: Crossing Distance and Signal Time</i>	137

11.6. *Appendix F: Community Meeting Results*139

11.7. *Appendix G: Surveys*157

11.8. *Appendix H: Origin-Destination Diagram*.....168

11.9. *Appendix I: Intersection Aerial Photographs*.....170

11.10. *Appendix J: Presentation Slides*175

1. ACKNOWLEDGEMENTS

The Traffic Safety Center (TSC) appreciates the significant contributions of many people who provided critical input and work on this project, including the following City of Emeryville staff: Maurice Kaufman (Senior Civil Engineer), John Flores (City Manager), Hank Van Dyke (Director of Public Works), and Peter Schultze-Allen (Environmental Programs Coordinator). The TSC would also like to thank Emeryville Mayor Richard L. Kassis and City Council members Gary Caffey, Ruth Atkin, Nora Davis, and Ken Bukowski, and the Bicycle/Pedestrian Subcommittee of the Traffic Committee. Steve Chan with Kimley-Horn Associates reviewed and commented on the recommendations.

The TSC especially want to thank the residents of the Pacific Park Plaza and Watergate Condominiums and other community members who attended the forums for contributing their perspectives on pedestrian and bicycle safety in Emeryville.

Staff and students at the Traffic Safety Center who contributed to this project include:

Raymond Chan: GIS mapping; data entry; charts and tables

Monique deBarruel: Data entry

Christina Ferracane: Observation and survey coordination and administration

Tammy Wilder: Survey design and administration; editing

Funding for this project was provided by the City of Emeryville with additional funding from the California Office of Traffic Safety (OTS) through the Business, Transportation and Housing Agency.

August 2005

2. EXECUTIVE SUMMARY

2.1. BACKGROUND

The City of Emeryville is small in area (1.2 square miles) and population (7,000), but it is one of the most regionally connected cities in the Bay Area. Emeryville is situated at the eastern end of the San Francisco-Oakland Bay Bridge, contains the intersection of Interstate Highway 80 (I-80) with several regional and other interstate highways, and has extensive transportation access by Amtrak Rail, Alameda County (AC) Transit and heavy cargo facilities at the nearby Port of Oakland. The city has many large employers and several large shopping areas, and the daytime population swells to over 20,000. These factors produce a very high vehicle volume.

Additionally, Emeryville is an important segment of a number of regional pedestrian and bicycle trails including the future Union Pacific right of way (Emeryville Greenway) and the Bay Trail, which will extend across the new eastern span of the Bay Bridge. The completion of planned regional trails in the area will place Emeryville at the nexus of recreational pedestrian and bicycling activity for the area. These factors mean that pedestrian and bicycle travel is likely to increase dramatically.

The combination of very high traffic volume and increasing pedestrian and bicycle traffic raise concerns about safety for pedestrians and bicyclists. Taking a proactive stance, the City has decided to intensify analysis and planning for pedestrian and bicycle safety. As part of this effort, the city contracted with the Traffic Safety Center at U.C. Berkeley to conduct an in-depth review of pedestrian and bicycle safety issues at four key intersections in the heart of Emeryville:

- Powell Street and Frontage Road
- Powell Street and I-80
- Powell Street and Christie Avenue
- Christie Avenue and Shellmound Street

These intersections were selected because they are on major arterials in the city that connect the waterfront, shopping areas, eating areas, residential complexes and business sites, and they are expected to experience increased pedestrian and bicycle traffic.

The resulting report includes: (i) methods, (ii) major issues, (iii) approaches to countermeasures, and (iv) a detailed description of issues and recommended countermeasures.

2.2. METHODS

The evaluation relied on the following types of data collection:

Collision data

The Statewide Integrated Traffic Record System (SWITRS), a computerized collision database maintained by the California Highway Patrol (CHP), was used to reconstruct collision data at the study intersections. In the five years from 1998 to 2002, there were seven reported bicycle-vehicle collisions and eight reported pedestrian-vehicle collisions at the four intersections. This number is low compared to urban intersections in Oakland or San Francisco primarily because of the relatively low pedestrian and bicycle volume in the Emeryville intersections. With expected increases in both, the number of pedestrian and bicycles, collisions in Emeryville would be expected to increase without the proactive steps that the City is taking.

Vehicle counts

Vehicle counts were provided by the City of Emeryville and include year 2002 counts from 9 a.m.-1 p.m. and 5-9 p.m. for all four intersections, and year 2004 a.m. and p.m. peak hour counts at three of the four intersections (all except Powell and I-80). The counts indicated very high vehicle volumes in most locations studied, with a particularly high volume of right-turning vehicles.

Community Forums

A forum was held at each of two major residential communities in the study area: the Watergate and the Pacific Park Plaza condominiums. The Watergate condominiums are located on Powell Street just south of I-80, and Pacific Park Plaza is located on Christie just north of Powell.

The Traffic Safety Center (TSC) moderated the forums. Approximately forty individuals attended the two meetings including residents, employees, members of Emeryville's Pedestrian and Bicycle Committee, and city council members and staff. A great deal of information and insight about the study intersections was gained at the forums. Participants universally agreed that the intersections being studied were intimidating, that they constituted strong barriers to walking and biking within Emeryville, and that changes were needed.

Pedestrian and bicyclist survey

A sample of 155 pedestrians or bicyclists at one of the four target intersections was surveyed to assess public perception of pedestrian and bicycle safety at the intersections. The survey questions were specific to the physical intersection at which they were administered. Many (47%) said that they did not feel safe crossing, and many (41%) said that they had had a "near miss" with a vehicle at the respective intersections.

Field observations

Observed vehicle, pedestrian, and bicycle behavior and interactions at each intersection were collected. Observations included many occurrences of vehicles failing to yield the right of way, pedestrians being unable to complete crossings during the "Walk" phase of the signal, and bicyclists having difficulty navigating among vehicles that were changing lanes.

Field inspection

Inspections were made of the infrastructure at each intersection and each crossing location to examine signal configuration, signage, pavement markings, adherence to ADA requirements, and other features. Many deficiencies were noted in these areas.

2.3. MAJOR ISSUES AND ASSOCIATED COUNTERMEASURES

General Assessment

The study area was designed to accommodate a high volume of motor vehicle traffic traveling within and through Emeryville. With close proximity to I-80, and with four freeway ramps in the area, there was a “freeway mentality” that needed to be addressed.

The TSC proposed that the City of Emeryville address this situation in a direct and aggressive fashion by: (i) increasing driver awareness of pedestrians and bicyclists and their right of way, (ii) alerting pedestrians and bicyclists to areas of risk, and (iii) improving ease of travel and of crossing intersections for pedestrians and bicyclists

Meeting these goals requires vigorous application of the many available countermeasures, especially engineering and enforcement. Motorists, bicyclists and pedestrians traveling in this area should have a sense that the area is special; i.e., that special attention has been taken to assure that pedestrians and bicyclists have a right to exist and travel in the area.

Countermeasures should be incorporated in such a way that the four target intersections have a clear identity as a special area in Emeryville. This can be accomplished through clear and consistent signage, a distinctive crosswalk treatment, appropriate lighting and other enhancements. This will make the area more inviting for pedestrians and bicyclists and provide cues to drivers that these intersections are shared spaces. This strategy needs to be combined with an equally clear and consistent pattern of enforcement of pedestrian and bicyclist right-of-way.

The selection of recommended countermeasures is based on discussions with City staff and data sources listed above (i.e., collision data, vehicle counts, forums, surveys, field observations, and field inspections).

A number of conditions were noted that affect the safety of the area as a whole and are discussed below.

- Right turns across pedestrian crossing

Violation of pedestrian right of way by vehicles turning right across crosswalks was by far the most predominant problem at the study intersections. The risk to pedestrians occurs when vehicles (i) turn right on a red light, (ii) turn right on a green light, and (iii) turn right in a non-signalized crossing (one location).

For right turns on red, drivers often simply did not stop as required, or when they did stop, drivers tended to look to their left for a gap in the traffic rather than toward where pedestrians were crossing. Countermeasures directed at drivers include installing recessed stop bars, signs clearly indicating “stop on red before proceeding” and “yield to pedestrians” (in some cases, existing signs are small or difficult to see), experimental pedestrian-triggered in-roadway lighting, and electronic signs indicating “yield to pedestrian,” and “no right turn on red.”

For right turns on green, drivers often failed to yield to pedestrians, moved very close to them before stopping, or followed very close behind them. Countermeasures include signs clearly indicating pedestrian right of way. Other countermeasures include experimental pedestrian-triggered in-roadway lighting or electronic signs instructing vehicles to “Yield to pedestrians.”

For right turns at the one unsignalized location, drivers often failed to yield to pedestrians as they accelerated toward a freeway on-ramp. Countermeasures include pedestrian-triggered in-roadway lighting, electronic signs or beacons instructing vehicles to “Yield to pedestrians,” and possibly signalization.

- Double right turns

Double right turns increase hazards for pedestrians crossing intersections because drivers in the outer right-turn lane often cannot see pedestrians who may be hidden by the right-turning vehicle in the inner right-turn lane; the view for pedestrians may be blocked; and the outer lane of a double turn has a greater turning radius, thus permitting greater speed. In addition to countermeasures taken for right turns discussed above, signs or pavement stencils could cue pedestrians to watch for vehicles in the second right-turn lane. These turns also increase risk for bicyclists traveling straight through these intersections across right-turn lanes.

- Vehicle speeds

Vehicle speed was not measured, but speeds did seem excessive at several locations and were one of the concerns voiced by participants in the community forums. Excess speed may result from proximity to freeway ramps and the wide turning radii of almost all the corners in the study intersections. Countermeasures for vehicle speed include reduced turning radii and radar speed displays.

- Long crossings

The TSC conducted an analysis of crossing distances and crossing times allocated by the pedestrian signals. The combination of long crossing distances, insufficient crossing time, and the lack of secure refuges puts pedestrians and bicyclists at risk. Countermeasures include adding bulbouts (i.e., curb extensions) to reduce walking distance, increasing the pedestrian signal time, and adding pedestrian countdown signals and pedestrian head-start timing.

- Poor crosswalk visibility

The crosswalks at all of the intersections studied have only minimal striping-- two parallel lines-- and many are faded. This contributes to many drivers' lack of awareness and compliance with pedestrian right of way at the intersections. In addition, although several crossings are part of bicycle routes, there is no indication that bicyclists are allowed to ride in these crossings. Countermeasures include greatly enhanced crosswalk and other pavement markings. In cases where both bicycles and pedestrians are allowed to cross (i.e., trail crossings), separate pathways for pedestrians and bicyclists should be marked.

- Poor connectivity

None of the four intersections studied has a complete set of crosswalks. While there may be good reasons for this, the result is a limitation of pedestrian routes. In addition, several sidewalks in the area are either extremely narrow, or they end. A systematic assessment should be conducted to determine the adequacy of existing connections between intersections. The connection will become more important as an increased number of pedestrians and bicyclists use the area.

- Lack of way-finding signage

There is a general lack of signage in this area directing pedestrians and bicyclists to common paths or destinations. For example, there are few markings identifying the Bay Trail or the precise location of bicycle routes, creating ambiguity about where bicyclists can travel. Trails and bicycle routes should be marked by distinctive signage throughout the area.

2.4. SPECIFIC INTERSECTIONS AND COUNTERMEASURES

A detailed analysis was conducted and a set of recommendations were prepared for each of the 13 street crossings at the four study intersections and for five connecting sidewalks or trail segments. For each of these locations, an analysis of risk conditions for pedestrians and bicyclists and detailed countermeasures is provided. The analyses are based on the data sources cited above. For most of the locations, a tiered set of recommendations has been provided. "Basic Treatments" are those that are fairly standard and could be done relatively easily. "Additional Items" would involve more planning and expense to provide additional safety for pedestrians and bicyclists. Finally, based on instructions from Emeryville staff, this report is more rather than less inclusive; that is, a wide range of recommendations for consideration have been included. These recommendations have also been reviewed by an engineering consultant to assess feasibility of each recommendation and to assign priorities to each.

2.5. PROJECT CHRONOLOGY

Upon completion of the observations, surveys, forums, and review of appropriate improvements, the TSC developed a draft report for review by City staff. The TSC also conducted several

presentations to City Staff and integrated their feedback into the report. The City then gave the report to a transportation engineering firm, Kimley-Horn, for comment on engineering recommendations. A final meeting was held with City staff, Kimley-Horn and the TSC. A matrix with the recommended improvements, approved by all parties, is shown in Table 1. Appendix A includes initial recommendations made by the TSC, additional suggestions made by the City Council, and subsequent comments and recommendations made by Kimley-Horn.

While these proposed countermeasures are expected to improve pedestrian and bicycle safety at the four intersections, the TSC recommends that the City conduct a before-and-after evaluation of safety conditions where countermeasures are installed to determine their effectiveness.

The TSC also recommends that the City continue to monitor and analyze pedestrian and bicycle safety issues. Finally, because the four intersections that were studied represent only a portion of a typical bicyclist's route, the TSC suggests that the City undertake a broader study of bicycle safety and connectivity in Emeryville.

Table 1: Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations
Basic Treatments for All Crossings
Add leading pedestrian interval and extend Flashing Don't Walk phase for all studied crosswalks, provided these changes do not adversely affect intersection level of service and degrade traffic circulation.
Enhance all studied crosswalks with high-visibility zebra style pattern markings and/or pavement texture.
Trim roadside vegetation that hinders the line of sight of drivers and pedestrians at the studied intersections.
Install high visibility fluorescent yellow-green signs or pavement stencils to increase pedestrian, bicyclist, and driver awareness of potential conflicts when entering crosswalks.
Install pedestrian countdown signals and audible signals where they are absent.
Upgrade sidewalks and curbs as necessary to ensure compliance with ADA curb ramp and walkway standards.

Crossing	Enhanced Treatments
1	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
1	Add pedestrian signal for crosswalk; add a right-turn arrow vehicular indications to control right-turn vehicular movements.
1	Enlarge pork chop island to reduce crosswalk distance.
2	Reduce northwest corner curb radius of Powell/Frontage intersection.
2	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
3	Reduce northwest corner curb radius of Powell/Frontage intersection.
3	Request controller software change from Caltrans to allow leading pedestrian interval.
3	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
3	Realign crosswalk from northwest corner to east side of I-80 on-ramp, and extend median island to meet the new crosswalk. Add bike path symbol along side of crosswalk.
3	Mark "KEEP CLEAR" between existing stop bar and realigned crosswalk.
3	Ensure that median/pedestrian refuge is visible to drivers.
4	Request controller software change from Caltrans to allow leading pedestrian interval.
5	Reduce northeast corner curb radius of Powell/I-80 intersection.
5	Request controller software change from Caltrans to allow leading pedestrian interval.
5	Evaluate no-right-turn-on-red operation based on new traffic count collection from current RSTP project.
5	Install pedestrian warning signs with pedestrian-activated flashing beacons.
6	Re-stripe center lane from left/through/right movements to left/right movements only.
6	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
7	Re-stripe existing southbound right-turn lane limit lines further south into the Powell/Christie intersection and install additional detector loops.
7	Install overhead signage to enhance lane usage assignment.
8	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
9	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
9	Enlarge median to create a refuge island with a pedestrian pushbutton.
9	Install "no right turn on red" sign on Christie.
9	Mark separate bicycle path in crosswalk.

10	Install crosswalk with pedestrian pushbuttons and countdown signal in conjunction with the Bay Street Site B development. Install pedestrian barricades for the interim until pedestrian signal is in place.
11	Reduce northwest corner curb radius of Shellmound St/Christie intersection.
11	Install pedestrian warning sign (W11-2) with pedestrian-activated flashing amber beacons.
11	Install bicycle lane on Christie and mark route for bicyclists to exit from Plaza and access bike lanes on Shellmound.

*Additional details on recommendations for crosswalks are included in the text and in Appendix A. Recommendations on the connectors that link the crosswalks are also included in the text.

3. INTRODUCTION

The City of Emeryville is one of the most regionally connected cities in the Bay Area. Situated at the eastern end of the San Francisco-Oakland Bay Bridge, Emeryville contains the intersection of I-80 with several regional and interstate highways, as well as extensive transportation access by Amtrak rail, Alameda County Transit and heavy cargo facilities at the nearby Port of Oakland.

Emeryville is a small city of 1.2 square miles with a population of approximately 7,000 residents. It is bordered by Berkeley to the north, Oakland to the east and south and the San Francisco Bay to the west (Figure 1). The city is characterized by a unique land use pattern with many large employers and several large shopping areas. Both employment sites and shopping areas serve as significant trip attractors to the city, causing its daytime population to swell to over 20,000.

Additionally, Emeryville is an important segment in a number of regional trails including the future Union Pacific right of way (Emeryville Greenway) and the Bay Trail, which will extend across the future new eastern span of the Bay Bridge. The completion of planned regional trails in the area will place Emeryville at the nexus of recreational pedestrian and bicycling activity in the area.

The combination of transportation access, large employers and trip attractors creates high vehicle volumes within the city. With the promise of an increase in future recreational trails and new housing developments, higher pedestrian and bicycle traffic volumes are likely for the long-term planning horizon.

With so many potential road users, safety is critical, and there is a great deal of concern for bicyclists and pedestrians, as these are the most vulnerable. To assess and increase pedestrian and bicycle safety, the City of Emeryville contracted the UC Berkeley Traffic Safety Center to evaluate four key intersections (See Figure 2 and Figure 3):

- Powell Street and Frontage Road
- Powell Street and I-80
- Powell Street and Christie Avenue
- Christie Avenue and Shellmound Street

Figure 1: Map of Emeryville



These intersections were selected for several reasons. First, these streets are major arterials in the city that connect the waterfront, shopping areas, eating areas, residential complexes and business sites. Second, the City expects an increase in pedestrian and bicycle traffic at these intersections due to future trails, hotels, housing and other development. Finally, each intersection holds great potential for pedestrian and bicycle safety improvements.

Traffic count data from the City of Emeryville shows a general pattern of very high vehicle volume in this area. Surrounding land uses (shopping and retail centers, large and small employment centers, recreational trails, and residential developments), short travel distances and observations indicate that there are also many pedestrians and bicyclists in Emeryville. These pedestrians and bicyclists are presented with a complex environment designed mainly for vehicles. Today, this same space must safely and efficiently accommodate increased use by many different travel modes.

While data from police collision reports document relatively few pedestrian and bicycle collisions and injuries in these intersections compared to the city as a whole, the existing traffic volume, current pedestrian and bicycle movement patterns, and projected increase in pedestrian and bicycle volumes indicate a potential for many future conflicts among different road users. Additionally, the low pedestrian and bicycle volumes relative to the number of vehicles at these intersections means that drivers may not expect pedestrians and bicyclists in the roadways and may be less aware of their needs. This results in a high risk of conflict and collision for each pedestrian and bicyclist.

The City of Emeryville has three goals for these four intersections: (i) to increase safety for pedestrians and bicyclists; (ii) to increase ease of use for pedestrians and bicyclists; and (iii) to accommodate traffic circulation for all users.

Therefore, the objectives of the current study are to:

- Evaluate the safety, perception of safety, and ease of use for pedestrians and bicyclists.
- Propose countermeasures to improve safety and ease of use for pedestrians and bicyclists.

The remainder of the report is organized in three sections: Methods, Overall Issues and Countermeasures, and Evaluation and Countermeasure Recommendations for each intersection. Additionally, the Appendices include data for the study intersections and background information on proposed countermeasures.

4. METHODS

4.1. CONCEPTUAL FRAMEWORK

This study focuses primarily on the street crossings at each of four intersections and then on the connections between the intersections. Each crossing is considered first, with a focus on marked crosswalks. Unmarked crosswalks that were observed to have or that are expected to have high use are also included. Several “connectors”—i.e., the sidewalks and paths adjacent to the intersections are then examined. This report also focuses on the main connectors between the four intersections.

While crosswalks and sidewalks are often considered to be for pedestrians only, it is important to note that crosswalk and connector issues are used by bicyclists as well. Improvements in these areas will help pedestrians as well as bicyclists who ride across crosswalks or on off-street paths.

Figure 2: Map of Study Intersections

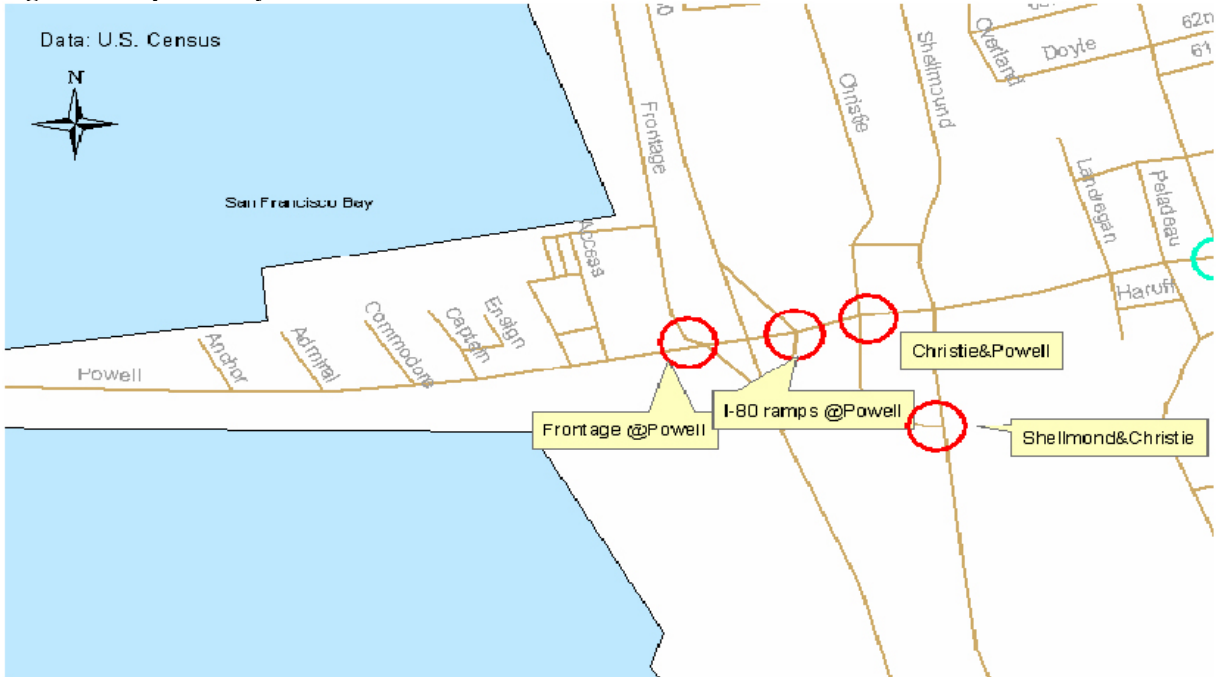




Figure 3: Aerial Photo of Study Intersections

For purposes of this study each crossing and connector have been labeled separately. These are listed in Table 2.

Table 2: List of Crossings and Connectors Studied

Crossings	Description
Intersection 1: Powell and Frontage	
Crossing 1:	Northeast corner to pedestrian island
Crossing 2:	Pedestrian island to northwest corner
Crossing 3:	West side of Frontage across Powell
Crossing 4:	South side of Powell across the southbound I-80 on-ramp
Intersection 2: Powell and I-80	
Crossing 5:	North side of Powell across the northbound I-80 on-ramp
Crossing 6:	South side of Powell across the northbound I-80 exit ramp
Intersection 3: Powell and Christie	
Crossing 7	North side of Christie across Powell (blocked)
Crossing 8:	West side of Christie across Powell
Crossing 9:	South side of Powell across Christie
Intersection 4: Christie and Shellmound	
Crossing 10:	North side of Christie across Shellmound (unmarked)
Crossing 11:	West side of Shellmound across Christie
Crossing 12:	South side of Christie across Shellmound
Crossing 13:	East side of Shellmound across Christie

Connectors	Description
A	North sidewalk under I-80
B	South sidewalk under I-80
C	Bicycle/Pedestrian path under I-80
D	North sidewalk on Powell east of Denny's
E	South sidewalk/bicycle path on Powell between I-80 and Christie

4.2. DATA COLLECTED

The evaluation utilizes data from five main sources: collision data and traffic counts; observations of vehicles, pedestrians, and bicyclists; a field survey of physical infrastructure and land use; a pedestrian and bicyclist survey; and community meetings.

The purpose of the field observations was to examine driver, pedestrian and bicyclist behavior in the intersections. None of the data collected through the observations, surveys, or community meetings contains personal identifying information about individuals.

4.2.1. Collision Data

Historically, there have been few collisions at the four intersections (Table 3). Over the five years from 1998 to 2002, there were seven reported bicycle-vehicle collisions and eight reported pedestrian-vehicle collisions at the four intersections. In part, this reflects the low volume of pedestrians and bicyclists at these intersections. However, these numbers do not account for non-reported collisions or near-misses, which may be common at these intersections. Thus, while the total collision count is low, risk for pedestrians and bicyclists may still be high, especially when considered per bicyclist and per pedestrian.

Of the four intersections, Powell and I-80 has the highest number of both bicycle and pedestrian collisions. Over the five year period, Powell and I-80 had five pedestrian collisions compared to one at each of the other three intersections, and three bicycle collisions compared to one or two at the other intersections.

Table 3: Pedestrian and Bicycle Collision Data

Emeryville - Collisions at selected intersections SWITRS 1998-2002				
	SELECTED INTERSECTIONS*			
	Frontage Powell	Route 80 & Powell	Christie & Powell	Christie & Shellmound
Collisions				
Bicycle	1	3	2	1
Pedestrian	1	5	1	1
Victims				
Bicycle Injuries	1	3	1	1
Pedestrian Injuries	1	6	0	1

4.2.2. Vehicle Volume

Table 4: Vehicle Volumes (2002 counts updated with 2004 a.m./p.m. peak hour counts)

Vehicle Flow	Intersection			
	Frontage & Powell	80 & Powell	Christie & Powell	Christie & Shellmound
Total AM Flow (9a.m.-1p.m.)	8,743	11,806	12,167	6,531
Average AM hourly flow	2,186	2,952	3,042	1,633
Peak hour AM flow	2,398	3,630	3,033	662
Total PM Flow (5-9p.m.)	9,952	12,810	13,667	7,630
Average PM hourly flow	2,488	3,203	3,417	1,908
Peak Hour PM flow	3,880	3,550	4,310	2,122
Total Peak Period Vehicle Flow (8 hrs)	18,695	24,616	25,834	14,161
Overall average flow (V/H)	2,337	3,077	3,229	1,770

Vehicle counts in Table 4 were provided by the City of Emeryville. These include Year 2002 counts from 9 a.m.-1 p.m. and 5-9 p.m. for all four intersections, and Year 2004 a.m. and p.m. peak hour counts at all of the intersections except Powell and I-80. These counts were used to understand overall traffic conditions. Additional data is provided in Appendix B.

Based on this data, it is clear that Powell and I-80 and Powell and Christie have much higher vehicle volumes than Powell and Frontage and Christie and Shellmound. While total a.m. and p.m. flow was similar for each intersection, volumes were slightly higher in the p.m., leading to a higher average hourly flow in the p.m. at each intersection. The 2004 counts show p.m. peak flow to be much higher than a.m. peak flow. The 2002 counts show much less differentiation between a.m. and p.m. peaks.

It is important to note a few limitations of these counts. The 2002 counts were done before Christie west of Shellmound was converted to a one-way street. Thus, the 2002 data do not reflect current traffic patterns at Christie and Shellmound and Christie and Powell. Additionally, the counts do not reflect patterns that are important for pedestrian and bicycle safety that occur sporadically. For example, when traffic on I-80 is very congested, many vehicles use Emeryville streets or intersections to bypass the freeway. This is particularly an issue for northbound through movements at Frontage and I-80.

4.2.3. Field Observations

Direct observations at each intersection were used to collect vehicle, pedestrian, and bicycle interaction and behavior. Observations were made between 12p.m. and 1p.m. for pedestrians and 12p.m. and 1p.m. or 5p.m. to 6p.m. for bicyclists.

Due to the relative rarity of pedestrian and bicyclist injury collisions and the difficulty in identifying significant changes in injury rates within a year or so after implementing

countermeasures, information was gathered on surrogate measures for vehicle-pedestrian or vehicle-bicyclist crashes. Observation variables and a summary of observation data are included in Appendix C.

4.2.4. Field Inspection of the Intersections

To present a more refined analysis, a field inspection of each of the intersections was conducted, collecting specific information about the presence of physical infrastructure.

A list of field inspection elements and a summary from the inspection of each intersection are provided in Appendix D. Crossing distance and signal timing is included in Appendix E.

4.2.5. Pedestrian and Bicyclist Surveys

The purpose of the surveys was to assess public perception of pedestrian and bicycle safety at the four intersections. A total of 155 individuals at the four intersections were surveyed. The survey questions were specific to the physical intersection at which they were administered. Because surveyors were located at intersections, mainly pedestrians were interviewed, although bicyclists who were acting as pedestrians; e.g., walking their bicycles on the sidewalk or in the crosswalk, were also surveyed. Surveys were administered between 12-1 and 5-6 during the week and 12-1 on weekends in August, 2004. No identifying information was recorded for any of the surveys. The survey results are included in Appendix G and a diagram of the origins and destinations of those surveyed is included in Appendix H.

Overall, 59% of the respondents were male and 68% were between 18 and 40 years of age. Over half (56%) of respondents said they worked in Emeryville, 28% were shoppers, and 22% lived in Emeryville (the percentages exceed 100% as people have dual roles). One-third (34%) of those interviewed crossed that particular intersection several times/week and an additional 23% crossed every day. For 21% of respondents, it was their first time crossing that intersection.

When asked how safe they felt when crossing the street at that location, 47% said they felt “not at all” or “not very” safe. People between ages 18-40 generally felt safer than people 51 and over. Females felt a little less safe than males.

Many (41%) respondents reported a “near miss” with a vehicle at their respective intersections. Most of these were interviewed at Powell and Frontage, followed by Christie and Shellmound. Most near misses were due to right-turning drivers on Powell turning right onto Frontage and from Christie onto Shellmound, with drivers not honoring the pedestrians’ right-of-way.

4.2.6. Community Meetings

Public meetings were held at the two major residential communities in the study area, the Watergate and the Pacific Park Plaza condominiums. The Watergate condominiums are located on Powell

Street just south of I-80, and Pacific Park Plaza is located on Christie just north of Powell. Traffic Safety Center (TSC) staff moderated the forums.

Approximately forty individuals attended the two community meetings. They included residents, employees, members of Emeryville's Pedestrian and Bicycle Committee, city council members and staff.

At each meeting, the TSC presented the project and showed enlarged aerial photographs of the four intersections. Participants were given post-it notes and asked to write comments about specific issues and to place them on the photographs. The TSC then asked for their perceptions of safety for pedestrians and bicyclists and suggestions for improvements for each intersection and wrote down responses and ideas. The responses were transcribed after the meeting, but no personal identifying data about participants were collected.

Of the four intersections studied, each group identified the most dangerous intersection as the one closest to their place of residence. Overall, the residents at the Watergate Condominiums identified Powell and Frontage as the most dangerous, while the residents at Pacific Park Plaza identified Powell and Christie.

The main issues for people in both community meetings were similar across intersections: poor visibility (due to radius of curb or overgrown foliage), high speeds of vehicles entering or exiting freeway on- or off-ramps (i.e., a "freeway mentality" among drivers), inaccessibility of pedestrian buttons to influence signals, insufficient signal timing, right-turning vehicles encroaching into crosswalks and not yielding to pedestrians, and limited visibility across double right-turn lanes.

Community meeting participants also identified common issues for bicyclists across intersections: difficulty riding among turning or merging vehicular traffic, conflicts from vehicles exiting and entering driveways, poorly-marked bicycle trails, and confusing transitions between off-street paths and bicycle routes on surface streets.

Detailed results and intersection maps with comments from each meeting are in Appendix F.

4.2.7. Presentation to the City of Emeryville

The TSC presented interim results to the Emeryville City Council on May 17, 2005. The presentation slides are in Appendix J. Comments from the City Council were incorporated into the recommendations in Appendix A.

5. OVERALL ISSUES AND COUNTERMEASURES

5.1. MAJOR ISSUES

Several issues are common to the study area as a whole and have an impact on safety for pedestrians and bicyclists at each intersection. These include:

- Right turns across pedestrian crossing
- Double right-turn lanes
- Vehicle speed
- Long crossings with inadequate timing
- Poor crosswalk visibility
- Poor connectivity (i.e., an incomplete network of crossings and connectors)
- Lack of pedestrian and bicycle “way finding” signage

5.1.1. Right turns across pedestrian crossing

The predominant issue for intersections studied is the violation of pedestrian right-of-way by right-turning vehicles. One reason for this is the large proportion of vehicles that turn right across pedestrian crossings (See Table 5 and Figure 4). The risk for pedestrians occurs from (i) right turns on red, (ii) right turns on green, and (iii) right-turns at a non-signalized crossing.

For right turns on red, the risk occurs to pedestrians crossing the intersection during their walk phase immediately in front of the vehicles facing the red light. Observers noted numerous instances where drivers simply did not stop as required or, when they did stop, they looked to their left for a gap in the traffic rather than where pedestrians were crossing.

For right turns on green, the risk occurs because the pedestrian walk phase on the crosswalk that parallels the initial direction of vehicles coincides with the green light for the vehicles. Numerous instances in which drivers simply failed to yield to pedestrians, moved very close to them before stopping, or proceeded very close behind them, were observed. In many cases, drivers seemed to be driving with the presumption that they had the right of way because they had a green light. Right turns on green are also difficult for bicyclists to navigate if they are proceeding straight-through, since they have to cross the right-turning traffic to proceed.

For right turns at the one unsignalized location (Crossing #1), vehicles were typically accelerating toward a freeway on-ramp. Many violations of pedestrian right-of-way were observed.

Table 5: Right-Turn Volumes at Each Intersection

Intersection	Total Intersection Volume (veh/8hr)	Volume Turning right	% of Total Turning Right
Frontage & Powell`	18,695	7,995	43%
I-80 & Powell`	24,616	9,078	37%
Christie & Powell`	25,834	9,157	41%
Christie & Shellmound*	2,784	893	32%

` 2002 8 hour counts (9a.m.–1 p.m. + 5p.m.–9p.m.)
 *2004 AM + PM peak hour counts (2 hours total)

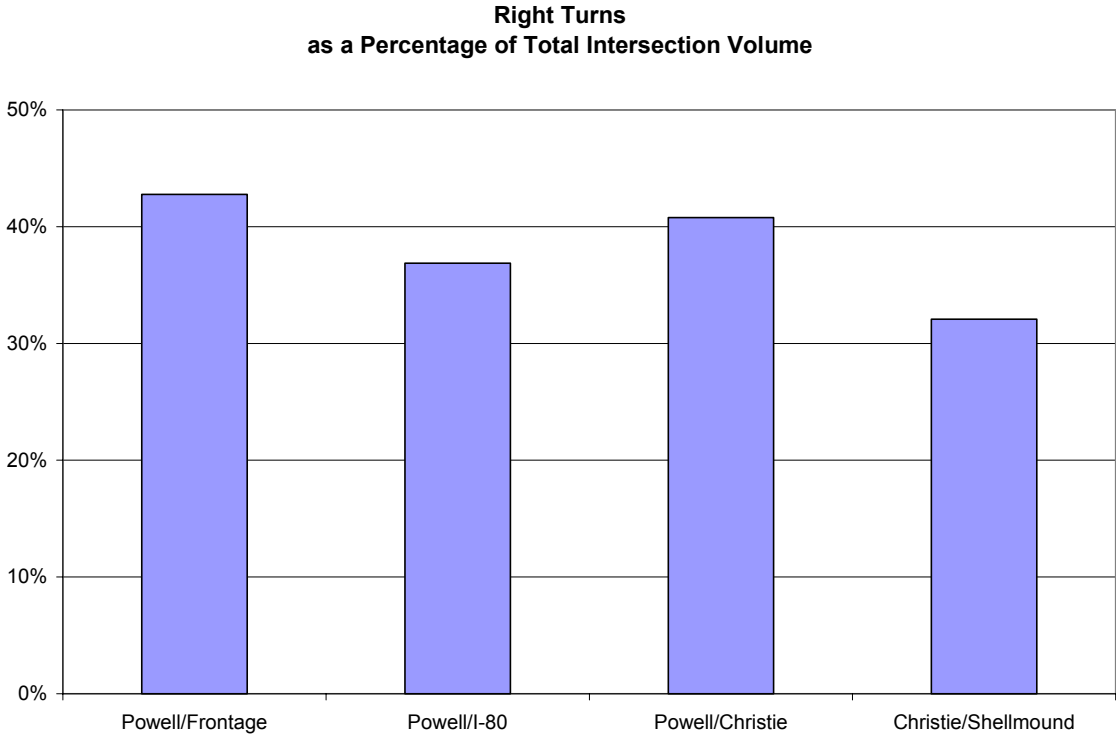


Figure 4: Right Turns at Each Intersection

5.1.2. Double right-turn lanes

Compounding the issue of right turns on red are double right-turn lanes. There are five instances of this in the four intersections. Double right-turn lanes increase crossing difficulty and hazards for pedestrians. First, the driver in the outer right-turn lane often cannot see pedestrians

beginning to cross who may be hidden by the right-turning vehicle in the inner right-turn lane, and pedestrians may not anticipate their lack of visibility to the vehicles in the outer lane. Second, the outer right-turn lane has a greater turning radius, thus permitting greater speed. Finally, the two lanes present a “multiple threat” to pedestrians—twice as many potential conflicts.

Double right-turn lanes are also difficult for bicyclists to maneuver. There are several locations in the study area where bicyclists traveling straight in the right-hand lane face increased risk from traffic merging into the right-turn lanes while bicyclists merge left into a through lane.

5.1.3. Vehicle speed

Excessive vehicle speed was a common concern for residents. While vehicle speed was not measured in the observational work, speeds seemed excessive at several locations, particularly at the freeway on- and off-ramps in the study area. Drivers exiting the freeway often did not slow down sufficiently before the crosswalk, and drivers heading onto the freeway tended to accelerate before the crosswalk.

At non-freeway ramp right turns, drivers commonly slowed but did not stop, and then they often accelerated across the crosswalk to fit in the gap in traffic. In several instances, the distance across the intersections allowed vehicles to accelerate substantially by the time they had crossed the far crosswalk. In general, high speeds are facilitated by the wide lanes, large intersections, and wide curb radii that characterize the area.

5.1.4. Long crossings

Many pedestrians had a difficult time crossing these intersections within the time provided. This is both a function of long crossing distances and interference from turning vehicles. Crossing distance is a problem at all intersections except Powell and I-80 (see Appendix E). An analysis of pedestrian signal timing shows that of the ten signalized crossings, only four (Crossings #5, #6, #8, and #13) provide sufficient “Flashing Red Hand” time for someone to cross at 4 feet/second—a relatively fast walking speed. Only crossing #6 provides enough “Flashing Red Hand” time for someone to cross at a more moderate 3.5 feet/second. This means that many pedestrians who begin to cross just as the “Walk” signal changes to “Flashing Red Hand” will not be able to finish before the signal changes to a “Solid Red Hand. Combining time for “Walk” and “Flashing Red Hand” phases, one crossing (#3) still did not provide enough time for someone to cross at 3.5 feet/second, and only two crossings (#4 and #6) provided enough time for someone to cross at 2.5 feet/second—a common standard for slower-speed pedestrians (such as seniors, parents with strollers, or disabled persons). Thus, even if they start crossing at the beginning of the “Walk” phase, many slower-speed pedestrians will not finish crossing the intersection before the signal changes to a solid red hand. This combination of long crossing distances and insufficient crossing time, coupled with the lack of secure refuges, puts pedestrians and bicyclists at risk.

5.1.5. Poor crosswalk visibility

The crosswalks at all of the intersections studied have only minimal striping-- two parallel lines-- and many of these are faded. This contributes to drivers' lack of awareness and compliance with pedestrian right-of-way. In addition, although several crossings are part of bicycle routes, there is no indication that bicycles are allowed in these crossings.

5.1.6. Poor connectivity

None of the four intersections studied has a complete set of crosswalks. Both Powell and Frontage and Christie and Shellmound have marked crosswalks across three legs, while Powell and I-80 and Powell and Christie have marked crosswalks across only two legs. While there may be good reasons for this in some cases, the lack of crosswalks limits pedestrian and bicyclist travel and makes the area less inviting and accessible for walking and bicycling. In addition, several sidewalks in the area either stop or are extremely narrow, further limiting pedestrian circulation. There are at least two locations where people were crossing at either a blocked crossing or at an unmarked crossing.

5.1.7. Lack of way-finding signage

There is a general lack of signage in this area directing pedestrians and bicyclists to common paths or destinations. For example, although these intersections include portions of the Bay Trail, there are no signs marking the route. Similarly, there is a designated bicycle path along the south side of Powell, but the transitions between sidewalks, crosswalks and the path are not clear, making the route confusing for bicyclists. Finally, there are several major attractions near the area, such as the Emeryville Marina, Bay Street Shopping Center, and the Powell Plaza, but there are no signs to help pedestrians or bicyclists find them.

5.2. COUNTERMEASURE APPROACH

The selection of recommended countermeasures is based on discussions with City of Emeryville staff, community meetings, analysis of observations of pedestrian, bicyclists, and vehicles, and analysis of existing infrastructure, in conjunction with a review of potential countermeasures. Based on feedback from City of Emeryville staff, this report includes a wide range of potential countermeasures to illustrate a variety of options. Recommended countermeasures are organized into two categories: a set of lower-cost and simpler “basic treatments” and a set of “additional items” that are often more costly or involved.

In this section, the relationship between issues and countermeasures is summarized.

5.2.1. Overall Goals

The study area was designed to accommodate a high volume of motor vehicle traffic traveling within and through Emeryville. With close proximity to the I-80, and with four freeway ramps in the intersections, there is a “freeway mentality” in the area that needs to be addressed. The TSC suggests that Emeryville address this situation in a direct and aggressive fashion by: (i) increasing drivers’ awareness of pedestrians and bicyclists and respect for their legal right-of-way, (ii) alerting pedestrians and bicyclists to areas of risk, and (iii) improving ease of travel and crossing for pedestrians and bicyclists.

Meeting these goals requires a vigorous application of available countermeasures, especially engineering and enforcement. Motorists, bicyclists and pedestrians traveling in this area should have a sense that the area is special; i.e., that special attention has been taken to increase safety for pedestrians and bicyclists in the area. Countermeasures should be incorporated so that the intersections have a clear identity as a special area in Emeryville. This can be accomplished through a clear, consistent pattern of signage, a distinctive crosswalk treatment, consistent lighting and other enhancements. This will make the area safer and more inviting for pedestrians and bicyclists, and provide cues to drivers that these intersections are shared spaces.

Issue	Countermeasures to Achieve Goals
Right turn on red at signalized crossing	Countermeasures include recessed stop bars and signs clearly indicating “Stop on red before proceeding” and “Yield to pedestrians.” (In some cases, existing signs are small or difficult to see.) Other countermeasures include experimental pedestrian-triggered in-roadway lighting or electronic signs indicating “Yield to pedestrians” or “No right turn on red.”
Right turn on green at signalized crossing	Countermeasures include signs clearly indicating that pedestrians have the right of way and signal timing that provides a leading pedestrian interval (i.e., the pedestrian-crossing phase begins prior to

Issue	Countermeasures to Achieve Goals
	the vehicles' green phase in order to give pedestrians a head start). Other countermeasures include experimental pedestrian-triggered in-roadway lighting or electronic signs indicating "Yield to pedestrians."
Right turn at unsignalized crossing	Countermeasures include pedestrian triggered in-roadway lighting, electronic signs or beacons indicating "Yield to pedestrians," and signalization.
Excessive speed while turning across a pedestrian crossing	Countermeasures include reduced turning radii. Radar speed displays in some locations might also be effective. For right turns on red, enforcing stopping before proceeding on red would reduce speed. For right turns on red, green, or at unsignalized crossings, a general countermeasure is signage clearly indicating that speed limits will be enforced.
Long crossings	Countermeasures include adding bulbouts (i.e., curb extensions) to reduce walking distance, increasing the pedestrian walk phase, and adding pedestrian countdown signals, pedestrian head-start timing, and enhanced medians.
Poor crosswalk visibility	Countermeasures include adding enhanced crosswalk and other pavement markings. In cases where both bicycles and pedestrians are allowed to cross (e.g., trail crossings), pathways for both pedestrians and bicyclists should be marked.
Poor connectivity	Countermeasures include a systematic assessment of the connectivity in the area to determine adequacy of existing connections. This will become more important as an increased number of pedestrians and bicyclists use the area.
Lack of way finding signage	Countermeasures include marking all of the bicycle routes in the area with a consistent treatment. This could include in-roadway markings, coloring on bicycle routes, and distinctive signage that both marks the route and directs bicyclists to it. Adding way-finding signage would encourage more pedestrian and bicycle activity and highlight the attractions of the area.

5.2.2. Countermeasures

Countermeasures include changes to signage and lighting, physical infrastructure, and signal timing, as well as enforcement and upgrades to meet ADA requirements. While each of these measures can play a role in making the intersections safer, it is also important to understand their limitations.

Signage and lighting:

Signage can alert drivers, pedestrians and bicyclists to potential hazards, but signs are passive and are often disregarded if the hazard is uncommon. Additionally, signs can clutter the roadway, causing confusion. Lighting can be effective, particularly at night and if triggered by pedestrian or bicyclist presence. However, during daylight hours, lighting may not be noticeable enough to change behavior.

Physical infrastructure changes:

Perhaps the most effective way to change driver, pedestrian and bicyclist behavior is by changing the physical environment of the roadway, for example, by adding medians, extending curbs, and tightening turns. Such changes also affect behavior in the daytime and at night. One important improvement is to create a distinctive crosswalk treatment that would improve driver awareness of pedestrians and bicyclists and mark the area as a shared space. The crosswalk pattern should be highly visible in daytime and at night. Potential treatments could include wide bold ladder stripes, texture, color, lighting, and bicycle route symbols where applicable.

Signal timing:

Changes to signal timing are generally effective, assuming people comply with the signal. For example, restricting right turns by vehicles during red lights can be effective if clearly signed and enforced. Even a limited restriction (e.g., during weekends or at mid-day) is effective because drivers have to consider whether the restriction applies, forcing them to slow down or even stop before turning. However, changing signal timing or restricting right turns can delay vehicles, particularly in areas with very high traffic volume. Additionally, restrictions may be violated during periods of low pedestrian and bicycle volume. A dynamic restriction (e.g., triggered by a pedestrian push-button) may be more effective.

Enforcement:

Enforcement, particularly for drivers, is critical to making these intersections safer. One approach is to install a series of signs at the main entrances to the area (e.g., at freeway off-ramps) that announce “Pedestrian and Bicyclist Right of Way Enforced” or something similar. Such signs could alert drivers to the issue of pedestrian and bicycle right of way and make them consider the consequences of violating it. Combined with regular “stings” and a clear, consistent policy for officers to enforce, such signs might help change driver behavior in this area. Emeryville will need to discuss this issue and develop a consistent policy for enforcement.

ADA requirements:

While most of the intersections comply with basic ADA requirements, many of the crossings and connectors are not easy to use for those with disabilities. Several of the paths are quite narrow, especially near crosswalks, where maneuverability is particularly important. Pushbuttons are not

always located close to the curb ramp, few of the ramps have texture, and only some of the crossings have audible signals. These improvements should be made as the intersections are upgraded.

6. POWELL AND FRONTAGE

6.1. DESCRIPTION

The intersection of Powell and Frontage is the furthest west of the four intersections. Frontage Road runs north-south along the waterfront and ends at Powell. Powell runs west to the Marina and east to San Pablo Avenue. This intersection includes two I-80 southbound on-ramps, one on the south side and one on the north. The northwest corner has a gas station and a hotel. Siebel's office building is to the north. The Bay Trail runs along Frontage from the north, heads west to the Marina, and returns east along the south side of Powell Street to Shellmound, all on off-street paths. An on-street bicycle lane also runs west along Powell, ending at Frontage (Figure 5).

During heavy freeway congestion, this intersection becomes an I-80 bypass. Drivers perform U-turns west of the intersection to access the less congested southbound I-80 on-ramp. This increases the overall vehicle volume at the intersection and also increases pedestrian exposure to vehicles, as each such commuting vehicle crosses an intersection crosswalk three times (#3 twice, and #4 once).

This intersection is very critical for Emeryville. It includes several segments of the Bay Trail and bicycle routes, and anyone traveling by foot or bike between Emeryville and the Marina must pass through this intersection.

Figure 5: Aerial Photo of Powell and Frontage

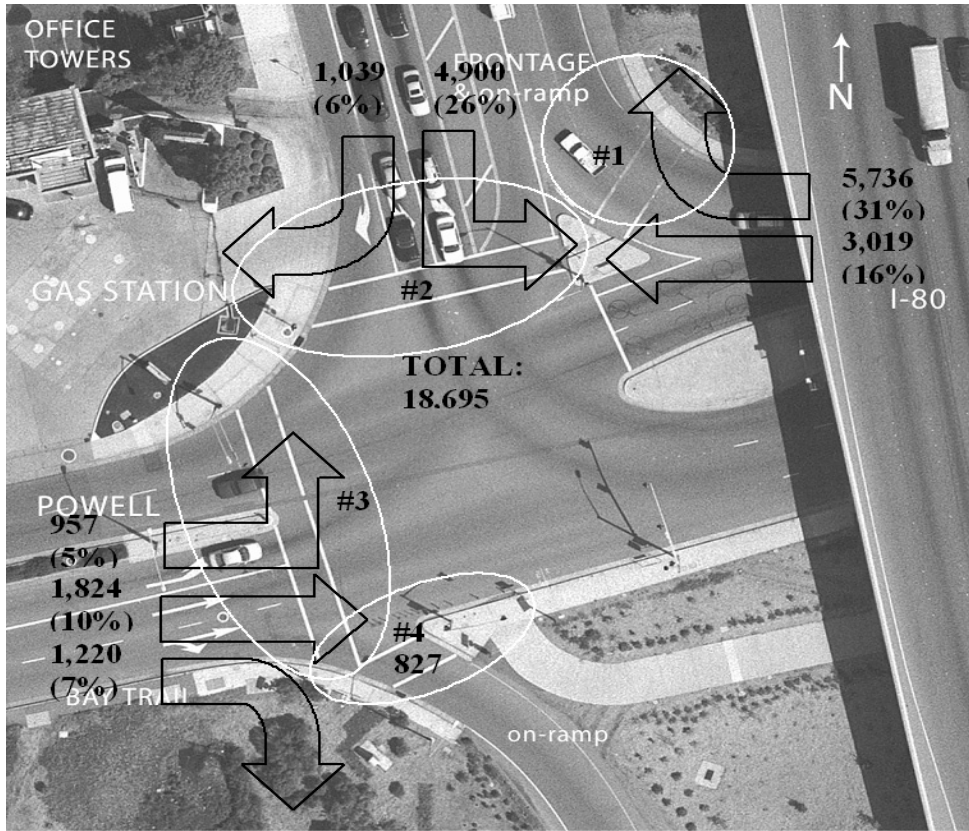


Table 7: Vehicle Volume at each Crossing: Powell and Frontage

CROSSING	VEHICLE VOLUME ACROSS CROSSING	PERCENT OF INTERSECTION TOTAL
#1	5,736	31
#2	7,763	42
#3	8,059	43
#4	1,220	7

Note: sum of percentages exceeds 100 because many vehicles cross more than one crosswalk.

6.2. VEHICLE PATTERNS

Based on traffic counts provided by the City, Powell and Frontage carries over 18,000 vehicles per day during the a.m. and p.m. peaks (9a.m.-1p.m. and 5p.m.-9p.m.) combined. AM and PM peak hour flows are 2,398 and 3,880 vehicles, respectively (Figure 5 and Table 7).

84% of the vehicles in this intersection are split between four main movements:

- Westbound vehicles on Powell make right turns toward I-80 on-ramp (free right turn) (31%)
- Southbound vehicles on Frontage make left turns onto eastbound Powell (26%)
- Westbound vehicles on Powell travel trough toward the Marina (16%)
- Eastbound vehicles on Powell travel towards the Powell Plaza (10%)

6.3. PEDESTRIAN PATTERNS

There are four crosswalks in this intersection. Crossing #1 connects the northeast corner to the pedestrian island. Crossing #2 connects the island to the northwest corner. Crossing #3 connects the northwest and southwest corners, and Crossing #4 crosses the southbound I-80 on-ramp from the southwest corner to the southern sidewalk. There is no north-south crosswalk on the east side.

During field observations, 60% of pedestrians used the northern crossings (#1 and #2), 22% used the western crossing (#3), and 13% used the southern crossing (#4). 6% crossed illegally on the eastern side. Most pedestrians were traveling east (44%) or west (29%). 70% of the pedestrians were male, and most (60%) traveled in groups of two or more.

The major issue at this intersection is violation of pedestrian right of way by right-turning vehicles that accelerate when approaching (#4) or entering (#1) freeway on-ramps. The vast majority (82%) of encroachment on pedestrian right of way occurred with right-turning vehicles. Visibility is a problem both for pedestrians and drivers. Drivers often are not looking for pedestrians when making these turns, and pedestrians have a difficult time seeing vehicles approaching from behind them (e.g., crossing west on #1 and crossing east on #4).

Pedestrian compliance with crossing signals is also an issue. Fully half of the observed pedestrians finished crossing with a “solid red hand” signal, the highest percentage of the four intersections. In part, this is because 36% of pedestrians began crossing either on the “flashing red hand” or the “Solid red hand” signals. Also, the long crossings (#2 and #3) are difficult to complete in time, and the lack of safe refuges increases pedestrian exposure to risk. The existing signal timing is inadequate, particularly at Crossing #3.

6.4. BICYCLE PATTERNS

Bicycle facilities at this intersection include the Bay Trail along the south sidewalk and the designated bicycle route running south along Frontage to Powell, crossing the I-80 southbound on-ramp and continuing along the south side of Powell Street. A bicycle lane also runs along Powell in both directions between Frontage and the Marina.

During field observations at this intersection, bicyclists were traveling south along Frontage and turning east onto Powell (33%), east along Powell from the west (22%) and west on combined routes (34%).

Most bicyclists were male (87%), and 22% of bicyclists were riding in groups - the highest of all the intersections. More bicyclists rode on the sidewalk here than at any of the other intersections: 21% entered the intersection on a sidewalk, and 37% exited on a sidewalk. The major issues for bicyclists at this intersection include potential conflicts with right-turning vehicles at the I-80 on-ramps and navigating between designated routes on sidewalks, paths, and the street. More bicyclists were observed using the #2 lane (second from the curb) at this

intersection than at the others (32%). This is likely to avoid right-turning vehicles. Bicyclists might favor entering and ending their crossings on sidewalks due either to the alignment of the Bay Trail or their difficulty in navigating the multiple lanes in the intersection. Bicyclists (and pedestrians) coming south along the Frontage Street sidewalk also face conflicts from vehicles cutting across the sidewalk to enter the gas station.

6.5. INDIVIDUAL CROSSINGS

6.5.1. Crossing #1— Northeast corner to pedestrian island

Description and primary issues

This segment is the first of two adjoining segments on the north side of Powell that cross Frontage Road. This segment crosses two lanes of traffic making right turns onto Frontage Road (north) from Powell after passing under the freeway. While most of these vehicles enter a freeway on-ramp about 50 yards past the crossing to the north, other traffic either proceeds on Frontage Road north to Berkeley or enters driveways along the west side of Frontage road. The segment is not signalized and is marked only by a crosswalk and a “Yield to Pedestrian” sign just before the crossing.

There are two primary issues at this crossing:

- Very heavy and fast vehicle traffic in both lanes during much of the day—vehicles traveling toward the freeway are beginning to accelerate, anticipating entering the freeway on-ramp, and they are not expecting to encounter pedestrians or bicyclists.
- Limited line of sight—a freeway column partially blocks the view between the lane next to the curb and the northwest corner.

Implications for pedestrian risk

Drivers often do not slow down or yield the right of way when a pedestrian begins to enter the crosswalk. Additionally, the general volume and speed of vehicles makes pedestrians reluctant to assert the right of way. Instead, they simply wait for an appropriate gap. However, the line of sight limitation impedes this strategy. At the community meeting at the Watergate condominium complex, residents noted that this was the most problematic crossing of all those included in the assessment. It should be noted that crossing from east to west on this segment is more difficult than crossing west to east because of the line of sight limitations, and because vehicles are approaching from behind pedestrians. Crossing from west to east is somewhat easier because the pedestrian is facing oncoming vehicles and drivers can more easily see pedestrians standing on the pedestrian island.

One possibility raised at meetings with City officials was to remove this crosswalk, on the grounds that it is not safe. The TSC recommends against removing this crosswalk on two grounds.

First, this crossing provides the only connection to the north side of Powell between Frontage and Christie. Removing it would increase walking distances and add crossings, exposing pedestrians to additional risk. For example, pedestrians walking to Denny’s from the Watergate condominiums would have to cross to the south side of Powell, cross the on-ramp at Frontage and the off-ramp at I-80, cross back to the north side at Christie, and then walk most of a block back to get to the restaurant. Many people would choose the more direct route, even given the

risk at this crossing. For these reasons, it is important to improve the crosswalk rather than eliminate it.

Second, there are several ways to improve this crosswalk. In particular, signalizing the segment is a viable option that would greatly improve pedestrian safety at the crossing. There is a gap in traffic of 16-18 seconds during each cycle when almost all traffic crossing this segment is blocked by vehicles turning on a protected left turn from Powell onto the freeway about 50 yards upstream (the exact length of this interval depends on number of vehicles waiting in the queue for the protected left turn). This gap could allow signalization of this segment with little if any delay in traffic flow.

Implications for bicycle risk

Bicyclists wishing to continue west on Powell past this crossing must cross two lanes of right-turning vehicles and negotiate with vehicles merging to the right. The speed and volume of these vehicles puts bicyclists at significant risk, which is exacerbated by poor lighting under the freeway.

Suggested improvements for Crossing #1

<p>Basic Treatment</p> <p>Physical infrastructure</p> <ul style="list-style-type: none">• Enhanced crosswalk marking• Reflectors mounted on corners of island on poles or barrier structure <p>Signage</p> <ul style="list-style-type: none">• Signs or pavement stencils at east corner for pedestrians to watch for vehicles• Fluorescent yellow-green “Yield to Pedestrians” sign to replace existing yellow sign• Enlarge “Yield to Pedestrians” sign <p>Enforcement</p> <ul style="list-style-type: none">• Vehicle compliance with pedestrian right of way <p>ADA</p> <ul style="list-style-type: none">• Upgrade curb ramps (add texture) and signals (add audible signals) as needed
--

<p>Additional Items</p> <ul style="list-style-type: none">• In-roadway lighting along crosswalk or pedestrian-activated flashing beacon above crosswalk• Pedestrian-activated flashing “Yield to Pedestrian” sign• Signalization of the segment with pedestrian countdown signal, coordinated with an already occurring gap in traffic (see text)• Experimental in-roadway lighting and audible signal activated by pedestrian push-button
--

6.5.2. Crossing #2—Pedestrian island to the northwest corner of the intersection

Description and primary issues

This segment is the second of two crossings joined by a pedestrian island that cross Frontage Road on the north side of Powell. While there are four vehicle lanes, the crossing is five lanes wide. Three lanes approach from the north: the right most lane is for right turns only onto Powell (west), and the other two are for left turns only onto Powell (east). The fourth lane is for traffic turning left off of eastbound Powell to travel north on Frontage. An area on Frontage (roughly equivalent to a traffic lane) is a striped median. The crossing segment is signalized and includes a pedestrian signal in which the “Walk” signal begins with the onset of the green light for eastbound and westbound traffic on Powell Street.

There are several issues at this crossing:

- Southbound vehicles turning right on red during pedestrian “Walk” phase
- Proximity of the crossing to a gas station driveway
- Substantial number of vehicles using this intersection as a freeway bypass to avoid freeway congestion. These drivers proceed west on Powell to do a U-turn and head back to the freeway ramp on the opposite side of the intersection.
- Insufficient pedestrian signal timing

Implications for pedestrian risk

Pedestrians are primarily at risk on the west side of the crossing from vehicles turning right on red lights during the pedestrian walk phase, although traffic is not as heavy or rapid as at other locations. Nevertheless, drivers who failed to yield the right of way and who encroached on the crosswalk were observed. Additionally, pedestrians on the west side of the crossing face risk from distracted drivers on the northwest corner exiting the gas station, particularly from those drivers looking to their left (east) to pull out to the right (west) and not watching for pedestrians on the sidewalk. While closing this driveway would reduce risk to pedestrians in the crosswalk, it would force drivers wishing to stop at the gas station to cross both Crossing #2 and Crossing #3 to reach the other gas station driveway on Powell. This might actually increase risk to pedestrians and bicyclists. Closing this driveway is therefore not recommended. However, the TSC recommends that signs be posted at the gas station driveway indicating that drivers should watch for pedestrians and bicyclists.

Implications for bicycle risk

Bicyclists riding along the Frontage sidewalk (which is part of the Bay Trail) face conflicts from drivers exiting the gas station at the northwest corner. As stated above, signs should be posted at the gas station driving indicating the drivers should watch for pedestrians and bicyclists.

Suggested improvements for Crossing #2

Basic Treatment

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar for southbound lanes
- Reflectors mounted on corners of island on poles or barrier structure

Signage

- “Yield to Pedestrian” sign at west corner for right-turning vehicles
- Sign at gas station exit driveway on Frontage for vehicles to watch for pedestrians and bicyclists

Enforcement

- Vehicle compliance with pedestrian right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical infrastructure

- Reduce curb radius to reduce vehicle speeds and reduce crossing distance for pedestrians

Electronic signage

- Pedestrian countdown signal
- Pedestrian triggered flashing “Yield to pedestrian” sign at west corner coordinated with pedestrian signal phase
- Experimental in-roadway lighting triggered by pedestrians

Signal timing

- Extend pedestrian signal timing (Flashing Red Hand phase)
- Coordinate signal timing with signal timing for Crossing #1, if possible
- Prohibit right turn on red, at least during off-peak periods (i.e., lunch hours and weekends)
- “No right-turn” arrow or electronic sign for southbound vehicles triggered by pedestrian push button

Other

- Prohibit commuting through EV by statute and/or by eliminating the U-turn west of the intersection on Powell (this would reduce the number of right turning vehicles onto Powell).

6.5.3. Crossing #3— West side of Frontage across Powell

Description and primary issues

This crossing is at the west side of the intersection. It is the second longest crossing in the study area, at almost 100 feet. There are five vehicle lanes along this crosswalk leg: two heading westbound on Powell towards the Marina and three heading eastbound. There is a very narrow median extending just to the crosswalk. The median is not of a suitable or comfortable size to be used as a refuge, the minimum size for which would be 4 to 6 feet, with a portion extending beyond the crosswalk. No pedestrians using this island were observed.

Of the two westbound lanes, the northernmost lane (next to the curb) receives traffic turning right from Frontage onto Powell, and the other (next to the median), receives traffic from west bound through traffic on Powell. Of the three eastbound lanes, the northernmost lane (next to the median) must turn left onto Frontage northbound. The center lane eastbound must proceed straight through on Powell, and the southernmost lane (next to the curb) may proceed straight or make a right turn onto I-80. There is a bicycle lane along the curb on both sides of Powell that ends (for eastbound bicyclists) and begins (for westbound bicyclists) at this crosswalk. The Bay Trail runs along this crossing, connecting segments to the north along Frontage to segments to the east and west. For the trail system to work well, bicycle crossings should be clear, both to bicyclists and drivers.

There are several issues at this intersection.

- High-speed traffic turning right from Frontage onto Powell during the pedestrian “Walk” phase.
- Distraction by drivers exiting or entering gas station driveways.
- Relatively low volume but high speed eastbound traffic turning right onto the freeway on-ramp.
- Encroachment of eastbound vehicles on the crosswalk.
- Insufficient pedestrian crossing time.
- Lack of a usable refuge in the median.
- No indication of a bicycle route in the crosswalk.

Implications for pedestrian risk

Pedestrian risk varies by portion of the crosswalk. For pedestrians in the north part of the crossing, the risk is from the two lanes of vehicles turning right off Frontage onto Powell. Because of the large turning radius and the distance traveled by drivers before they reach the crosswalk, these vehicles are proceeding fairly rapidly.

For pedestrians in the south part of the crossing, the risk is from vehicles turning right off of Powell onto the I-80 on-ramp. These vehicles may turn on red, and, during the red phase, observers noted many vehicles not stopping, or only partially stopping, before turning. Restricting right turns on red would result in some delay for vehicles. However, given the

relatively low right-turn volumes, it would not impede overall capacity very much. Additional risk is from vehicles traveling eastbound on Powell encroaching on the crosswalk during the red phase.

For pedestrians proceeding either way on the crosswalk, there is potential risk for those who do not complete the crossing and are forced to wait on the narrow raised median. The pedestrian signal timing at this crossing does not allow sufficient “Flashing red hand” or “Walk” time for a pedestrian to cross, even at a relatively fast speed.

Implications for Bicycle Risk

Bicyclists riding on the bicycle lane face risk when the lane ends. It is also unclear whether the crosswalk is part of the Bay Trail or bicycle route. Because this segment connects two bicycle routes, it is likely that many bicyclists will be crossing here.

*Suggested improvements for Crossing #3***Basic Treatment**

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar for vehicles in the east-bound lanes
- Marked bicycle path in crosswalk

Signage

- Signs or pavement stencils at north corner for pedestrians to watch for vehicles turning right off of Frontage onto Powell
- Bay Trail and/or bicycle route signage
- “Yield to pedestrians” signs at north and south corners

Signal timing

- Extend pedestrian signal timing (“Walk” and “Flashing red hand”)

Enforcement

- Vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical infrastructure

- Widen median and extend across crosswalk, adding refuge space
- Reduce curb radius at north end of the crossing to slow turning vehicles and reduce crossing distance
- Pull the crosswalk diagonally from northwest to southeast corner (on other side of southbound on-ramp) or expand the crosswalk to include the I-80 freeway on-ramp. The latter should be combined with “No right turn on red” for eastbound right turns

Electronic signage

- Pedestrian triggered flashing “Yield to pedestrian” sign at both right turns, coordinated with “Walk” signal phase
- Experimental in-roadway lighting triggered by pedestrians
- Pedestrian countdown signal

Signal timing

- Create leading pedestrian interval, possibly triggered by pedestrian push-button

Other

- Prohibit commuting through Emeryville by statute and/or by eliminating the U-turn west of the intersection on Powell (which would reduce the number of vehicles at both right turns).
- Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends).

6.5.4. Crossing #4— South side of Powell across the southbound I-80 on-ramp

Description and Issues

This leg consists of a single lane heading southbound onto I-80. Only vehicles heading eastbound on Powell may use this lane. The crosswalk is fairly short—less than 30 feet—and is considered part of the Bay Trail.

There are several issues at this crossing:

- Relatively low volume but high-speed right turns. Vehicles turn to enter an on-ramp to I-80, and begin to accelerate accordingly. Right turns on red are permitted after stopping, but vehicles rarely come to a full stop.
- Since the crossing is narrow, pedestrians and bicyclists often cross without either pushing the pedestrian button or waiting for the light. Almost no one observed waited for the pedestrian signal.
- The line of sight was substantially blocked by bushes on the southwest corner of the intersection. While these bushes have been trimmed, they are growing back and will be an ongoing maintenance issue unless they are removed.
- Confusing cluster of signs on sign post at east end of crossing.

Implications for Pedestrian Risk

The primary risk here is relatively high-speed vehicles turning right and not noticing pedestrians, concentrating instead on entering the freeway on-ramp. A mitigating factor is that these vehicles do not have to watch for other vehicle traffic. Pedestrians crossing to the east likely have the greater risk because they must look over their shoulder to observe approaching vehicles. Pedestrians crossing to the west face vehicles and therefore can more easily observe them. The pedestrian “Flashing red hand” phase does not allow enough time to cross at a moderate to fast walking rate, although the combined “Walk” plus “Flashing red hand” time is sufficient.

The relatively short length of the crosswalk, in conjunction with relatively low traffic volume, has created a situation in which the crosswalk signal is almost irrelevant for pedestrian crossings. The predominant pattern is that pedestrians simply wait for an adequate gap in vehicle traffic, irrespective of the pedestrian signal.

Implications for Bicyclist Risk

The primary risk for bicyclists at this crossing is crossing the entrance to the freeway on-ramp while monitoring any approaching traffic behind them. Furthermore, there is inadequate signage and street markings at this point and ambiguity about whether bikes are supposed to enter the sidewalk or the trail and how bikes are to enter the stream of traffic if they proceed on the street.

Suggested improvements for Crossing #4

Basic treatment

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar for vehicles
- Remove bushes on southwest corner (these have been cut but appear to be growing back)
- Mark bicycle path in crosswalk

Signage

- Signs or pavement stencils for pedestrians to watch for vehicles
- “Yield to Pedestrians” sign at southwest corner
- Reduce and clarify the cluster of signs at the east side of this crossing

Enforcement

- Vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical infrastructure

- Reduce curb radius to force turning vehicles to slow and reduce crossing distance.
- Pull crossing #3 diagonally from northwest to southeast corner (on other side of southbound on-ramp), or expand crossing #3 to include the I-80 freeway on-ramp.

Electronic Signals

- Pedestrian triggered flashing “Yield to pedestrian” sign
- Experimental in-roadway lighting triggered by pedestrian

Signal timing

- Create leading pedestrian interval, possibly triggered by pedestrian push-button

Other

- Prohibit commuting through Emeryville by statute and/or by eliminating the U-turn west of the intersection on Powell.
- Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends).

7. POWELL AND I-80

7.1. DESCRIPTION

The intersection of Powell and I-80 is immediately east of Powell and Frontage. Powell proceeds east and west through this intersection, with an on-ramp to I-80 on the north side, and an off-ramp from I-80 on the south side. There are pedestrian crosswalks at both ramps. The pedestrian crossings are connected to Powell and Frontage by sidewalks underneath the I-80 overpass. Land uses include a Denny’s Restaurant on the northeast corner and the Powell Street Plaza shopping center to the southeast. A designated bicycle route (part of the Bay Trail) runs along the south leg of the intersection (Figure 6).

Figure 6: Aerial photo of Powell and I-80 on-ramps

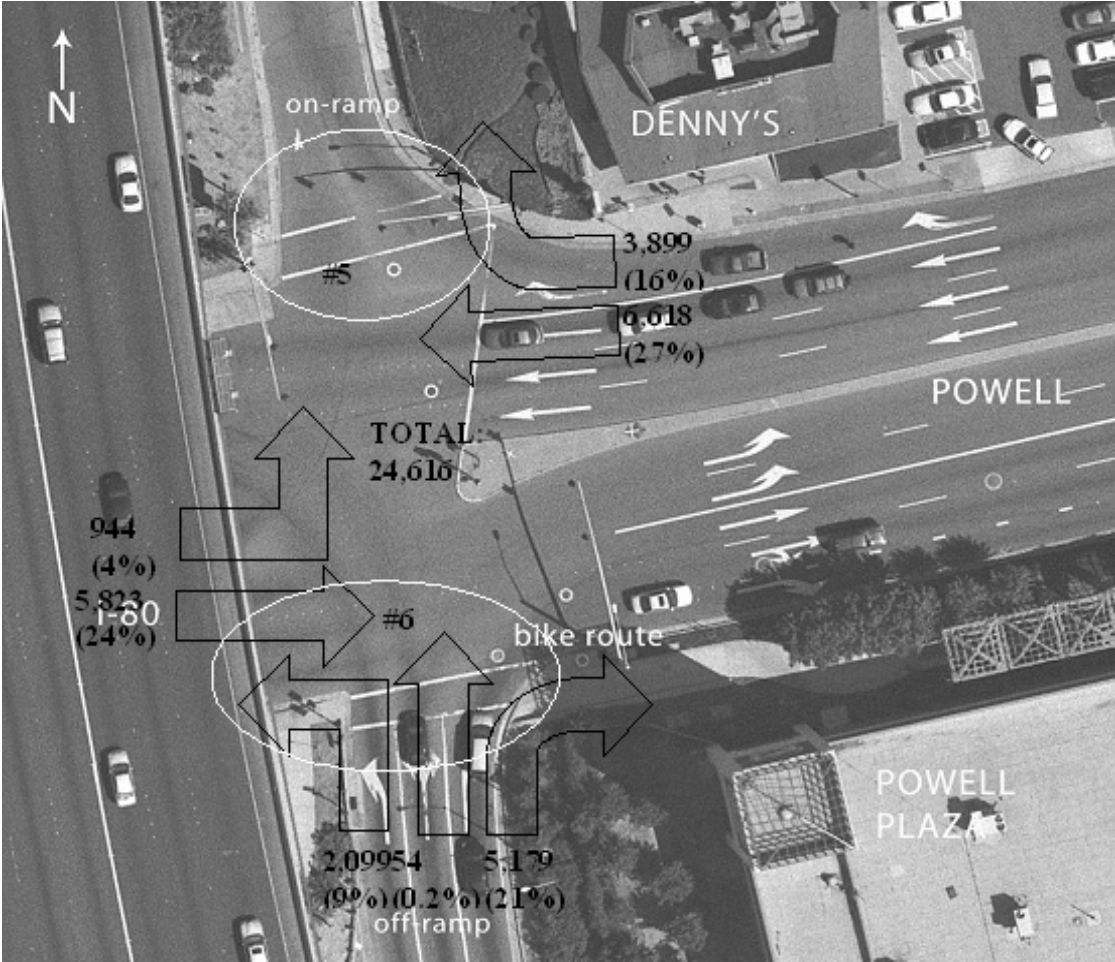


Table 8: Vehicle Volume at each Crossing: Powell at I-80

CROSSING	VEHICLE VOLUME ACROSS CROSSING	PERCENT OF INTERSECTION TOTAL
#5	4,897	20
#6	7,332	30

7.2. VEHICLE PATTERNS

Based on traffic counts provided by the City of Emeryville, the intersection at Powell and Frontage carries close to 25,000 total vehicles during the a.m. and p.m. peaks (9a.m.-1p.m. and 5p.m.-9p.m.) (Figure 6 and Table 8). Peak hour flows at this intersection are 3,630 and 3,550 vehicles at 12-1p.m. and 5-6p.m., respectively.

The primary threats for pedestrians at this intersection are from the two right turns, which account for about 37% of the total traffic:

- Right turns off of westbound Powell onto the on-ramp (3,899 vehicles, or 16% of the total)
- Right turns from the off-ramp onto eastbound Powell (5,179 vehicles, or 21% of the total)

During periods of high congestion, many drivers use this intersection to bypass traffic on I-80. This is facilitated by the “through” option in the center lane from the off-ramp which allows vehicles to simply exit, cross through the intersection, and then re-enter the freeway. The vehicle data provided by the City indicates a low number of northbound through vehicles (54) during the two observation periods combined. However, during periods of heavy freeway congestion, many vehicles per cycle using this intersection to bypass the freeway were observed.

7.3. PEDESTRIAN PATTERNS

There are two crosswalks in this intersection. Crossing #5 is at the entrance to the northbound on-ramp at the north leg and connects the sidewalk under the freeway to the northeast corner occupied by a Denny’s Restaurant. Crossing #6 is at the exit of the I-80 off-ramp at the south leg of the intersection and connects the sidewalk under the freeway to the southeast corner occupied by a shopping center. There is no north-south crosswalk at either the east or west legs of the intersection.

During the period of the observations, 80% of the pedestrians used the southern crossing, while the remaining 20% used the northern crossing. All pedestrians were traveling east (48%) or west (52%). Observers did not see any pedestrians crossing illegally in north or south directions. This is probably due to the fast speeds and heavy volume of east-west vehicle traffic and the absence of a travel-time advantage for pedestrians. Most (61%) pedestrians were male and over 60% traveled in groups of two or more.

Compared to the other intersections, pedestrians at Powell and I-80 were more likely to change stride to avoid a vehicle. The intersection also had the second highest number of vehicle violations of pedestrian right of way. All encroaching vehicles were turning right.

Over 20% of pedestrians began crossing on the “Flashing Red Hand” signal, and over 30% finished crossing on the “Solid Red Hand.” Because the crosswalks are short, pedestrians may be more inclined to disregard the signal. This may also help explain their many conflicts with vehicles.

7.4. BICYCLE PATTERNS

Bicyclists in this intersection can either travel east or west along Powell. On the northern portion of the road, bicyclists are expected to use the traffic lanes (though some use the sidewalk). There is no designated bicycle lane on the street. On the southern portion, bicyclists can either use the bicycle path on the south side of the street (Bay Trail) or the traffic lanes. During the period of the observations, over 70% were traveling west to east.

During observation, bicyclists at this intersection were fairly evenly split between commuters and recreational bicyclists. Most were riding alone (85%), and over 90% were male. Compared to other intersections, Powell and I-80 had the highest number of young bicyclists between ages 10 and 17 (14%). Also, bicyclists at Powell and I-80 were the most compliant with signals, with 95% starting to crossing on green, and less than 5% starting to cross on red. There were no observed conflicts, violations, or vehicle encroachments on bicyclist right of way.

A major issue for bicyclists traveling in the northern portion of the road is the right-turning vehicles entering the I-80 on ramp. Bicyclists traveling straight (west) on Powell must ride in between the through lanes and the right-turn lane, and then move left again as they approach Frontage to avoid a second lane of right-turning vehicles. Another issue is drivers cutting across bicyclists' paths as they enter or exit the gas station or Denny's driveways on the northern sidewalk.

Another major issue for bicycles traveling on Powell is that drivers turning right may not see or yield to the bicyclists. The bicycle route on the south side of the intersection is also poorly marked, and it may be unclear to bicyclists where to go. The crosswalk on the south side of the intersection is part of the Bay trail and therefore may be used by bicycles. However, drivers may not expect bicyclists there, and drivers, especially those turning right, may encroach on the crosswalk and not look to their right to see oncoming westbound bicyclists.

7.5. INDIVIDUAL CROSSINGS

7.5.1. Crossing # 5— North side of Powell across the northbound I-80 on-ramp

Description and primary issues

This crosswalk crosses a two lane on-ramp to northbound I-80. Cars enter the on-ramp, from Powell; eastbound vehicles turn left onto the on-ramp, and westbound vehicles turn right. In addition, some vehicles on northbound I-80 use the intersection as a shortcut to bypass congestion on the adjacent segment of I-80 by exiting into the south side of the intersection and traveling straight through to the I-80 on-ramp on the north side. The crosswalk has standard striping and is offset from the sidewalk under the freeway. Caltrans maintains jurisdiction for the on-ramp, while Emeryville has jurisdiction of the crosswalk and intersection.

There are a number of issues at this crossing:

- Line of sight—a tall railing and newsstand on the east corner (on the driveway to Denny’s) partially obstructs the line-of-sight between drivers and pedestrians, particularly when pedestrians are crossing from east to west. Due to the geometry of the northeast corner, pedestrians crossing west have to look back over their shoulder to observe traffic.
- Sign clutter approaching the intersection—there is a series of signs along westbound Powell as one approaches the freeway on-ramp including a pedestrian sign, a ”Right-turn only” sign, a height limit sign, a “Yield to pedestrians” sign, and an “After stop, right turn permitted on red” sign. The signs clutter the roadway and make it difficult to see each sign. Additionally, the “Yield” sign is somewhat small and hard to read.
- Narrow sidewalk—the sidewalk leading to and adjacent to the crosswalk is narrow, barely meeting ADA standards.
- Faded pavement markings—both the crosswalk and the stop bar are faded.
- Accelerating vehicles—Right-turning vehicles are beginning to accelerate to freeway speed and do not always stop for pedestrians in the crosswalk. This is facilitated by a large turning radius.

Implications for pedestrian risk

The first risk for pedestrians at this crossing is from vehicles turning right during the pedestrian walk phase. Vehicles have a green light, are often traveling at high speed, are not expecting to encounter a pedestrian, and often do not stop or yield. Several pedestrians not using the push-button were observed.

The second risk for pedestrians at this crossing comes during the pedestrian “Don’t Walk” phase. Because the crossing is relatively short, pedestrians may be tempted to cross against the signal. Observers noted several of these violations. While vehicles can legally turn right on red after stopping, they rarely come to a complete stop.

Both of these risks are compounded by the line-of-site limitation and the narrow sidewalk on the northeast corner.

Suggested improvements for Crossing #5

Basic Treatment

Physical Infrastructure

- Widen sidewalk on west corner
- Enhance crosswalk marking
- Re-paint stop bar for westbound traffic

Signage

- Remove or relocate signs along westbound Powell to reduce visual clutter
- Replace “Yield to pedestrians” sign with larger, brighter (fluorescent yellow-green) sign

Enforcement

- Enforce vehicle compliance with pedestrian right of way and stop before right turn on red

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical Infrastructure

- Square off and extend east corner to reduce vehicle speed of right-turning vehicles, increase visibility of pedestrians waiting to cross, and provide room for ADA-compliant sidewalk and ramp

Signal timing

- Provide leading pedestrian interval, possibly triggered by pedestrian push-button

Signage

- Install pedestrian-activated experimental in-roadway lighting
- Install pedestrian-activated “Yield to pedestrians” sign

Other

- Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends).
- Remove or relocate newsstand on Denny’s driveway to improve visibility at corner

7.5.2. Crossing #6— South side of Powell across the northbound I-80 exit ramp

Description and primary issues:

This is a three lane exit ramp off of I-80 northbound. Vehicles in the right lane must turn right onto Powell eastbound. Vehicles in the middle lane may make a right or left turn, or proceed straight onto the I-80 northbound entrance ramp. During periods of heavy freeway congestion, many drivers use this middle lane to bypass a portion of the freeway and re-enter on the opposite ramp. Prohibiting this movement would reduce vehicle volumes across the crossing. Vehicles in the left lane must make a left turn onto Powell westbound. The crosswalk has standard striping and is part of the Bay Trail. There is a pedestrian signal with a pushbutton at both ends of the crosswalk.

There are several major issues at this crossing.

- Vehicles approaching at high speed—Drivers coming off the off-ramp are decelerating quickly from high speeds and often encroach on this crosswalk.
- Driver attention on traffic coming from the left—There is a “Ped Xing” sign at the west corner, but drivers turning right are focused on traffic coming from their left and do not look to their right where pedestrians or bicyclists may be crossing. Many also do not stop before turning right.
- Line of sight limitation—the southeast corner has an embankment with overgrown foliage that restricts drivers’ visibility of pedestrians attempting to cross to the west.

Implications for pedestrian risk:

The risks for pedestrians vary depending on the signal phase and portion of the crosswalk. During the pedestrian “Walk” phase, the primary risk is in the east part of the crosswalk from vehicles turning right on red when pedestrians (and bicyclists) have the right-of-way. These vehicles are exiting the freeway at high speeds and are focusing on vehicles approaching from their left. The risk is exacerbated by the line of sight limitations caused by bushes and the embankment at the southeast corner and possibly by the low expectation of encountering a pedestrian or bicyclist. Observers learned anecdotally about two bicycle collisions or near misses at this location.

During the pedestrian “Don’t walk” phase, pedestrians are also at risk while standing on the southeast corner. This risk is from vehicles, especially trucks, encroaching on the sidewalk as they turn right. Since this is a relatively short crossing, pedestrians may be tempted to cross against the light during a gap in traffic. This puts pedestrians at risk in any part of the crosswalk since approaching vehicles will have the light in their favor.

Implications for bicyclist risk in the bicycle path:

The TSC generally found that bicyclists stopped for the red light at this location; however, a bicyclist not stopping for the light would be at risk given the speed of vehicles coming off the

freeway. Bicyclists following the traffic signal are at risk primarily from vehicles turning right on red, given that drivers are focused on vehicles and do not expect to encounter a bicyclist.

Additionally, although this crossing is part of a bicycle route, it is not clear where bicycles are allowed to be, and drivers may not expect them in the crosswalk.

*Suggested improvements for Crossing #6***Basic Treatment**

Physical Infrastructure

- Enhanced crosswalk marking
- Add texture prior to crosswalk to alert drivers to approaching crosswalk
- Recessed stop bar
- Marked bicycle path in crosswalk
- Remove shrubbery on southeast corner

Signage

- Signs or pavement stencils for pedestrians to watch for vehicles
- Upgrade “Ped Xing” sign
- Bay Trail signage to clarify bicycle route and alert drivers to existence of bicycle route

Enforcement

- Vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional Items

Physical infrastructure

- Extend curb on the east side of the crossing to force turning drivers to slow, while accommodating right-turning trucks
- Extend median further into the intersection to restrict northbound through movements

Electronic signs

- Pedestrian triggered flashing “Yield to Pedestrian” sign on both sides of the off-ramp
- In roadway lighting triggered by pedestrian

Signal timing and traffic flow

- Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends)
- Add red arrow signal prohibiting northbound right turns activated by pedestrian push-button

Other

- Change middle lane to right-turn only, prohibiting traffic from going straight back onto freeway. (This reduces the possibility of backed-up traffic on off-ramp due to no right turn on red and restricts use of the intersection as a freeway bypass).

8. POWELL AND CHRISTIE

8.1. DESCRIPTION

The intersection of Powell and Christie is one block east of Powell and I-80. To the north along Christie are commercial, office, and residential developments. To the south, Christie serves the Powell Street Plaza and then turns east to meet Shellmound Street. To the east, the Powell Street Bridge crosses over the railroad tracks and to the west Powell continues to the I-80 on-ramps and the Marina. Land uses at this intersection include a hotel to the southeast, the shopping center parking lot to the southwest, an electronics store to the northeast, and a gas station to the northwest. The crosswalk on the south leg of the intersection (crossing Christie) is also part of the Bay Trail (Figure 7).

Figure 7: Aerial View of Powell and Christie

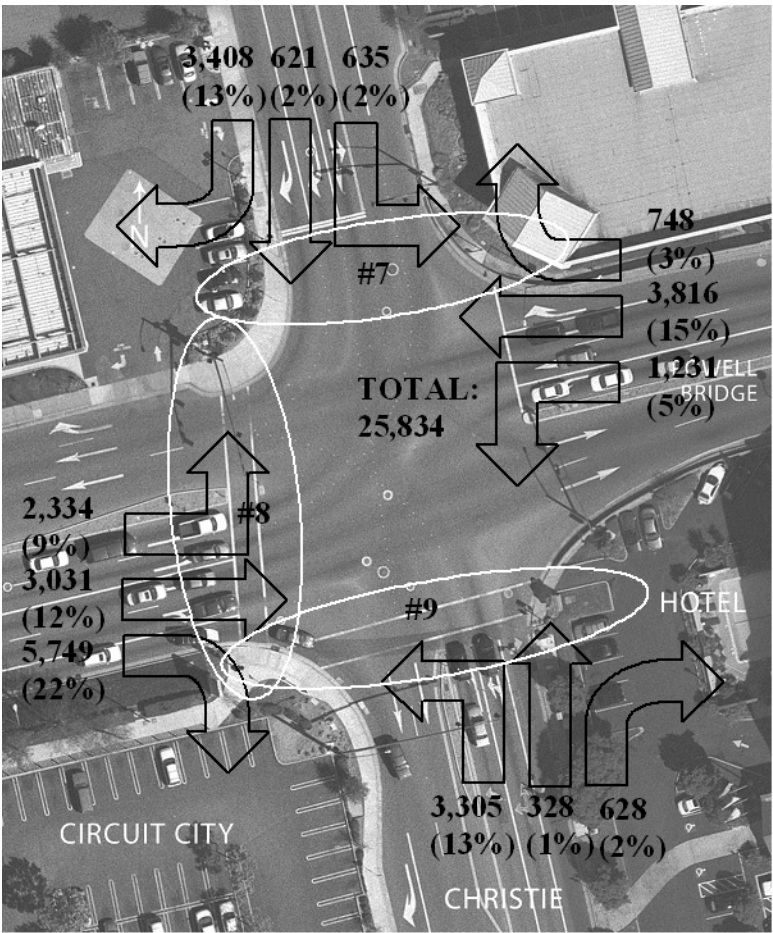


Table 9: Vehicle Volume at Each Crossing: Powell and Christie

CROSSING	VEHICLE VOLUME ACROSS CROSSING	PERCENT OF INTERSECTION TOTAL
#7	8,074	30
#8	21,643	84
#9	11,862	45

Note: sum of percentages exceeds 100 because many vehicles cross more than one crosswalk.

8.2. VEHICLE PATTERNS

Based on traffic counts provided by the City, Powell and Christie has the highest vehicle volume of the four intersections, carrying almost 26,000 total vehicles during the a.m. and p.m. data collection periods (9a.m.-1p.m. and 5p.m.-9p.m.) (Figure 7 and Table 9). The a.m. and p.m. peak hour flows are 3033 and 4310, respectively. Vehicle patterns here are also more varied than at the other intersections.

All four right turns at this intersection are permitted during the red phase. Red light running has been an issue at this intersection, particularly for left turns from westbound Powell onto Christie. A camera to enforce red light running was recently installed to help address this issue.

About 35 percent of vehicles are split between two right-turn movements:

- Eastbound Powell onto southbound Christie (22 %)
- Southbound Christie onto westbound Powell (13%)

It should be noted that vehicle data for this intersection was collected before Christie was made one-way eastbound by Shellmound Street. This one-way segment starts several hundred feet from the intersection, and has resulted in a decrease in the volume of vehicles entering the intersection northbound on Christie.

8.3. PEDESTRIAN PATTERNS

There are only two legal crosswalks in this intersection, on the west (crossing Powell) and south (crossing Christie). Both of these crosswalks have pedestrian countdowns, and these are the only countdowns in the four intersections included in this study. Neither the north leg of the intersection (crossing Christie) nor the east leg (crossing Powell) is presently a legal crosswalk: both have signage and barriers prohibiting pedestrian crossing.

During the observations, over 50% of pedestrians used the western crossing and 22% used the southern crossing. However, an additional 19% crossed the northern leg, and 5% crossed the eastern leg of the intersection. That pedestrians cross at these illegal crossing sites suggests that there is demand to cross these legs. Pedestrian destinations were fairly evenly split between west (32%), south (32%), and north (26%), with 10% going east.

Pedestrians were fairly evenly split by gender (56% male/44% female). This intersection had the highest percentage of older pedestrians, with 8% over 65, and 65% of pedestrians traveled in groups of two or more.

Of all the intersections studied, Powell and Christie had the highest percentage of vehicle violations of pedestrian right of way, experienced by more than 23% of observed pedestrians. This rate is two to ten times higher than other intersections. Most of these vehicles were turning right. These violations were evenly split between the south and west crossings.

Compared to other intersections, this one also had many more conflicts where vehicles changed course to avoid a pedestrian. Most of these were between pedestrians crossing west in the north leg and right turning vehicles from Powell.

Pedestrian compliance with signals was high: over 80% began crossing on the “Walk” signal, and almost 90% finished crossing before the “Solid red hand”. However, this intersection also had the highest percentage of people running to get across the street—over 15%. Most of these were people crossing the northern (illegal) leg. A few, crossing the western leg, stopped in the median.

This intersection also had the highest percentage of left-turning vehicles observed encroaching on pedestrians. All except one of these left-turn encroachments occurred between pedestrians crossing (illegally) at the north leg of the intersection and vehicles from the dual left-turn lanes on eastbound Powell.

From this analysis and feedback at community meetings, the main issues at this intersection include right-turning vehicles not stopping for pedestrians, long crossing distances, and the lack of a crosswalk in the north leg.

8.4. BICYCLE PATTERNS

Bicycle facilities at this intersection include a Class I bike path on the southwest sidewalk that runs along the northern edge of the Powell Plaza shopping center. This is proposed to be part of the Bay Trail. The route continues across the southern crosswalk and through a hotel parking lot (via land granted as an easement) on the southeast corner. There is a bike route sign at the southwest corner with an arrow directing bicyclists across Christie. This route runs parallel to the Powell Street Bridge and connects to a bike lane on Shellmound and to the continuation of the Bay Trail to the south on Shellmound.

Bicyclists at Powell and Christie had the most diverse travel patterns: north to south (29%), east to west (19%), west to east (19%); and west to south (14%). The vast majority traveled in lane 1 (next to the curb) rather than the sidewalk path. Over 85% began in lane 1, and over 70% ended in lane 1. This may be because most were commuters, who tend to prefer riding on the street. It may also reflect the poor signage and incomplete network of off-street paths.

Compared to other intersections, this intersection had the highest percentage of bicycle commuters (94%) and lowest percentage of recreational bicyclists (6%). It also had the highest percentage of female bicyclists (near 25%). Almost all bicyclists were riding alone (90%).

The majority of bicyclists here were compliant with signals. Over 85% began crossing on green. However, this intersection had the lowest percentage of bicyclists able to finish crossing on green (68%). Vehicles at Powell and Christie were most likely to stop or swerve to avoid a bicyclist, though this was still very rare (2 cases observed). Both cases involved right-turning vehicles stopping to avoid through-moving bicyclists. There were a few bicyclist violations

(crossing on a red light), and no vehicle violations observed. All of the encroachment issues involved right-turning vehicles.

Based on feedback from community meetings, a major issue for bicyclists at this intersection is that drivers turning right from Powell to Christie often do not stop and do not expect bicyclists. A second issue is that southbound bicyclists in the northern leg on Christie have to ride in the middle of the street to avoid the dual left-turn lanes. Finally, although there is a “Bike Route” sign with a straight arrow at the southern crossing, the bicycle route through the parking lot is not obvious to drivers and may be unclear to bicyclists.

8.5. INDIVIDUAL CROSSINGS

8.5.1. Crossing #7— Unmarked (blocked) crossing across north leg of Christie

Description and primary issues

This leg has five lanes of traffic: two northbound and three southbound, which include dual right-turn lanes and a combined through/left-turn lane. The stop bar for southbound vehicles is pulled back substantially from the corner.

There are two related issues at this crossing:

- Although this crosswalk has a pedestrian barrier, a substantial number of pedestrians were observed crossing here – almost as many as used the south crosswalk. Because the east side of the intersection is also not a marked crosswalk, and has six lanes of high-speed traffic, pedestrians who want to go from the northeast corner (by Good Guys) to any other corner in the intersection will most likely cross at the north leg.
- Drivers do not expect a pedestrian here since it is not a legal pedestrian crossing.

Given the high pedestrian use, lack of alternative crossings, and the low volume of right turns from Powell onto northbound Christie, re-stripping this crosswalk should be considered.

According to City staff, the worst bottleneck in Emeryville occurs at this intersection in the southbound direction. This could potentially be improved by converting Christie back to two-way traffic. In the meantime, countermeasures should be considered in light of this bottleneck and attempt to limit vehicle delay.

Implications for pedestrian risk

The fact that this crossing is blocked means that most drivers do not expect pedestrians at this crossing. This is borne out by the observation data, which shows many pedestrians running across the northern leg, and several conflicts between pedestrians and westbound vehicles turning right from Powell onto Christie.

Implications for bicyclist risk

Because there is only one through lane, drivers going to the shopping center at the southwest corner of the intersection must merge across two lanes (across right-turning vehicles from Powell) to make a right turn into the parking lot. This is a problem for bicyclists, who must ride in the middle of traffic if they want to go straight through the intersection.

Suggested improvements for Crossing #7

Basic Treatment

Physical Infrastructure

- Convert to legal crosswalk
- Pedestrian pushbuttons and countdown signal
- Textured curb ramps and audible signals

Enforcement

- Vehicle compliance with pedestrian right of way

Additional Items

Physical infrastructure

- Extend curb at northeast corner to reduce speeds of right-turning vehicles from Powell Street Bridge
- Change center southbound lane from right turn only to through-only

Signal timing

- Implement a leading pedestrian interval (for pedestrians at northeast corner)

8.5.2. Crossing #8— West side of Christie across Powell

Description and primary issues

This crosswalk crosses eight lanes of traffic: five eastbound and three westbound. It is the longest crossing in the study at 100 feet. Eastbound lanes include dual left-turn lanes onto Christie, a through lane, a through/right-turn lane onto Christie, and a right-turn lane onto Christie. The three westbound lanes receive traffic from the two right-turn lanes off of Christie, two through lanes on Powell, and a left-turn lane from Christie. The northwest corner is bulbed out. There is a “Yield: Pedestrian Crossing” sign at the north corner. The pedestrian signal is a countdown. There is median extending to the crosswalk with a very small “thumbnail” piece on the opposite side of the crosswalk.

There are several major issues at this crossing:

- Two lanes of heavy, high speed traffic turning right on green from Christie onto Powell during the pedestrian “Walk” phase.
- Two lanes of heavy, high speed traffic turning right on red from Powell onto Christie during the pedestrian “Walk” phase.
- The sheer width of the intersection and volume of traffic is intimidating to cross.
- Narrowness of the median. There is a push button on the median, but very little space for pedestrians to stand.

Implications for pedestrian risk

Pedestrian risk depends on the portion of the crossing. At the south end of the crossing pedestrians face risk from the two lanes of vehicles turning right from Powell onto Christie. This is the heaviest vehicle right-turn pattern in the set of intersections (5,749 vehicles during the 8 hour a.m. and p.m. peaks) matched only by the right-turn volume from westbound Powell onto the Frontage on-ramp (5,736). The primary risk for pedestrians in this segment is vehicles turning right on red during the pedestrian “Walk” phase. Vehicles are typically moving at fairly high speeds, made possible by the large turning radius. The potential for “multiple threat” injuries is high at this location since the view of a vehicle in the outer lane may be blocked by a vehicle in the inner lane (i.e., the lane next to the curb). In addition, vehicles in the outer lane have a larger turning radius and may be traveling faster than vehicles in the inner lane. When drivers do stop for pedestrians, they often stop inside the crosswalk area, encroaching on pedestrian space.

At the north end of the crossing pedestrians face risk from the two lanes of vehicles turning right from Christie onto Powell. In this case the traffic is proceeding during a green phase at the same time as the pedestrian “Walk” phase. Otherwise, there are similar issues, including the potential for “multiple threat” injuries and the high volume and speed of vehicles. At this segment there is the additional issue that the stop bar for vehicles turning right from Christie onto Powell is set back considerably from the intersection. Right turning vehicles off of Christie onto Powell have

a substantial distance to the northwest corner, and a tighter turning radius than at the southwest corner.

This is the longest crossing in the set of crossings in this study (100 feet). While the “Walk” and “Flashing Red Hand” times are sufficient for moderate speeds, it may be difficult for slower pedestrians to cross in time. The median is not large enough to feel safe given the speed and volume of traffic, and there is not a sufficient standing area for pedestrians caught in the middle. Extending the median would not only provide a pedestrian refuge; it would also force vehicles to slow down when making left-turns. Reflectors placed on the ends of the median would make it more visible at night.

Additionally, both pedestrian push buttons are located far from the crosswalk and are difficult to reach for wheelchair users. Several pedestrians did not use the push-button at all.

Suggested improvements for Crossing #8

Basic Treatment

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar for eastbound vehicles
- Relocate pedestrian push-buttons at north and south corners closer to crosswalk

Signage

- Move stop bar at southbound Christie forward to align with sidewalk to increase right-turning drivers' view of pedestrians
- Signs or pavement stencils for pedestrians to watch for vehicles

Enforcement

- Vehicle compliance with pedestrian right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical infrastructure

- Enlarge median and extend across crosswalk to create usable refuge island
- Reduce curb radius at southwest corner to force turning vehicles to slow and reduce crossing distance
- Change center southbound lane at Crossing #7 from right turn only to through-only

Electronic signage

- Install pedestrian-triggered flashing "Yield to Pedestrian" sign
- Install experimental in-roadway lighting triggered by pedestrians

Signal timing

- Extend pedestrian crossing time
- Create leading pedestrian interval (for pedestrians crossing from northwest corner)

Other

- Prohibit right turn on red at southwest corner during off-peak periods (i.e. lunch hours and weekends)

8.5.3. Crossing #9— South side of Powell across Christie

Description and primary issues

This crosswalk is over 90 feet long and crosses five lanes of traffic. The three northbound lanes include a left-turn lane onto Powell, a through/left-turn lane onto Powell, and a right-turn lane onto Powell. The two southbound lanes receive traffic from the two right-turn lanes off of Powell, the through lane on Christie, and a left-turn lane off of Powell onto Christie. The crossing is also part of a designated bicycle route, as marked by a sign on the southwest corner. This crossing has a pedestrian countdown signal. There is also a very narrow median that ends before the crosswalk. The west corner is bulbed out. However, the bulb-out is past the crosswalk area and is meant to block off a lane that turns right into the shopping center parking lot. In effect, the corner has maintained a wide turning radius that facilitates high vehicle and truck speeds.

There are several issues at this crossing:

- Two lanes of heavy, high-speed traffic turning right on green from Powell onto Christie during the pedestrian "Walk" phase.
- Two lanes of relatively heavy, high-speed traffic, turning right on red from Christie onto the Powell Street Bridge during the pedestrian "Walk" phase.
- Length of crossing and lack of sufficient crossing time, especially given the volume of right-turning vehicles.
- Narrowness and placement of the median. There is a push button on the median, but it is substantially south of the crosswalk, and there is virtually no place for pedestrians to stand.

Implications for pedestrian risk

Pedestrian risk depends on the location in the crosswalk. The greatest risk is at the west segment of the crosswalk in which pedestrians face conflicts from high volume, high-speed traffic in two right-turn lanes from Powell onto southbound Christie. The drivers are traveling in the green phase, and many do not yield to pedestrians attempting to cross. The potential for "multiple threat" conflicts is high at this location since the view of drivers in the outer lane may be blocked by vehicles in the inner lane (next to curb). In addition, vehicles in the outer lane have a greater turning radius, and therefore may be traveling faster than vehicles in the inner lane.

Pedestrian risk in the east segment of the crosswalk arises from vehicles turning right on red from Christie onto the eastbound Powell Street Bridge. Right turning vehicles are entering the stream of eastbound through traffic across the Powell Street Bridge, and their drivers may not be watching for pedestrians. Pedestrians who might be trapped in the middle have no place to stand because the median is very narrow and doesn't extend to the crosswalk.

Implications for bicycle risk

Like pedestrians, bicyclists at this intersection face conflicts from vehicles turning right from

Powell onto Christie that do not stop to yield. In addition, many drivers may not expect bicyclists to be riding in the crosswalk. Although there is a sign for bicyclists at the crossing, the bicycle route is not obvious to drivers, and the transition from the bike path to the street may even be unclear to bicyclists.

*Suggested improvements for Crossing #9***Basic Treatment**

Physical Infrastructure

- Enhance crosswalk marking
- Recess stop bar for vehicles approaching the crosswalk north on Christie
- Relocate pedestrian pushbutton on west side closer to crosswalk
- Enlarge median and extend across crosswalk to create true refuge island

Signage

- Install signs or pavement stencils to pedestrians to watch for vehicles
- Install signage alerting drivers to presence of bicycle route
- Mark bicycle path in crosswalk
- Install “Yield to Pedestrians” sign for vehicles turning right from Powell onto Christie

Signal timing

- Extend pedestrian “Flashing red hand” phase

Enforcement

- Enforce vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional items

Physical infrastructure

- Reduce curb radius at both corners to force turning vehicles to slow and reduce crossing distance
- Remove one northbound lane and extend the curb at the east corner to reduce the crossing distance (given the low through and right-turn volumes on northbound Christie, the current middle lane could accommodate through movements and right turns).

Electronic signage

- Install pedestrian-triggered flashing “Yield to Pedestrian” sign at southwest corner
- Install experimental in-roadway lighting triggered by pedestrians

Signal timing

- Create leading pedestrian interval for pedestrians crossing from the southwest corner

Other

- Prohibit right turn on red during off-peak periods (i.e. lunch hours and weekends)

9. CHRISTIE AND SHELLMOUND

Figure 8: Aerial of Christie and Shellmound

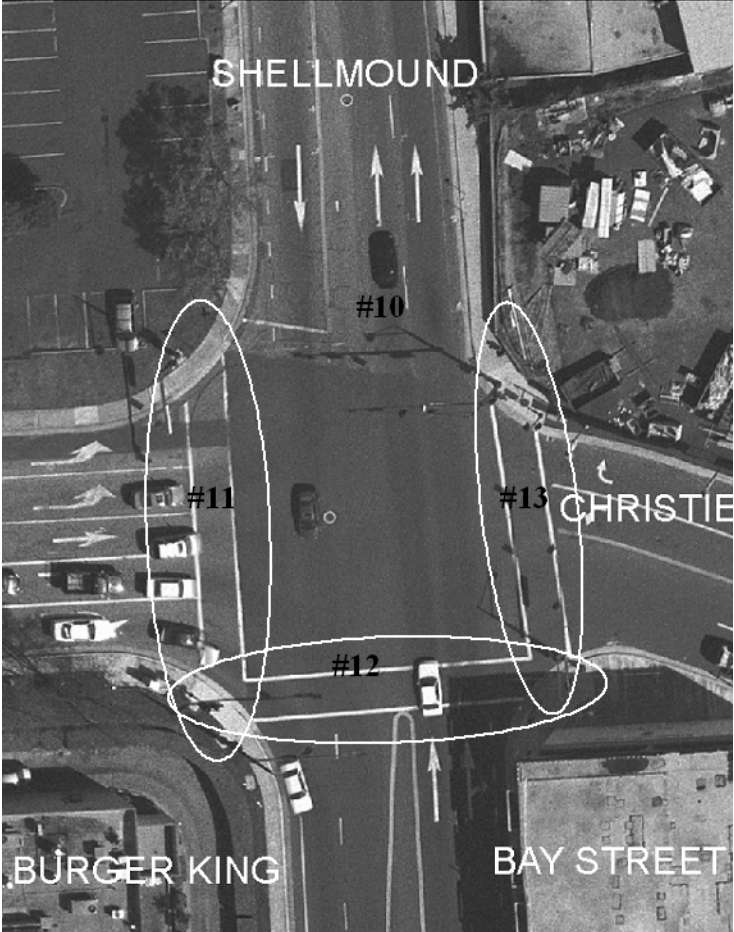


Table 10: Vehicle Volume at each Crossing: Powell and Christie (AM + PM Peak Hour only)

CROSSING	VEHICLE VOLUME ACROSS CROSSING	PERCENT OF INTERSECTION TOTAL
#10	1812	64
#11	1047	38
#12	2511	89
#13	198	7

Note: sum of percentages exceeds 100 because many vehicles cross more than one crosswalk.

9.1. DESCRIPTION

One block south of Powell, Christie turns east and intersects Shellmound, which runs north-south. The Bay Street Shopping Center is to the southeast, and the Powell Street Plaza Shopping Center is to the southwest. To the northwest is a parking lot and restaurant, and to the northeast is a new development site, possibly for a hotel.

While vehicle volumes are currently relatively low at this intersection, both vehicle and pedestrian traffic is expected to increase with the new development planned. Approximately 360 residential units are under development at Bay Street, and the hotel site on the northeast corner will also add substantial pedestrian and vehicle traffic.

There are three marked crosswalks at this intersection, at the west, east, and south legs. This intersection is the only marked crossing within some distance both to the north and south on Shellmound as well as to the west on Christie. There is a striped (Class II) bicycle lane in both directions on Shellmound. To the west of Shellmound, Christie is one-way eastbound, so westbound vehicles at the east leg of Christie must turn either right or left. This was done to accommodate signal timing and improve circulation, but may not be necessary given the low vehicle volumes at the intersection (Figure 8).

9.2. VEHICLE PATTERNS

Prior to the re-configuration of Christie to one-way west of Shellmound, this intersection carried just over 14,000 vehicles during the a.m. and p.m. peaks (9a.m.-1p.m. and 5p.m.-9p.m.), slightly more than half the volume at Powell and Christie and Powell and I-80, and about three-quarters of the volume at Powell and Frontage (Figure 8 and Table 10). This volume has decreased substantially since the reconfiguration. Counts from 2002 show that almost 80% of traffic was split between three movements:

- Eastbound vehicle turns right to go south on Shellmound towards Bay Street (37%)
- Northbound vehicles on Shellmound travel through intersection toward Powell (23%)
- Northbound vehicles turn left onto Christie to go towards the Plaza (18) (This turn is no longer possible since Christie was converted to a one-way eastbound street.)

In total, right turns made up over 40% of all vehicle movements.

Limited data from after the reconfiguration to one-way traffic shows that during a.m. and p.m. peak hours almost 80% of the vehicles at the intersection are now split between two movements:

- Eastbound vehicles turn right (30%)
- Northbound vehicles travel through (47%)

Right turns now make up 32% of all movements, the vast majority from eastbound right turns onto southbound Shellmound.

9.3. PEDESTRIAN PATTERNS

There are three crosswalks at this intersection, at the west, south, and east legs. The crosswalk at the north leg is not marked and it does not have a pedestrian barrier.

During the observations, 44% of pedestrians used the eastern crossing, 36% used the southern crossing, and 20% used the western crossing. None used the unmarked north crossing. Over 40% were traveling south (44%), while others were split about evenly between north (21%), west (20%) and east (16%). This intersection had the highest percentage of females, with over 50%, and the highest percentage of young people, with 12% aged 17 or younger. Pedestrians at this intersection were the most likely to travel in groups (over 70%). These demographic patterns are most likely related to the presence of the Bay Street and Powell Street Plaza Shopping Centers.

Compared to other intersections, pedestrians at Shellmound and Christie were the most compliant with signals. Over 80% began crossing on the “Walk” signal, and less than 10% began on the “Solid red hand.” Most pedestrians were also able to finish crossing on time—only 13% finished on the “Solid red hand.” Pedestrians here were the least likely to have to run to cross the street (less than 5%).

On the other hand, pedestrians here were the most likely to cross out of the crosswalk (over 20%), with some of this is due to vehicles encroaching on the crosswalk. Many pedestrians cut toward their destination as they reached the end of the crossing (many going to Bay Street), and some were simply jaywalking.

All instances of vehicle encroachment occurred with right-turning vehicles. However, there were few full vehicle violations of pedestrian right of way (less than 5% of observed pedestrians), and few observed conflicts between pedestrians and vehicles.

Based on feedback from community meetings, a major issue for pedestrians here is the two right-turn lanes from eastbound Christie onto southbound Shellmound. The first vehicle may block the second driver’s view of pedestrians, causing the second driver to not stop or yield at the crosswalk. Drivers turning right on red from Christie onto northbound Shellmound also tend to go fast and not look for pedestrians.

Another issue is the long crossings, particularly on the west and south crosswalks. Residents noted that turning vehicles make it hard to start crossing on the “Walk” signal, and after waiting, they often don’t have enough time left to cross.

9.4. BICYCLE PATTERNS

Bicycle infrastructure at this intersection includes a striped bicycle lane on both sides of Shellmound. Based on field observations, all bicyclists at this intersection traveled alone, and over 80% were male. In total, 90% of observed bicyclists were traveling either north to south (30%), south to north (30%), or west to south (30%). Nearly all bicyclists riding on Shellmound used the bicycle lane.

Bicyclists at Christie and Shellmound were very compliant with signals. Although close to 30% began (and finished) crossing on red, these were all bicyclists making right turns from Christie onto Shellmound. The only observed bicycle-vehicle conflict involved vehicles entering the bicycle lane on southbound Shellmound, violating a bicyclist's right of way. There were no bicycle violations of right of way.

According to this data, it appears that the main issue for bicyclists here is right-turning vehicles cutting across their path, particularly northbound vehicles turning left (east) onto Christie and eastbound vehicles turning right (south) onto Shellmound.

Based on feedback from community meetings, another issue is that bicyclists leaving the shopping center who want to go north on Shellmound must cut across three lanes in less than half a block to get to a left-turn lane. However, there a signal near Trader Joe's that should facilitate this.

The lack of westbound access on Christie is also inconvenient for bicyclists. If necessary, bicyclists can ride up to Powell from the shopping center through the plaza parking lot.

9.5. INDIVIDUAL CROSSINGS

9.5.1. Crossing #10— North side of Christie and Shellmound

Description and primary issues

The north side of Christie is currently an unmarked crosswalk, but there are no pedestrian barriers. There are three marked lanes here, two northbound and one southbound, as well as a large space in the center that seems to have been a striped median. There is a faded stop bar for southbound traffic. There is also a bicycle lane on both sides of Shellmound. While observers did not see pedestrians using this crossing, pedestrian volumes will increase with a hotel or other development on the northeast corner of the intersection. Increased pedestrian activity will increase demand for a crosswalk at this leg.

Issues at this crossing include:

- Ambiguity over whether or not this is a legitimate crossing. Although it is a legal crossing, it has no crosswalk markings or pedestrian signal.
- Two left-turn lanes from eastbound Christie onto northbound Shellmound.
- Westbound right-turn lane from Christie onto northbound Shellmound (although volume presently is very low).

Implications for pedestrian risk

Pedestrians wishing to cross this leg face potential conflicts from vehicles turning right from westbound Christie and vehicles turning left from eastbound Christie. Vehicles may also encroach over the faded stop bar.

Implications for bicycle risk

Northbound bicyclists in this leg may face conflicts from vehicles turning right from westbound Christie. Bicyclists traveling southbound across this leg do not currently face conflicts from right-turning vehicles because Christie has been reconfigured to one-way. The clearly marked bicycle lane also helps drivers expect bicyclists and recognize their right of way.

Suggested improvements for Crossing #10

Basic Treatment

Physical Infrastructure

- Mark crosswalk with enhanced crosswalk marking
- Install pedestrian signal with pushbuttons and countdown signal
- Include textured curb ramps and audible signals

Signal Timing

- Leading pedestrian interval

Signage

- Repaint stop bar
- Stripe or construct median

Enforcement

- Vehicle compliance with pedestrian right of way

9.5.2. Crossing #11— West side of Shellmound and Christie

Description and primary issues

This crosswalk crosses five lanes of one-way traffic, including two left-turn lanes, a through lane, a through/right lane, and a right-turn lane. Based on 2004 peak hour traffic counts, left-turn and through volumes in the west leg are very low.

Issues at this crossing include:

- Length of crossing (86 feet) and insufficient pedestrian crossing time.
- Large turning radii at each corner, allowing high-speed turns.
- Absence of median refuge.

Implications for pedestrian risk

Issues for pedestrians here include the difficulty of crossing given the width of the street, insufficient crossing time, lack of refuge, and volume of vehicles turning right on red onto Shellmound.

Implications for bicycle risk

Bicyclists traveling south along Shellmound may face conflicts from drivers turning right onto Shellmound on red, cutting across their path. Additionally, bicyclists leaving the shopping center who want to go north on Shellmound cannot cross easily—they must cut across three lanes in less than half a block to get to a left-turn lane.

Suggested improvements for Crossing #11

Basic Treatment

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar

Signage

- Install “Yield to Pedestrians” sign at southwest corner
- Signage to alert drivers to presence of bicycle lanes and route

Signals

- Restrict right turn on red, at least during off-peak hours
- Extend pedestrian signal timing (Walk and Flashing Red Hand phases)

Enforcement

- Enforce vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional Items

Physical Infrastructure

- Extend curb and tighten curb radii at southwest and northwest corners to reduce crossing distance and slow vehicles.
- Convert west leg of Christie back to two-way traffic and create median with refuge in center of crosswalk. Alternatively, remove second left-turn lane and widen sidewalks and/or add bicycle lanes.

9.5.3. Crossing #12—South side of Christie and Shellmound

Description and primary issues

This crosswalk crosses four lanes of traffic, including two southbound lanes, a northbound through lane, and a northbound through/right lane, as well as two bicycle lanes. It is almost 90 feet long.

Issues at this crossing include:

- The southwest corner is wide, allowing high-speed turns.
- There is a painted median, but no physical separator and no refuge.
- Insufficient pedestrian crossing time (both “Walk” and “Flashing red hand” phases).
- The sidewalk on the east side of Shellmound ends shortly south of the intersection.

Implications for pedestrian risk

For pedestrians, the main issues here are the length of the crossing, the lack of adequate crossing time, and right-turning vehicles cutting across their path, including northbound vehicles turning east on red onto Christie, but especially eastbound vehicles turning south on green onto Shellmound.

Implications for bicycle risk

For bicyclists, the main issue is vehicles turning right from Shellmound to Christie across the bicycle lane.

Suggested improvements for Crossing #12

Basic Treatment

Physical Infrastructure

- Enhanced crosswalk marking
- Recessed stop bar

Signage

- Install “Yield to Pedestrians” sign at southwest corner
- Install signage instructing eastbound and northbound right-turning drivers to watch for bicycles
- Install signage or in-pavement marking instructing eastbound through-moving bicyclists to move to center of through/right lane

Signals

- Restrict right turn on red for eastbound right turns
- Extend pedestrian crossing time
- Install leading pedestrian interval to allow pedestrians to cross before right-turning vehicles at southwest corner

Enforcement

- Vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional Items

Physical Infrastructure

- Tighten curb radius on southwest corner to reduce vehicle speeds and shorten crossing
- Create physical (concrete) median with refuge through crosswalk
- Extend sidewalk on east side of Shellmound south to intersection with Bay Street.

9.5.4. Crossing #13— East side of Shellmound and Christie

Description and primary issues

This crosswalk crosses four lanes of traffic: a westbound right-turn lane, westbound left-turn lane, and two eastbound lanes.

Issues at this crossing include:

- The northeast corner is wide, allowing high-speed turns.
- There is no median.
- There is no sidewalk along the north side of Christie.

Implications for pedestrian risk

The main concern for pedestrians here is that drivers turning right on red from westbound Christie onto northbound Shellmound tend to go fast and not look for pedestrians. There may also be conflicts with northbound vehicles on Shellmound turning right on green onto Christie in front of pedestrians. Finally, many pedestrians in this crossing are coming or going to Bay Street, and some jaywalk to reach the shopping center more directly.

Implications for bicycle risk

Northbound bicyclists face conflicts from northbound vehicles turning right across the bicycle lane into the Bay Street shopping area. They may also face conflicts from westbound drivers turning right on red onto northbound Shellmound in front of them.

Suggested improvements for Crossing #13

Basic Treatment

Physical Infrastructure

- Enhance crosswalk marking
- Recess stop bar for right-turning vehicles

Signage

- Install “Yield to pedestrians and bicycles” sign for westbound right turning drivers.
- Install signage for northbound right-turning drivers to yield to bicycles

Signals

- Restrict right turn on red for westbound right turns
- Install leading pedestrian interval to allow pedestrians to cross in front of right-turning vehicles at southeast corner

Enforcement

- Enforce vehicle compliance with pedestrian and bicyclist right of way

ADA

- Upgrade curb ramps (add texture) and signals (add audible signals) as needed

Additional Items

Physical Infrastructure

- Tighten curb radius on northeast corner to reduce vehicle speeds and shorten crossing distance
- Create physical (concrete) median with refuge through crosswalk

For hotel development

- Extend sidewalk on north side, and provide crossing into Bay Street from future hotel
- Minimize driveways across sidewalk
- Locate driveways away from intersection

10. INDIVIDUAL CONNECTORS

Figure 9: Connectors



The TSC chose to analyze these several specific connectors because they link three of the four study intersections and are integral to the safety of these intersections.

10.1. CONNECTOR A—NORTH SIDEWALK ALONG POWELL UNDER I-80

Description and primary issues

This sidewalk connects the residential and recreational areas west of the freeway to the shopping and restaurants east of the freeway. It runs from the northeast corner of Powell and Frontage under the I-80 freeway and ends at the on-ramp at Powell and I-80. It is used by residents of Watergate condominiums and employees at office buildings west of Frontage, as well as recreational walkers going to the Marina or the Bay Trail.

Issues along this connector include:

- The sidewalk is narrow—only 3 feet and 8 inches at the narrowest point by the freeway columns (where there is an unused bus loading zone), widening to up to 7 feet past the columns, but becoming narrower (5 to 6 feet) by both crosswalks. This limits maneuverability, particularly near the crosswalks.
- The sidewalk is almost entirely underneath the freeway, and there is little lighting, making it dark and uninviting.

- There is no buffer between the sidewalk fast moving, often heavy traffic on Powell Street. These factors make pedestrians feel isolated, unsafe and vulnerable.

Implications for pedestrian risk

A recent sculpture installation, which included adding some lighting and painting the walls of the underpass, has improved the attractiveness of this path and may reduce the sense of isolation. However, the proximity to heavy traffic continues to create actual and perceived risk for pedestrians.

Moving the sidewalk inside the freeway columns would create more space for pedestrians and provide a buffer between the sidewalk and traffic. This would also align the sidewalk with the crosswalk at Powell and I-80, and would also create a better angle of approach to Crossing #1 (from the northeast corner of the intersection of Powell and Frontage to the pedestrian refuge). Alternatively, the sidewalk could be expanded into the bus loading zone, which is no longer used.

Suggested improvements for Connector A

<p>Infrastructure</p> <ul style="list-style-type: none">• Move sidewalk inside the freeway columns to provide buffer between sidewalk and the street• Alternatively, widen sidewalk into unused bus loading area• Provide lighting to improve visibility <p>Other</p> <ul style="list-style-type: none">• Install emergency phone

10.2. CONNECTOR B—SOUTH SIDEWALK ALONG POWELL UNDER 1-80

Description and primary issues

Like Connector A, this sidewalk connects the area west of the freeway to the main part of Emeryville to the east. It also runs almost entirely underneath the freeway and is placed between the freeway columns and Powell Street. It has issues similar to Connector A.

Issues along this connector include:

- The lack of a buffer between the sidewalk and Powell Street traffic forces pedestrians to walk directly next to high-speed traffic.
- Narrowness of the sidewalk (approximately 5 feet near the Powell/I-80 crosswalk), which limits maneuverability, though it meets basic ADA standards.
- Limited lighting, making it dark and uninviting. These factors make pedestrians feel vulnerable, uncomfortable, and unsafe.

However, pedestrians on this side also have the option of walking along the wider bicycle/pedestrian path inside the columns (Connector C), which is much more pleasant.

Implications for pedestrian risk

A recent sculpture installation, which included adding some lighting and painting the walls of the underpass, has improved the attractiveness of this path, and may reduce the sense of isolation. However, the proximity to heavy traffic continues to create actual and perceived risk for pedestrians.

Suggested improvements for Connector B

<p>Infrastructure</p> <ul style="list-style-type: none">• Consider closing this sidewalk and routing pedestrians to Connector C.• Widen sidewalk, especially near crosswalk at Powell/I-80• Provide buffer between sidewalk and traffic• Add lighting to improve visibility <p>Other</p> <ul style="list-style-type: none">• Install emergency phone

10.3. CONNECTOR C—PEDESTRIAN/BICYCLE PATH UNDER 1-80 (PARALLEL TO SOUTH SIDEWALK ALONG POWELL)

Description and primary issues

This path is a designated bicycle route that is proposed to be part of the Bay Trail connecting the Marina to Shellmound Street. It runs parallel to the south sidewalk, but it is located further away from the road, inside the freeway columns. It is at least twice as wide as the south sidewalk, and is bordered by flowers and landscaping.

Issues along this connector include:

- Lack of clarity of signs. There is a bicycle route sign with a straight arrow at the corner of Powell and Frontage, although the sign does not clearly indicate which route to take (Connector B or C).
- Lack of markings indicating appropriateness for bicycle use. There is no marking on the path itself to show that it is intended for bicycle use.
- Lack of lighting. The path is also dark, though the art installation has provided some lighting. In general, this path feels much more open and pleasant than the sidewalks outside the freeway columns.

Implications for bicycle risk

The transition from the crosswalk at Powell and Frontage to the bicycle path could be more clearly marked. Additional lighting would also increase visibility and safety.

Suggested improvements for Connector C

<p>Infrastructure</p> <ul style="list-style-type: none">• Add lighting to improve visibility• Reconfigure the bike route sign and arrow to provide clearer directions to bicyclists• Mark path to show bicycle and pedestrian paths <p>Other</p> <ul style="list-style-type: none">• Install emergency phone
--

10.4. CONNECTOR D—NORTH SIDEWALK ALONG POWELL (EAST OF DENNY’S)

Description and primary issues

This sidewalk connects Christie Street to Frontage Road, the Marina and the Bay Trail. It is extremely narrow (approximately 4 feet) at the northbound I-80 on-ramp, but broadens to 7 to 9 feet as it moves east. It passes a Denny’s Restaurant and a gas station, both of which have wide entrance and exit driveways off of Powell that cut across the sidewalk. Adjacent to the sidewalk is a right-turn lane for the I-80 northbound ramp, where vehicles tend to travel very fast.

Issues at this connector include:

- Crossing of several driveways leading to Denny’s restaurant and the gas station
- Close, high speed traffic

Implications for pedestrian risk

Pedestrians walking along this sidewalk face conflicts from vehicles exiting and entering the driveways to Denny’s and the gas station. The narrow sidewalk at the corner by Denny’s feels unsafe and uncomfortable, especially given the high speeds of adjacent traffic.

Suggested improvements for Connector D

<p>Infrastructure</p> <ul style="list-style-type: none">• Widen sidewalk near west corner (by Denny’s)• Narrow driveways to reduce vehicle speeds, and add signs alerting drivers to watch for pedestrians and bicyclists <p>Signage</p> <ul style="list-style-type: none">• Provide signage at northwest corner of Powell and Christie directing bicycles to bicycle route on south side of intersection
--

10.5. CONNECTOR E—SOUTH SIDEWALK/BICYCLE PATH BETWEEN I-80 AND CHRISTIE

Description and primary issues

This sidewalk is a shared pedestrian and bicycle path and is proposed to be part of the Bay Trail. It connects bicyclists from the Marina to a bicycle lane along Shellmound Street, and it brings people from the Watergate condominiums to the Powell Street Plaza Shopping Center. It is wide (about 10 feet) and nicely landscaped.

Issues at this connector include:

- Absence of clear signs. There is a bike route sign at Powell and I-80, but it is not clear that it refers to this path.
- Absence of clear markings. There is no marking on the path itself to show that bicycles are allowed and encouraged to use it.

Implications for bicycle risk

Signage clearly designating this path as a bicycle route would encourage use and improve safety for bicyclists.

Suggested improvements for Connector E

- Signage
- Reconfigure sign/arrow at Powell and I-80 to provide clear directions to bicycle path
 - Mark path to show bicycle and pedestrian paths

11. APPENDICES

- A. Recommendations and Consultant Responses
- B. Vehicle Volumes
- C. Pedestrian/Bicycle/Vehicle Observations
- D. Infrastructure Observations
- E. Crossing Distance and Signal Time
- F. Community Meeting Results
 - a. Watergate
 - b. Pacific Park Plaza
- G. Surveys
- H. Origin-Destination Diagram
- I. Intersection Aerial Photographs
- J. Presentation to the City of Emeryville

11.1. APPENDIX A: RECOMMENDATIONS AND CONSULTANT RESPONSES

Note: Items listed in the matrix without highlighting are recommendations listed in the report. Those that are highlighted in yellow were raised by City Council members at a presentation in May 2005. Those highlighted in orange are included in the report, but were additionally raised to be considered by City Council members at the presentation in May 2005.

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
1	Pedestrian-activated flashing "yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.
1	Signalization of the segment with pedestrian countdown signal, coordinated with an already occurring gap in traffic	Utilizing a 5 second "Walk" and 8 seconds "Flashing Red Hand", a pedestrian sequence could be added to the existing signal operation of Powell/Frontage intersection that is coordinated with the existing traffic gap at this location without significant impact to vehicular traffic.	Yes	Also install right-turn arrow indications to control right-turn traffic
1CC	Confirm that signal is normally a green arrow, unless pedestrian pushes button (then becomes a red arrow)	Right-turn arrow will be green for the majority of the cycle. The right-turn arrow will be red concurrently with the eastbound left-turn green indication on Powell Street and when there is pedestrian pushbutton actuation. Current controller software can not allow independent pedestrian crossing function separate from the existing traffic signal operation.	No	
1 CC	Enlarge pork chop island	Existing pork chop island could be enlarged to reduce the crosswalk distance by 2 feet while maintaining existing lane widths.	Yes	

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
2	Reduce northwest curb radius to reduce vehicle speeds and reduce crossing distance for pedestrians	Reduction of curb radius that allows for a STAA truck with 18m turn radius would not degrade the right-turn movement level of service. This would reduce the crosswalk distance by approximately 9 feet. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and does not have design speed standards for turning movements for an intersection. Reducing curb radius for the on ramp would require sidewalk, push button, wheel chair ramp, curb, gutter, and striping improvements.	Yes	None
2	Pedestrian triggered flashing "Yield to Pedestrian" sign at west corner coordinated with pedestrian signal phase	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians from Crossing 2 and 3.
2	Extend pedestrian signal timing (Flashing Red Hand Phase)	The "Flashing Red Hand" phase could be extended to the recommended 18 seconds (for 4ft/sec pedestrian crossing speed) without significant affect to traffic operation.	Yes	None
2	Coordinate signal timing with signal timing for Crossing #1 if possible	In order to take advantage of the existing traffic gap, Crossing 2 would not be able to occur concurrently with Crossing 1.	No	None
2	"No right turn" arrow for southbound vehicles triggered by pedestrian push button.	A pedestrian-actuated "No right turn" arrow is not recommended. A variable red arrow would likely confuse motorists and would be difficult to enforce.	No	None

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
3	Extend pedestrian signal timing ("Walk" and "Flashing Red Hand")	The "Flashing Red Hand" phase could be extended to the recommended 23 seconds (for 4ft/sec travel time) without significant affect to traffic operation.	Yes	None
3	Reduce curb radius at north end of the crossing to slow turning vehicles and reduce crossing distance.	Reduction of curb radius that allows for a STAA truck with 18m turn radius would not degrade the right-turn movement level of service. This would reduce the crosswalk distance by approximately 9 feet. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and does not have design speed standards for turning movements at the intersection. Reducing curb radius for the on ramp would require sidewalk, push button, wheel chair ramp, curb, gutter, and striping improvements.	Yes	None
3	Pedestrian-activated flashing "Yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "Yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.
3	Pull the crosswalk diagonally from northwest to southeast corner (on other side of southbound on-ramp)	Realignment of the crosswalk would place pedestrian further into the intersection and increase exposure to traffic. Also pedestrian would no longer be able to use the median island as a refuge.	No	Realignment of the crosswalk from the northwest to the east side of the I-80 on ramp accompanied by extension of the median island to meet the new crosswalk is recommended. This would limit pedestrian exposure to

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
				vehicular traffic. Also, Add bike path symbol parallel to crosswalk striping.
3	Expand the crosswalk to include the I-80 Freeway on-ramp. This should be combined with no RTOR for eastbound right turns.	Motorists are likely to violate the proposed “no right turn on red” sign because of the high right-turn vehicle traffic volume, low pedestrian traffic, and relatively long red times for the eastbound approach during PM peak hour.	No	None
3	Create leading pedestrian interval, possibly triggered by pedestrian push-button.	Leading pedestrian movement could be added without significantly affect intersection operation. However, Powell Street/Frontage Road signal is currently operated by Caltrans with the C8 software. The current software does not allow for leading pedestrian movement without significant software modification. A request to Caltrans to change the existing controller software to BI-TRAN software is required.	Yes, see Alternative	Request controller software change from Caltrans to allow leading pedestrian movement.
3CC	Mark "KEEP CLEAR" between existing stop bar (from existing crosswalk) and realigned crosswalk	"KEEP CLEAR" marking would be included in the crosswalk realignment modification.	Yes	
3CC	Ensure that median/pedestrian refuge is large and visible to drivers, particularly piece on far side of crosswalk	The median improvement will mirror the existing median width and height. A median nose could be added to enhance the pedestrian refuge area.	Yes	

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
4	Pull crossing #3 diagonally from north west to southeast corner (on other side of southbound on-ramp), or expand # 3 to include the I-80 freeway on-ramp	Realignment of the crosswalk would place pedestrian further into the intersection. Also pedestrian could no longer use the median island as a refuge. Expanding the crosswalk to include the I-80 freeway on-ramp would eliminate the existing Crossing 4 pedestrian phase. The proposed pedestrian crossing would combine both the crossing 3 and crossing 4 into one movement. This would result in inefficient operation by granting 30 seconds of pedestrian crossing time to travel a 20 foot crosswalk.	No	None
4	Create leading pedestrian interval, possibly triggered by pedestrian-button	Leading pedestrian movement could be added without significantly affect intersection operation. However, Powell Street/Frontage Road signal is currently operated by Caltrans with the C8 software. The current software does not allow for leading pedestrian movement without significant software modification. A request to Caltrans to change the existing controller software to BI-TRAN software is required.	Yes, see Alternative	Request controller software change from Caltrans to allow leading pedestrian movement.
5	Square off and extend east corner to reduce vehicle speed of right turning vehicles, increase visibility of pedestrians waiting to cross, and provide room for ADA-compliant sidewalk and ramp.	Reduction of curb radius that allows for a STAA truck with 18m turn radius would not degrade the right-turn movement level of service. This would reduce the crosswalk distance by approximately 11 feet. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and does not have design speed standards for turning movements for an intersection. Reducing curb radius for the on ramp would require sidewalk, push button, wheel chair ramp, curb, gutter, striping, and storm drain improvements.	Yes	None

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
5	Provide leading pedestrian interval, possibly triggered by pedestrian-button	Leading pedestrian movement could be added without significantly affect intersection operation. However, Powell Street/I-80 Ramps signal is currently operated by Caltrans with the C8 software. The current software does not allow for leading pedestrian movement without significant software modification. A request to Caltrans to change the existing controller software to BI-TRAN software is required.	Yes, See Alternative	Request controller software change from Caltrans to allow leading pedestrian movement.
5	Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends)	Observed field condition during the p.m. peak period does not correlate with the right-turn volume. "No right turn on red" operation evaluation is deferred until new traffic data is collected.	No	Evaluate no right turn on red operation based on new traffic count collection from current RSTP project.
5 TSC	Install pedestrian warning sign with flashing beacons instead of "No right turn on red" (since pedestrians will be crossing when westbound vehicles have green signal)	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.	Yes	
6	Pedestrian-activated flashing "Yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
6	Extend median further into the intersection to restrict northbound through movements	Prohibiting through movement produce no benefit to the pedestrian crossing movement. The off ramp movement is red when the pedestrian phase occurs at this crossing.	No	None
6	Prohibit right turn on red, at least during off-peak periods (i.e. lunch hours and weekends)	Prohibiting right turn on red would significantly impact the level of service for the right-turn movement during Weekday Noon and PM peak hours. Highest right turn occur during Noon with LOS change from D to F. Right turn PM peak LOS would change from C to E. Current weekend volume is not available, but it is expected to be similar to weekday noon and p.m. peak volumes.	No	None
6	Add red arrow signal prohibiting northbound right turns activated by pedestrian push-button	A pedestrian-actuated "No right-turn" arrow is not recommended. A variable red arrow indication would likely confuse motorists and would be difficult to enforce.	No	None
6	Change middle lane to right turn and left-turn movements only, prohibiting traffic from going straight back onto freeway (this reduces the possibility of back-ups onto off-ramp due to no right turn on red and restricts use of the intersection as a freeway by-pass.)	Prohibiting through movement would reduce freeway cut through and lower total approach volume. Lower vehicular volume would reduce conflicts with pedestrians.	Yes	None
6CC	Work with Caltrans to legislate 'no through commuting' and install sign by off-ramp	Submit formal request to Caltrans to eliminate through movement striping to prevent freeway cut through traffic.	Yes	

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
6CC	Consider treatment used at San Pablo near the Oaks Club, or near Holiday Inn/Fire station #1 for median to prevent through traffic	Oaks Club median treatment is a traffic calming measure. Caltrans is unlikely to install this type of modification that restrict traffic flow on the freeway off ramp	No	Design median that prohibits through movement as much as possible without restricting I-80 on and off ramp left-turn movements.
6CC	Paint allowed turning movements further south in off-ramp lanes (before crosswalk)	Two sets of lane designation markings already exist on the off ramp, the first set of markings is located at the limit line and the second set is located at 150' back from the first set. Additional lane markings would not conform to Caltrans standard practice and would require design exception.	No	
6CC	Stripe an advance limit line before crosswalk (NOTE: right-turning drivers will likely pull into crosswalk to look for oncoming traffic before turning)	With an advance limit line, right-turn vehicles would still have to pull up to the crosswalk to see around freeway structural columns to make a right turn on red. However, the advance limit line would reduce vehicle approach speed to the crosswalk during the red indication phase and increase pedestrian safety.	Yes	
7	Confirm effects on signal timing and congestion to add this crosswalk with pedestrian phase	Creating a crosswalk at the current southbound traffic limit line would create potential conflicts with westbound right-turning vehicles. Right-turning vehicles may not be able see pedestrians in the crosswalk until they have almost completed their turning movements and picked up considerable speed. This would be similar to the current condition of crossing 6.	No	None ¹

¹ Grading constraints for Crosswalk at new limit line location: Coming from the eastern leg of the intersection, the Good Guys electronics store building will partially obstruct any proposed crosswalk. Additionally, the westbound traffic from the Powell Street structure is a downgrade approach to the intersection. The westbound average travel speed is the highest at the intersection. The combination of reduced visibility and high vehicle speed put pedestrian at a higher rate of conflict at the proposed crosswalk. Therefore, a crosswalk is not recommended at this location.

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
7CC	Separate left/through movements into separate lanes, and add overhead signs on pole or cable showing allowed turning movements in each lane	There is insufficient roadway width to separate existing shared through and left lane into two lanes.	No	Overhead signage could be installed to enhance lane usage assignment
8	Change center southbound lane at Crossing #7 from right turn only to through only	Reducing the right-turn lanes from 2 right-turn lanes to 1 right-turn lane would degrade the vehicle level of service for the right-turn movement to E from D during the PM peak hours.	No	None
8	Pedestrian-activated flashing "Yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.
8	Reduce southwest curb radius to force turning vehicles to slow and reduce crossing distance	The current curb radii of the n/w and s/w corner allow for a STAA truck to turn from the outside lane to the outside lane. Reducing curb radius on the northwest corner would not meet the 18m turning radius for a STAA truck. Reducing curb radius on the southwest corner while maintaining STAA truck turn radius would reduce crosswalk length by 3 feet and shorten pedestrian time by less than 1 second. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and does not have design speed standards for turning movements at the intersection.	No	Re-stripe existing southbound right-turn lane limit lines further south into the intersection. Pedestrians in the crosswalk will be more visible to the southbound right-turn vehicles. Initial vehicle speed through the crosswalk would also be lower. Striping change would need to be accompanied by installation of new detector

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
				loops.
8	Extend pedestrian crossing time	Current Pedestrian crossing time meets the standard 4ft/s crossing speed. Although, crossing time could be raised slightly without seriously affecting operation of the intersection during the peak hours.	Yes	None
8	Create leading pedestrian interval (for pedestrians crossing from northwest corner)	A leading pedestrian interval of 3 seconds could be added without affecting overall operation. Leading pedestrian interval operation requires the use of BI-TRAN controller software.	Yes	None
8	Prohibit right turn on red at southwest corner during off-peak periods (i.e. lunch hours and weekends)	Eastbound Powell right-turn volumes are high throughout the day. Right-turn queue often extends to I-80 EB off ramp during weekday noon hours and weekend periods. Prohibiting right turn on red may cause blockage at the I-80 EB ramps intersection.	No	None
8CC	Install pedestrian-activated red arrow for right-turning cars at SW corner	Vehicular green and pedestrian walk movements occur at the same time. Installation of pedestrian-activated red arrow would prevent vehicles from making a right turn on green whenever a pedestrian actuates the red arrow. Downstream intersections would likely suffer from grid lock condition during the peak hours with the installation of the pedestrian actuated red arrow.	No	

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
8CC	Take land from 76 Gas station at northwest corner and use to enlarge median and create refuge, possibly with bollards	NW corner curb return could be reduced to allow for enlargement of Powell Street median island without limiting right or left-turning movement onto Powell Street. However, overall crossing distance and pedestrian crossing time would be increased with the NW curb reduction.	No	Existing Powell Street median could be widened into the westbound through lanes to create a pedestrian refuge area without modification of NW corner curb.
9	Enlarge median and extend across to create true refuge island	Existing median island could be extended to meet the crosswalk without restricting vehicle movements. A pedestrian pushbutton could also be added to the enlarged median island.	Yes	None
9	Extend pedestrian Flashing Red Hand phase	Pedestrian crossing time could be changed by from the existing 18 seconds "Flashing Red Hand" to recommended 22 seconds "don't walk" for 4ft/s crossing rate without serious effects on operations.	Yes	None
9	Pedestrian-activated flashing "Yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized inter+C9section to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.
9	Reduce curb radius at both corners to force turning vehicles to slow and reduce crossing distance	Curb radius reduction on both corners while maintaining STAA truck radius of 18 m would only shorten crosswalk length by less than 8 feet and reduces crossing time by 2 seconds. Passenger vehicle speed is not expected to be affected by curb radii changes. Improvement cost is high for a small reduction in crossing time.	No	None

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
9	Remove one northbound lane and extend the curb at the east corner to reduce the crossing distance. (Given the low through and right-turn volumes on northbound Christie, the current middle lane could accommodate through and right turns.)	The #2 northbound lane is currently striped as a combination through and left-turn lane. Removal of the right-turn only lane and re-striping the #2 lane to left/through/right would degrade the approach LOS from E for the PM peak hour to F. Two left-turn lanes are needed to serve the left-turn traffic volume.	No	None
9	Create leading pedestrian interval for pedestrians crossing from the southwest corner	A leading pedestrian interval of 3 seconds could be added without affecting overall operation. Leading pedestrian interval operation requires the use of BI-TRAN controller software.	Yes	None
9	Prohibit right turn on red during off-peak periods (i.e. lunch hours and weekends)	Prohibiting right turn on red would change right turn LOS from A to B during Noon and PM peak periods. Currently weekend volume is not available, but is expected to be slightly higher than Weekday Noon peak volume.	Yes	Install "no right turn on red" sign on Christie
9CC	Mark separate bicycle path in crosswalk, ensuring that bicyclists can travel through median/refuge area easily and safely	Crosswalk striping could be widened to accommodate a bike path without affecting operation.	Yes	

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
10	Install crosswalk with pedestrian signal, pushbuttons and countdown signal	Creating a new pedestrian crosswalk movement timed together with the existing Crossing 12 pedestrian movement could be accomplished without significant impact to the intersection LOS.	Yes, see Alternative	Site B development on Bay Street will change the physical geometry of the northeast corner of the intersection. Pedestrian signal should be installed in conjunction with the Bay Street Site B development. Install pedestrian barricade for the interim until new pedestrian movement is in place.
10	Leading pedestrian interval	A leading pedestrian interval of 3 seconds could be created for the new pedestrian movement without affecting overall operation. Leading pedestrian interval operation requires the use of BI-TRAN controller software.	Yes, see Alternative	Site B development on Bay Street will change the physical geometry of the northeast corner of the intersection. Pedestrian signal should be installed in conjunction with the Bay Street Site B development. Install pedestrian barricade for the interim until new pedestrian movement is in place.
11	Pedestrian-activated flashing "yield to pedestrian" sign	MUTCD 2003 standard usage for "Yield to Pedestrian" sign is for unsignalized pedestrian crossing. A pedestrian warning sign W11-2 is more appropriate use on a signalized intersection to alert road users of where unexpected pedestrian crossing activities might occur. A symbolic sign is also more readily understood by roadway users than a message sign. A flashing sign is not permitted in the current MUTCD. Currently MUTCD standards define flashing operation for signal indication only. As a substitute for a flashing "yield to pedestrian" sign, a W11-2 pedestrian warning sign accompanied by two amber flashing signal beacons would serve the save intended purpose and also comply with current MUTCD standards.	No	Install pedestrian warning sign (W11-2) with amber flashing beacons activated by pedestrians.

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
11	Restrict right turn on red, at least during off-peak hours	There is limited storage space to the downstream intersection at Powell Street Plaza. Prohibiting right turn on red may cause blockage of the Powell Street Plaza intersection.	No	None
11	Extend pedestrian signal timing (walk and flashing red hand phases)	Pedestrian walk time could be slightly lengthened without severely impacting existing coordination timing.	Yes	None
11	Tighten curb radius on southwest corner to reduce vehicle speeds and shorten crossing	Reducing southwest corner curb radius while still maintaining STAA truck turning radius turning from far lane to far lane would reduce crossing distance by 6 feet and crossing time by 1.5 seconds. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and do not have design speed standards for turning movements at the intersection. Improvement cost is high for a small reduction in crossing time.	No	None ²
11	Extend curb at northwest corner to reduce crossing distance and slow vehicles	Northwest corner curb radius could be reduced while still maintaining STA truck turning radius. Crossing distance could be reduced by 12 feet. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and do not have design speed standards for turning movements at the intersection.	Yes	None
11	Remove second left-turn lane and widen sidewalk and/or add bicycle lanes.	Second left-turn lane has been re-striped to a through lane for increased through traffic volume to Bay Street.	No	None

² The turning radius requirement is for a STAA design vehicle, 21m long semi-truck. If turning radius to be reduced, the City needs to prohibit semi-trucks from traveling through this location.

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
11CC	Install bicycle lane on Christie and mark route for bicyclists to exit from Plaza and access bike lanes on Shellmound	Christie Avenue is a one-way street from Powell Street Plaza to Shellmound Street. Adding a bike lane to this section of Christie Avenue would require widening the sidewalk on the north side of Christie Avenue to accommodate both bikes and pedestrians. Also a new crosswalk on the north side of the Shellmound Street/Christie Avenue intersection is needed to connect the Christie Avenue bike path to northbound Shellmound Street bike path, and a new crosswalk at Christie Avenue/Powell Street Plaza to connect the Christie Avenue bike path to Powell Street Plaza. Installation of a bike lane on Christie Avenue should be concurrently constructed with the Site B Development modification of the Shellmound Street/Christie Avenue intersection to avoid confusion and inconvenience to the public.	Yes	
12	Restrict right turn on red for eastbound right turns	There is a high percentage of right-turn-on-red movement during the peak periods, and the short storage space between the downstream at Powell Street Plaza may cause intersection blockage.	No	None
12	Extend pedestrian crossing time	Pedestrian crossing time could be increased from the current 18 seconds "Flashing Red Hand" to 21 seconds at 4ft/s without severely impacting existing coordination timing.	Yes	None
12	Leading pedestrian interval to allow pedestrians to cross before right-turn vehicles at southwest corner.	Leading pedestrian of 3 seconds could be added without significantly affecting operation.	Yes	None

Crossing	Emeryville Pedestrian and Bicycle Safety Evaluation Recommendations	KHA Comments	KHA Recommendations	KHA Recommended Alternatives
12	Tighten curb radius on southwest corner to reduce vehicle speeds and shorten crossing.	Reducing southwest corner curb radius while still maintaining STA truck turning radius turning from far lane to far lane would reduce crossing distance by 6 feet and crossing time by 1.5 seconds. The reduction in turning speed could not be quantified. AASHTO assigns a 10mph turning speed at controlled intersections and do not have design speed standards for turning movements for an intersection. Improvement cost is high for a small reduction in crossing time.	No	None
13	Leading pedestrian interval to allow pedestrians to cross before right-turn vehicles at southwest corner.	Leading pedestrian of 3 seconds could be added without significantly affecting operation.	Yes	None
general/ other CC comments	Consider requiring a full stop, rather than yield, where pedestrian warning signs are installed.	A W11-2 pedestrian warning sign with amber warning beacons will be installed in all cases. A regulator sign requiring full stop for pedestrian is not a standard sign. This type of regulator sign would likely increase rear end time accidents	No	
	Install Bay Trail signage for bicyclists and pedestrians		Yes	
	Change/remove "one-way" sign in hotel parking lot by Powell/Christie to allow bicyclists to travel both ways on bike path through lot	There is limited roadway width and visibility for two way vehicular traffic. One-way vehicular traffic movement should be kept. Separate two way bike path signing and striping could be installed without modifying one way vehicular traffic movement.	Yes	

11.2. APPENDIX B: VEHICLE VOLUMES

FRONTAGE/POWELL		Northbound				Southbound				Eastbound				Westbound				Total										
		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right												
Total	9-1	0	0%	0	0%	0	0%	0	0%	2314	26%	0	0%	445	5%	485	5%	866	10%	434	5%	0	0%	1517	17%	2682	30%	8744
	5-9	0	0%	0	0%	0	0%	0	0%	2586	26%	0	0%	594	6%	472	5%	958	10%	786	8%	0	0%	1502	15%	3054	31%	9953
	AM + PM	0	0%	0	0%	0	0%	0	0%	4900	26%	0	0%	1039	6%	957	5%	1824	10%	1220	7%	0	0%	3019	16%	5736	31%	18697
Peak total	AM (12-1)	0	0%	0	0%	0	0%	0	0%	723	27%	0	0%	118	4%	130	5%	247	9%	146	6%	0	0%	473	18%	816	31%	2653
	PM (5-6)	0	0%	0	0%	0	0%	0	0%	758	27%	0	0%	156	5%	121	4%	276	10%	229	8%	0	0%	378	13%	902	32%	2820
POWELL/I-80		Northbound				Southbound				Eastbound				Westbound				Total										
		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right								
Total	9-1	1240	11%	38	0%	2484	21%	0	0%	0	0%	0	0%	430	4%	2785	24%	0	0%	0	0%	0	0%	2966	25%	1863	16%	11807
	5-9	859	7%	16	0%	2695	21%	0	0%	0	0%	0	0%	514	4%	3038	24%	0	0%	0	0%	0	0%	3652	29%	2036	16%	12811
	AM + PM	2099	9%	54	0%	5179	21%	0	0%	0	0%	0	0%	944	4%	5823	24%	0	0%	0	0%	0	0%	6618	27%	3899	16%	24618
Peak total	AM (12-1)	356	10%	5	0%	711	20%	0	0%	0	0%	0	0%	100	3%	952	26%	0	0%	0	0%	0	0%	944	26%	562	15%	3631
	PM (5-6)	221	6%	3	0%	706	20%	0	0%	0	0%	0	0%	145	4%	883	25%	0	0%	0	0%	0	0%	1083	31%	509	14%	3551
CHRISTIE/POWELL		Northbound				Southbound				Eastbound				Westbound				Total										
		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right								
Total	9-1	1483	12%	149	1%	345	3%	321	3%	296	2%	1318	11%	894	7%	1627	1300%	2754	23%	579	5%	2023	17%	378	3%	12181		
	5-9	1822	13%	179	1%	283	2%	314	2%	325	2%	2090	15%	1440	11%	1404	10%	2995	22%	652	5%	1793	13%	370	3%	13668		
	AM + PM	3305	13%	328	1%	628	2%	635	2%	621	2%	3408	13%	2334	9%	3031	12%	5749	22%	1231	5%	3816	15%	748	3%	25849		
Peak total	AM (12-1)	423	11%	48	1%	92	2%	112	3%	83	2%	518	14%	276	7%	552	15%	836	22%	166	4%	566	15%	113	3%	3786		
	PM (5-6)	474	12%	58	2%	73	2%	108	3%	77	2%	559	15%	347	9%	424	11%	824	22%	194	5%	554	15%	108	3%	3801		
CHRISTIE/SHELLMOU		Northbound				Southbound				Eastbound				Westbound				Total										
		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right		Left	Thru	Right								
Total	9-1	1153	18%	1515	23%	0	0%	0	0%	595	9%	327	5%	489	7%	0	0%	2452	39%	0	0%	0	0%	0	0%	0	0%	6532
	5-9	1600	21%	1902	25%	0	0%	0	0%	712	9%	256	3%	617	8%	0	0%	2543	33%	0	0%	0	0%	0	0%	0	0%	7631
	AM + PM	2753	19%	3417	24%	0	0%	0	0%	1307	9%	583	4%	1106	8%	0	0%	4995	35%	0	0%	0	0%	0	0%	0	0%	14163
Peak total	AM (12-1)	327	16%	585	28%	0	0%	0	0%	202	10%	101	5%	169	8%	0	0%	722	34%	0	0%	0	0%	0	0%	0	0%	2107
	PM (6-7)	435	20%	582	26%	0	0%	0	0%	202	9%	78	4%	176	8%	0	0%	728	33%	0	0%	0	0%	0	0%	0	0%	2202

11.3. APPENDIX C: PEDESTRIAN/BICYCLE/VEHICLE OBSERVATIONS

Observation Variables

Data collected for pedestrians included:

- Leg of intersection/crosswalk used by pedestrian;
- Whether the pedestrian was alone or part of a group;
- Age group and gender of pedestrian;
- Whether the pedestrian pushed the pedestrian signal button (if applicable);
- Pedestrian signal phase at time of pedestrian entry into crosswalk (Walk, Flashing Don't Walk, Solid Don't Walk);
- Pedestrian signal phase at time of pedestrian exit from crosswalk;
- Whether the pedestrian crossed outside of the crosswalk;
- Whether the pedestrian walked, ran (due to discomfort or fear of traffic), or aborted their crossing (due to change in signal or oncoming traffic);
- Vehicle presence and movement;
- Vehicle violation (e.g. violation of pedestrian right of way, or running a red light);
- Conflicts with vehicle, if any.

Data collected for bicyclists included:

- Leg of intersection used by bicyclist;
- Whether the bicyclist was alone or part of a group;
- Age group and gender of bicyclist;
- Signal phase at time of bicyclist entry into intersection (Green, Yellow, or Red);
- Signal phase at time of bicyclist exit from intersection;
- Starting direction of travel;
- Ending lane and direction of travel;
- Turning direction (if any);
- Starting and ending lane of travel (or sidewalk);
- Bicyclist violation (running a red light or violating another vehicle's right of way);
- Vehicle presence and movement;
- Vehicle violation (e.g. violation of pedestrian right of way, or running a red light);
- Presence and type of conflict with vehicle, if any.

Observation periods were used to document the following surrogate measures for collisions:

- Vehicle encroachment ("movement") on pedestrian or bicyclist right of way
- Vehicle violation of pedestrian or bicyclist right of way
- Vehicle/pedestrian and vehicle/bicyclist conflicts
- Pedestrians running or aborting their crossing (indicating discomfort or fear of collision)
- Pedestrian and bicyclist compliance with signals

Vehicle encroachment was defined as moving into the crosswalk without fully blocking the crosswalk or forcing the pedestrian to change direction or move out of the way.

Vehicle violation included a clear violation of the pedestrian or bicyclist right of way, such as blocking a crosswalk or making a right turn in front of a bicyclist or pedestrian.

Vehicle/pedestrian and vehicle/bicyclist conflicts were defined by one of two events occurring: a pedestrian or bicyclist changing his or her speed or direction to avoid a perceived or real threat, or a vehicle stopping or swerving to avoid a pedestrian or bicyclist.

Pedestrian compliance with signals is defined as beginning the crossing on the WALK signal, and ending the crossing before the steady red hand/DON'T WALK signal. Bicyclist compliance with signals is defined as beginning a crossing on a green light and ending before a red light. Drivers were deemed non-compliant if they violated the pedestrian or bicyclist's right of way, or broke a traffic law (e.g. running a red light).

Pedestrian Form

Pedestrian Behavior Form

Location:		Corner:		Observer:														
Date:		Time Start:		End:		Weather:					Notes							
X walk Leg	Ped Observation					Begin Crossing				Finish Crossing				Out of crosswalk	Ped Action (R A W)**	Vehicle ? If yes, movement (L, R, etc.)	Vehicle violation ? *****	P.V. Conflict (?) If yes, Type
	Number	e, G=group	Sex (M/F)	Age (A-D)*	Pres'd PED button	W	RH/fDWRH/DW	RH/DW	RH/DW	W	RH/fDWRH/DW	RH/DW	RH/DW					
	1																	
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	
	11																	
	12																	
	13																	
	14																	
	15																	
	16																	
	17																	
	18																	
	19																	
	20																	
	21																	
	22																	
	23																	
	24																	
	25																	
	26																	
	27																	
	28																	
	29																	
	30																	
	31																	
	32																	
	33																	
	34																	
	35																	
	36																	
	37																	
	38																	
	39																	
	40																	

*A=0-9, B=10-17, C=18-64, D=65+//, **Run, Abort, Walk

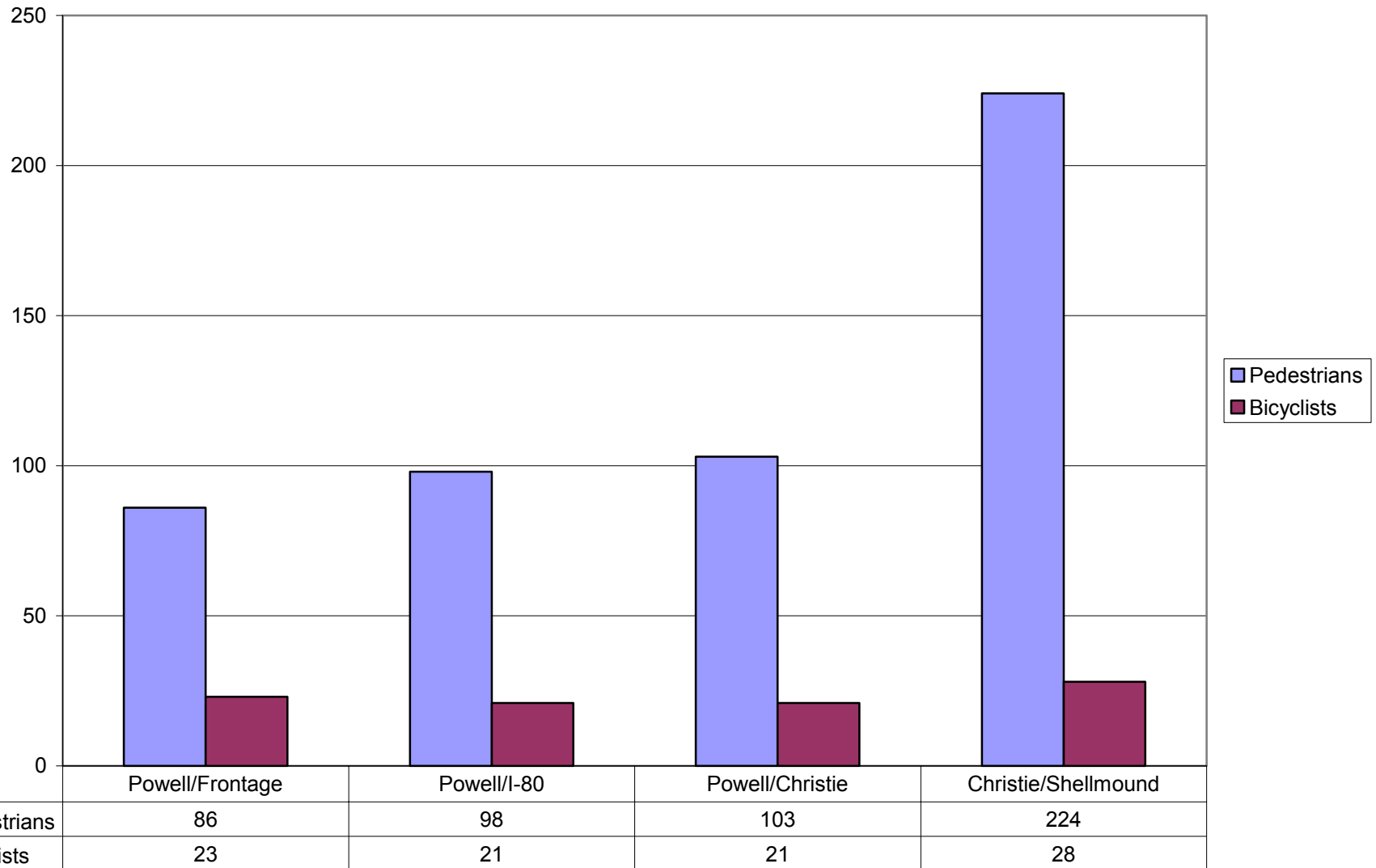
***(1)Ped changed gait or stride to avoid perceived/real threat, (2) Vehicle stops or swerves to avoid a pedestrian

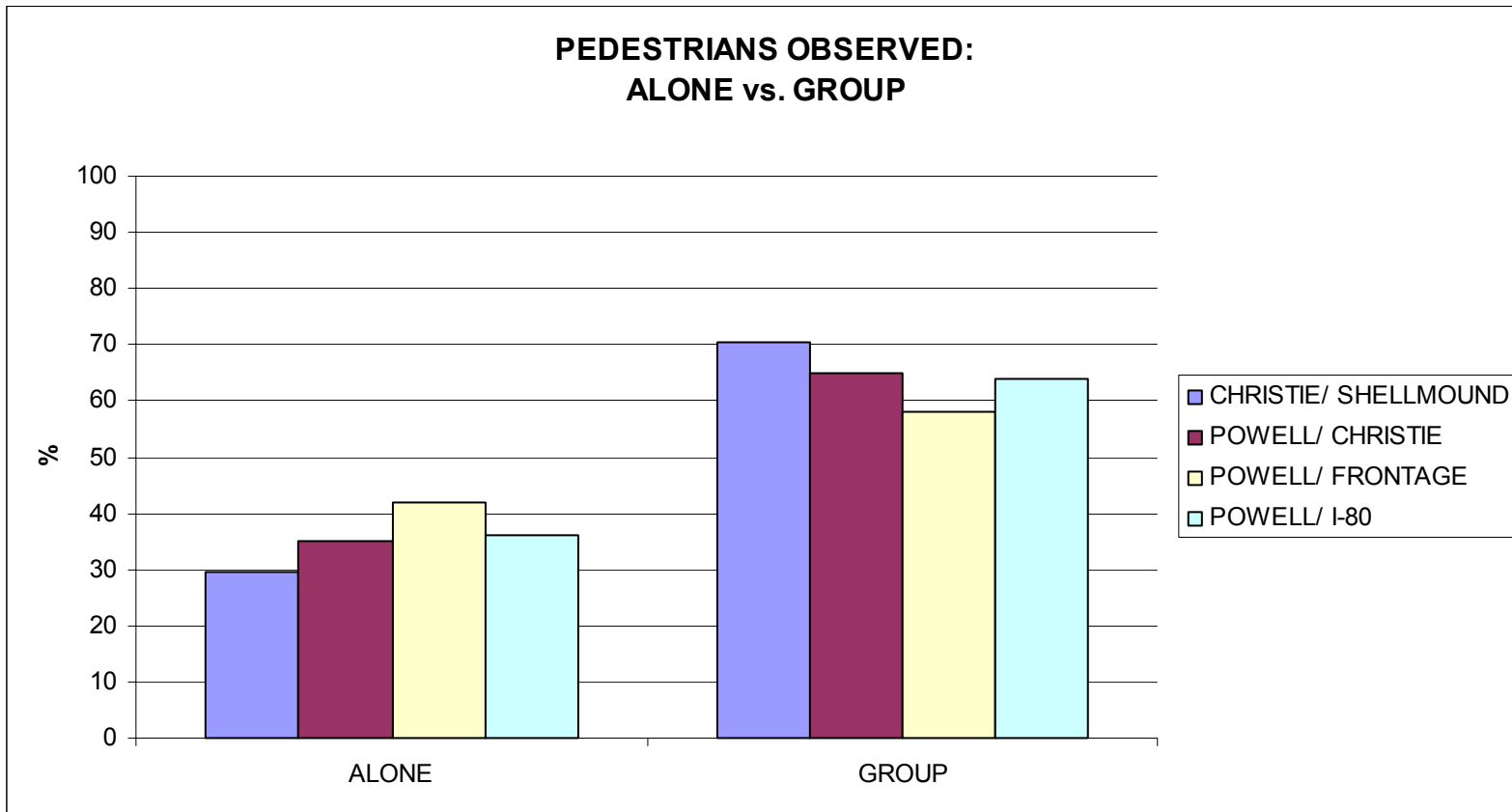
****Vehicle near/encroaching on PED during which maneuver Left, Right, Through/Straight

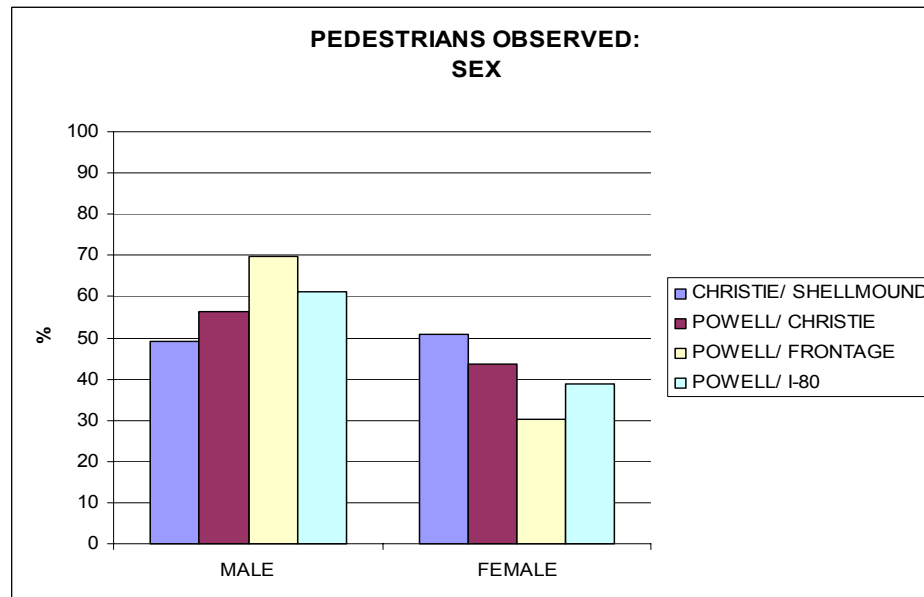
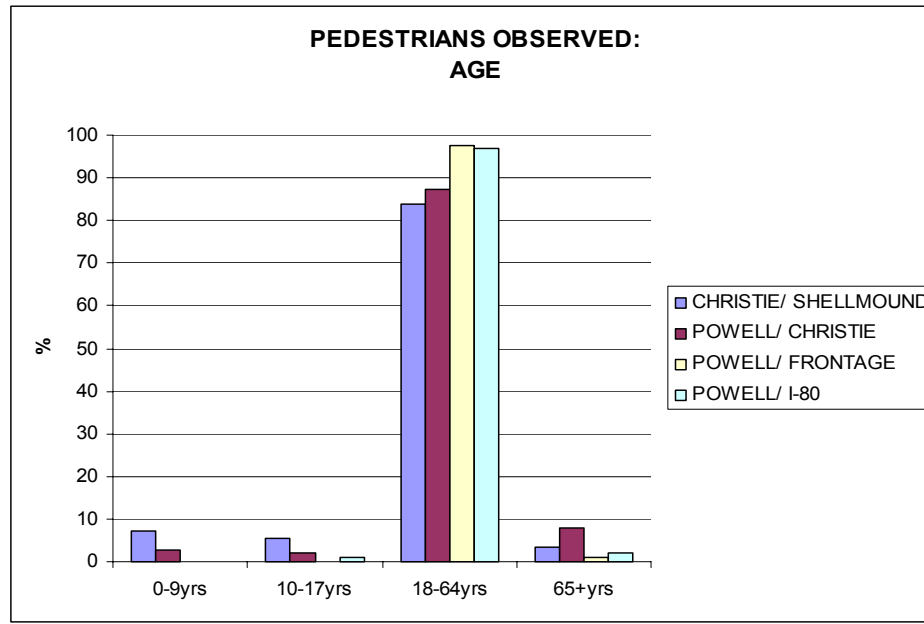
*****Vehicle violation: vehicle violates ped ROW, and/or breaks traffic law (e.g. runs red light)

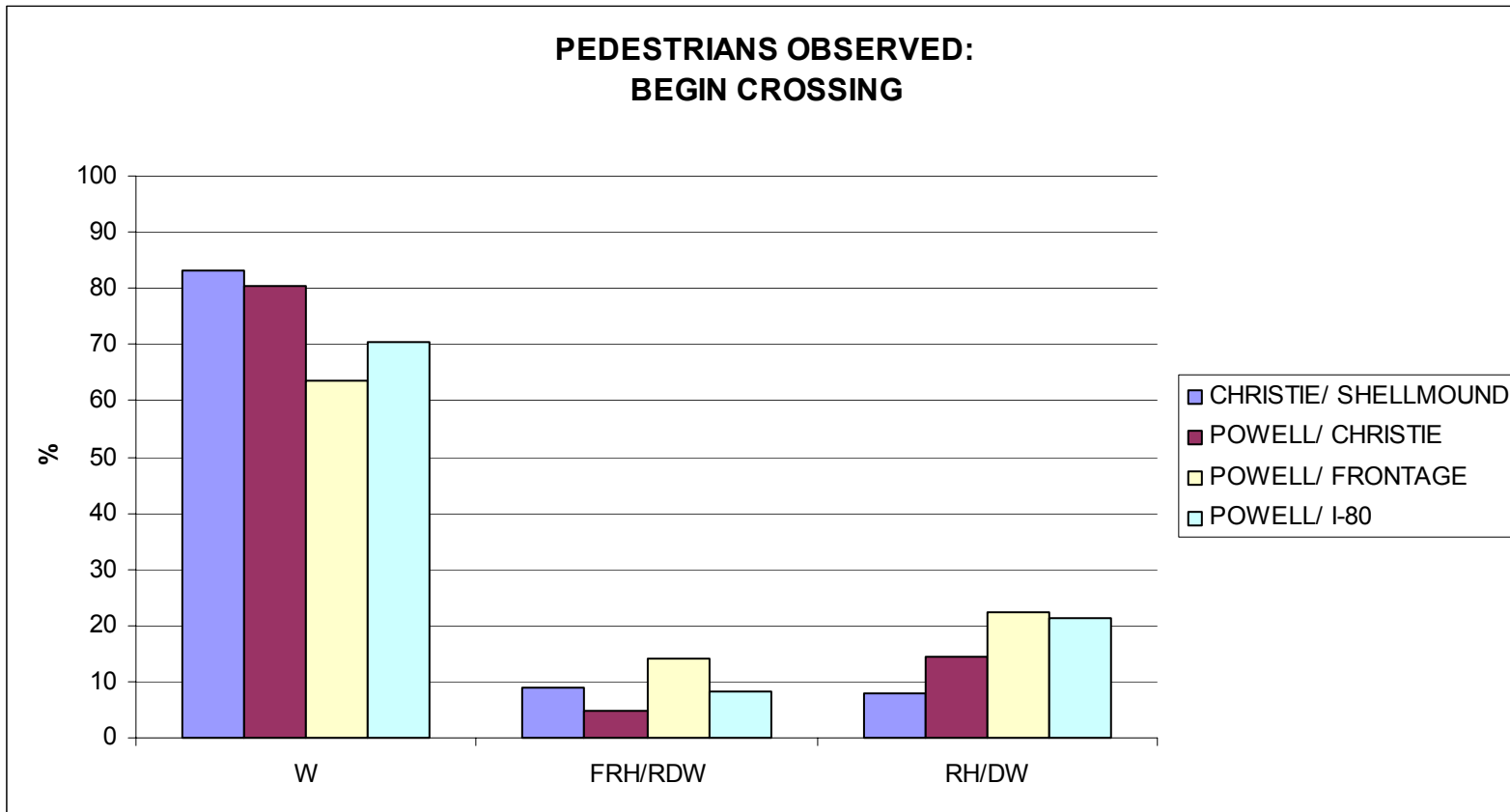
NOTE: Please make a footnote if a PED stops on a median island or if they are running but you are unsure if there is a safety concern.

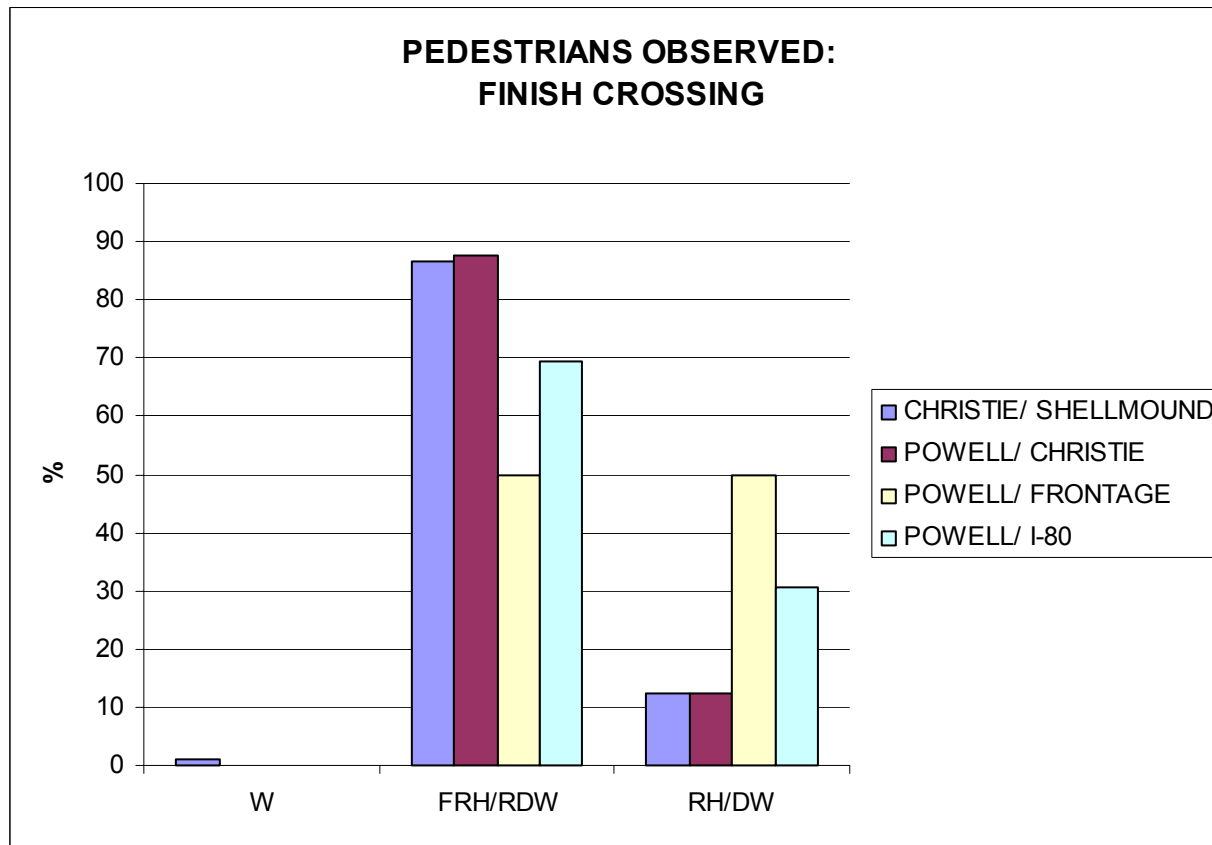
Pedestrian and Bicyclist Volumes (observed)

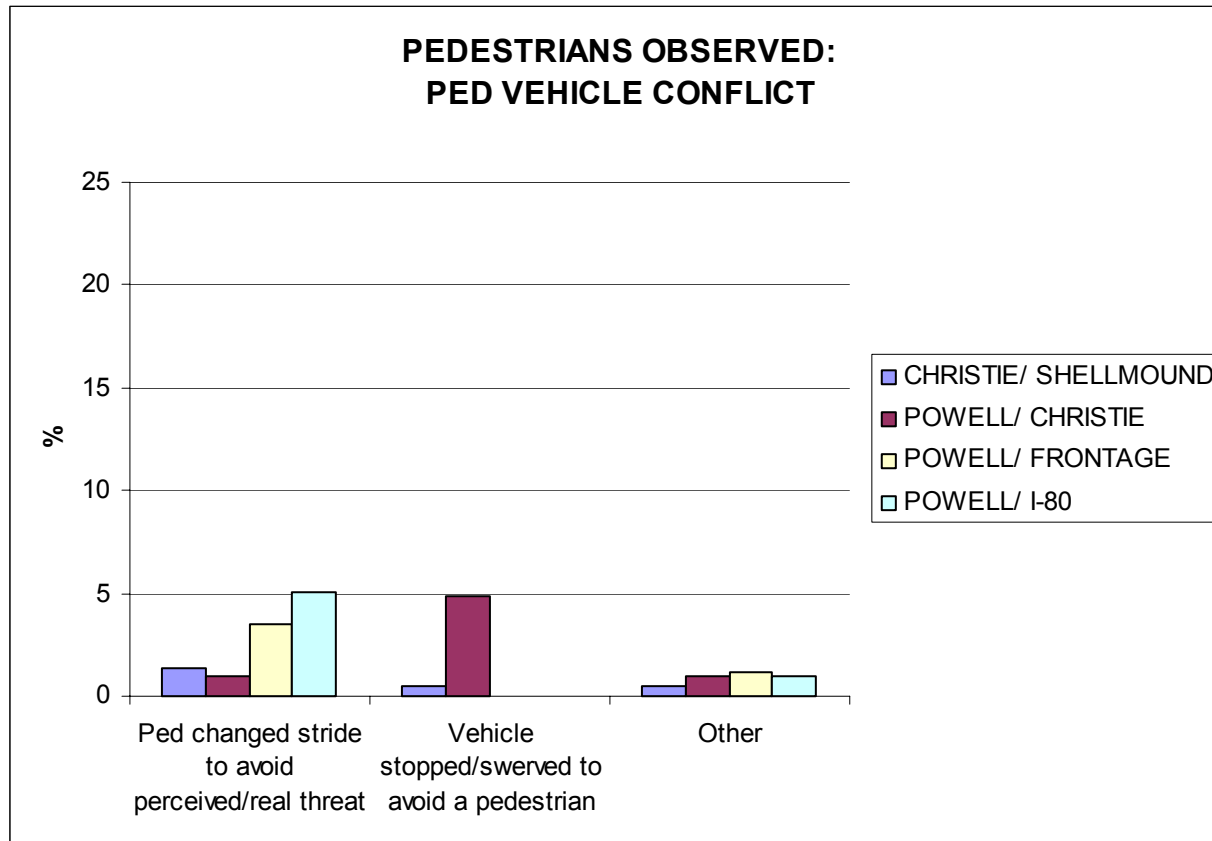


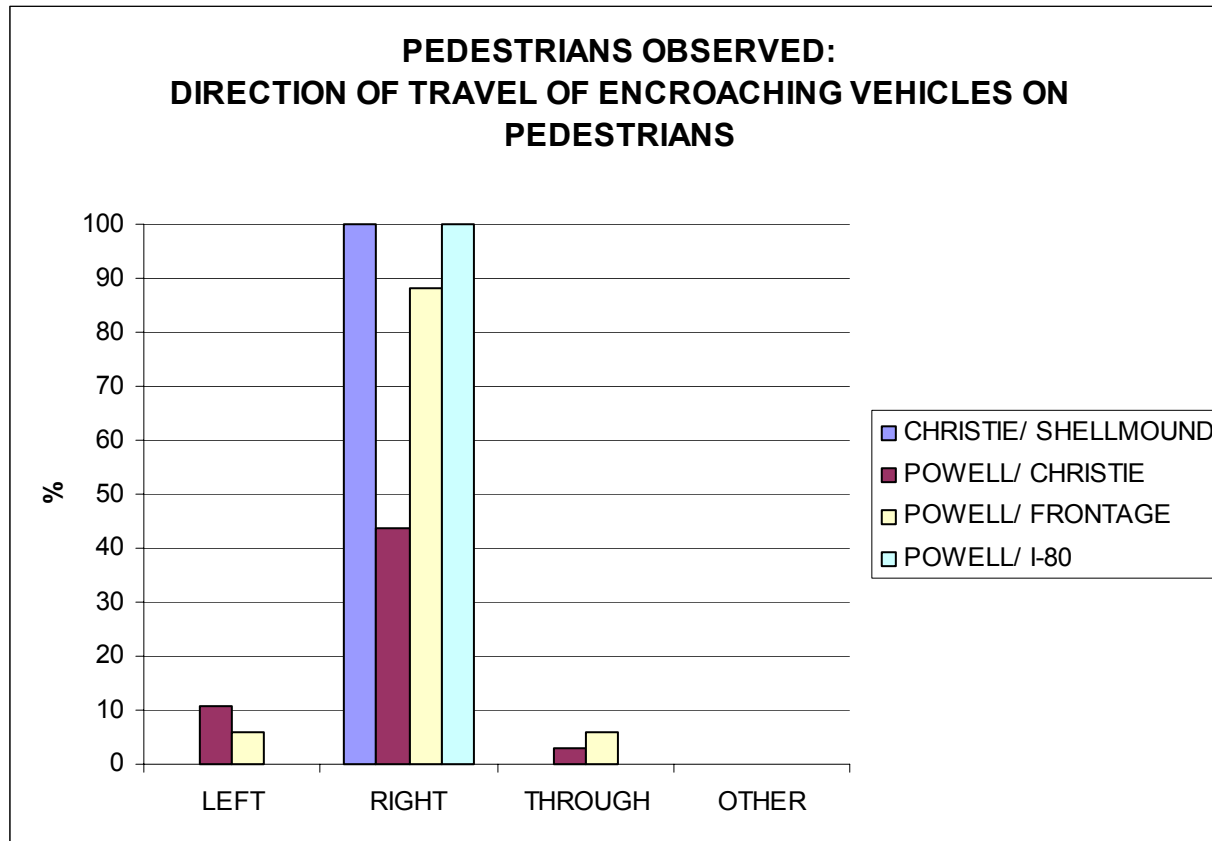


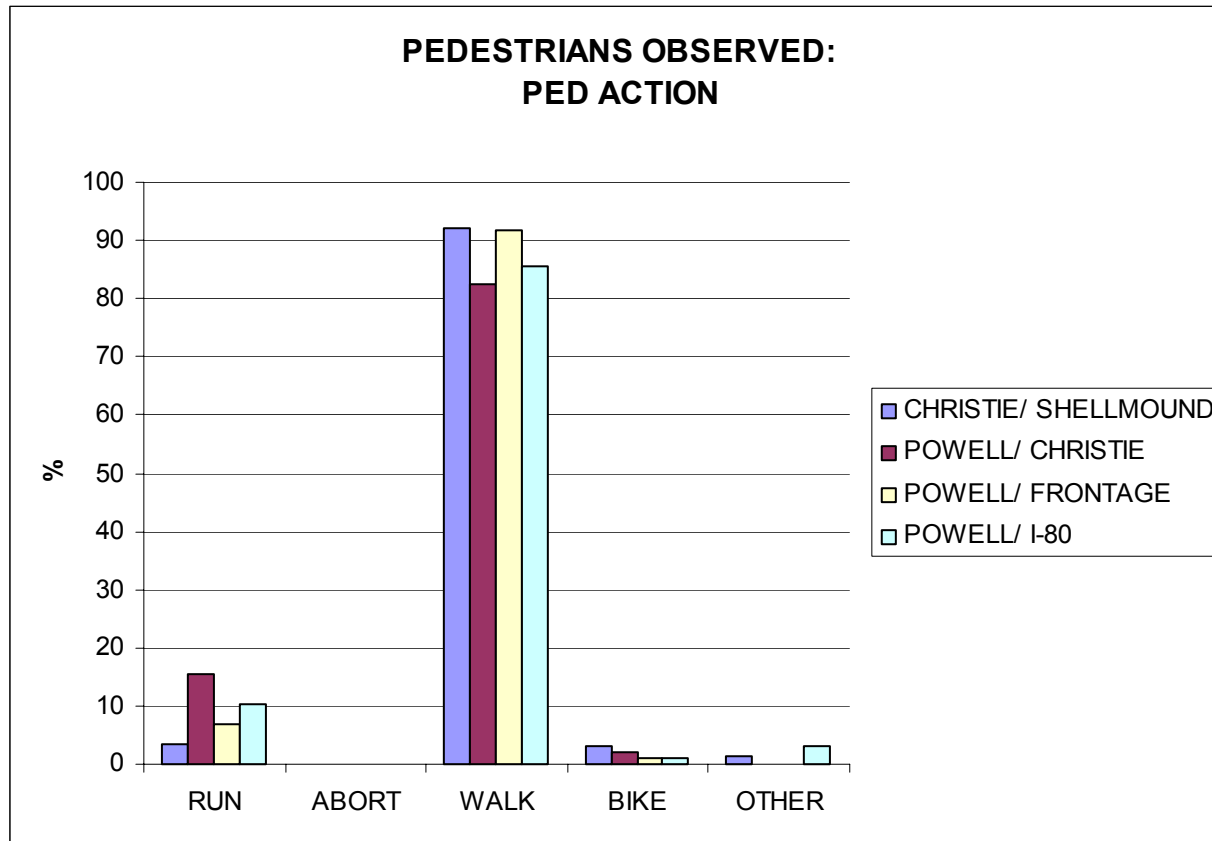


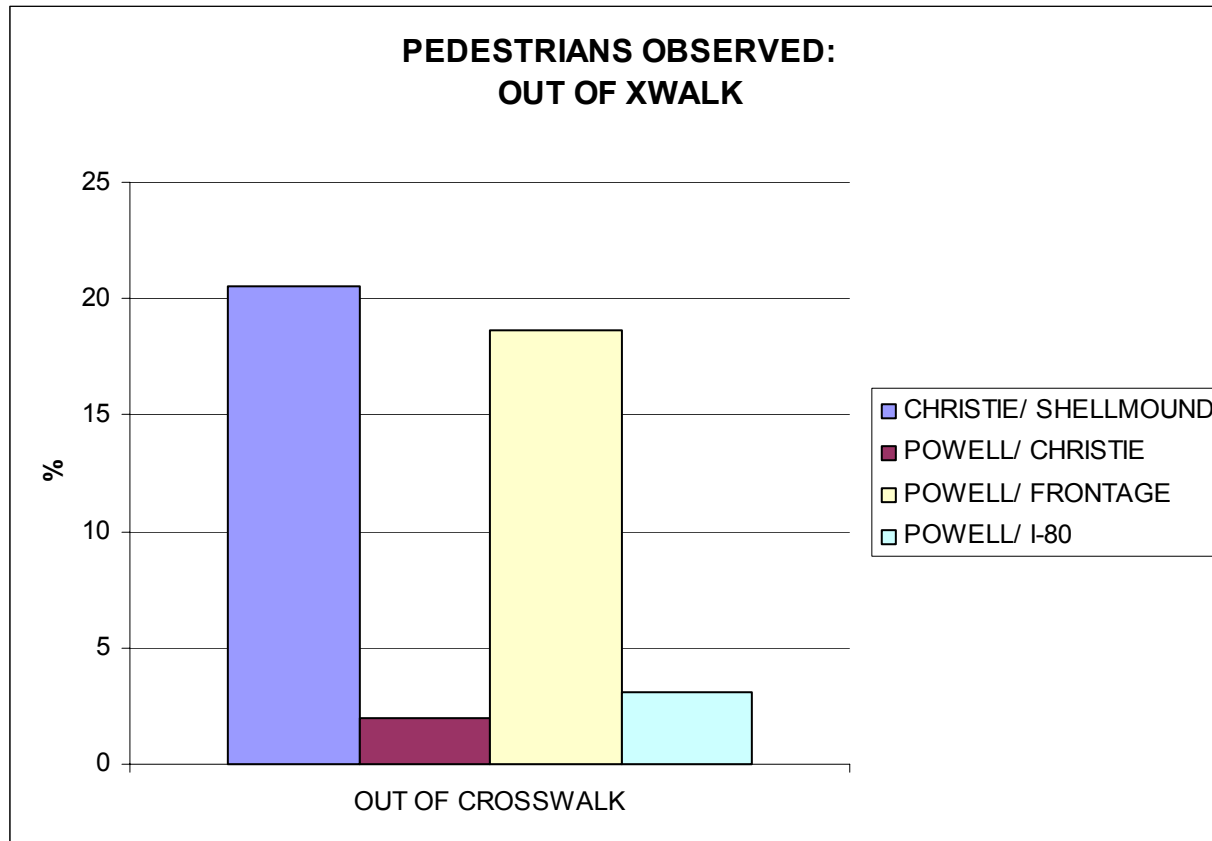


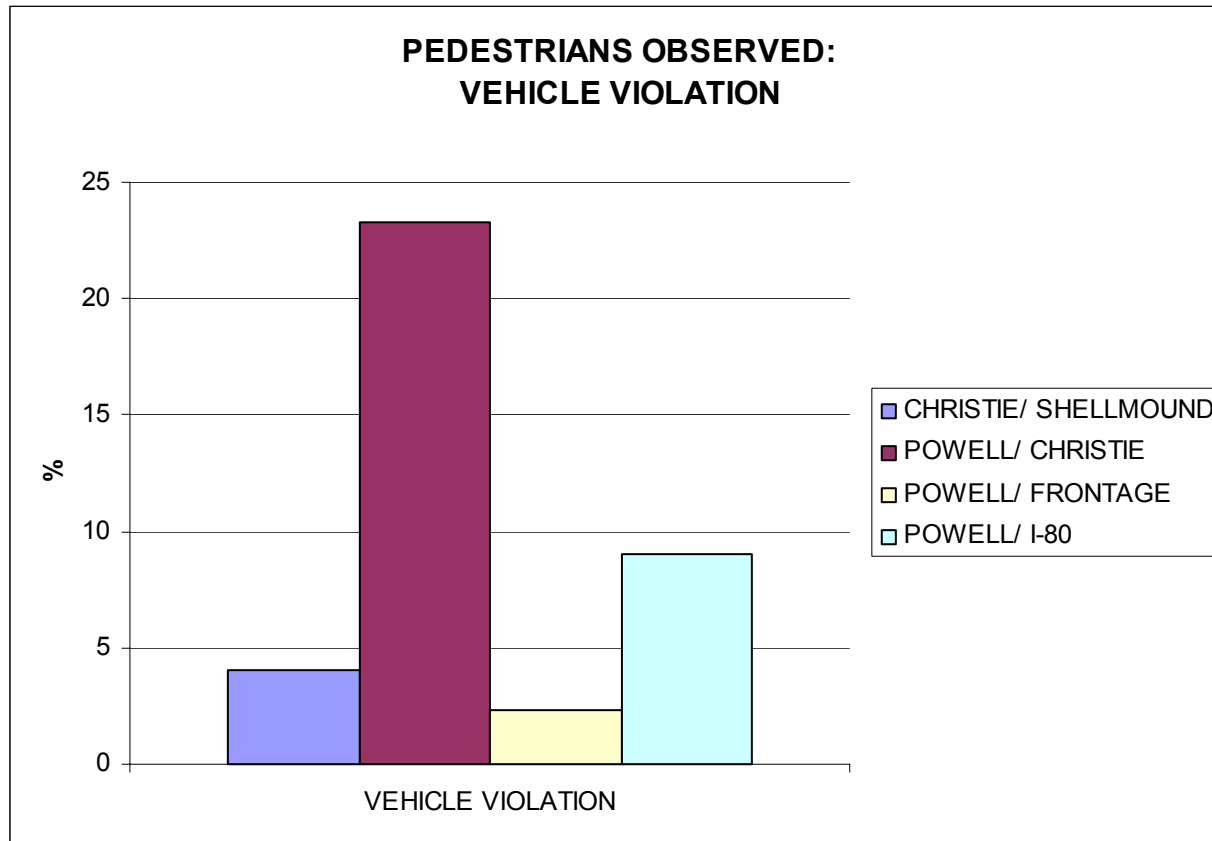


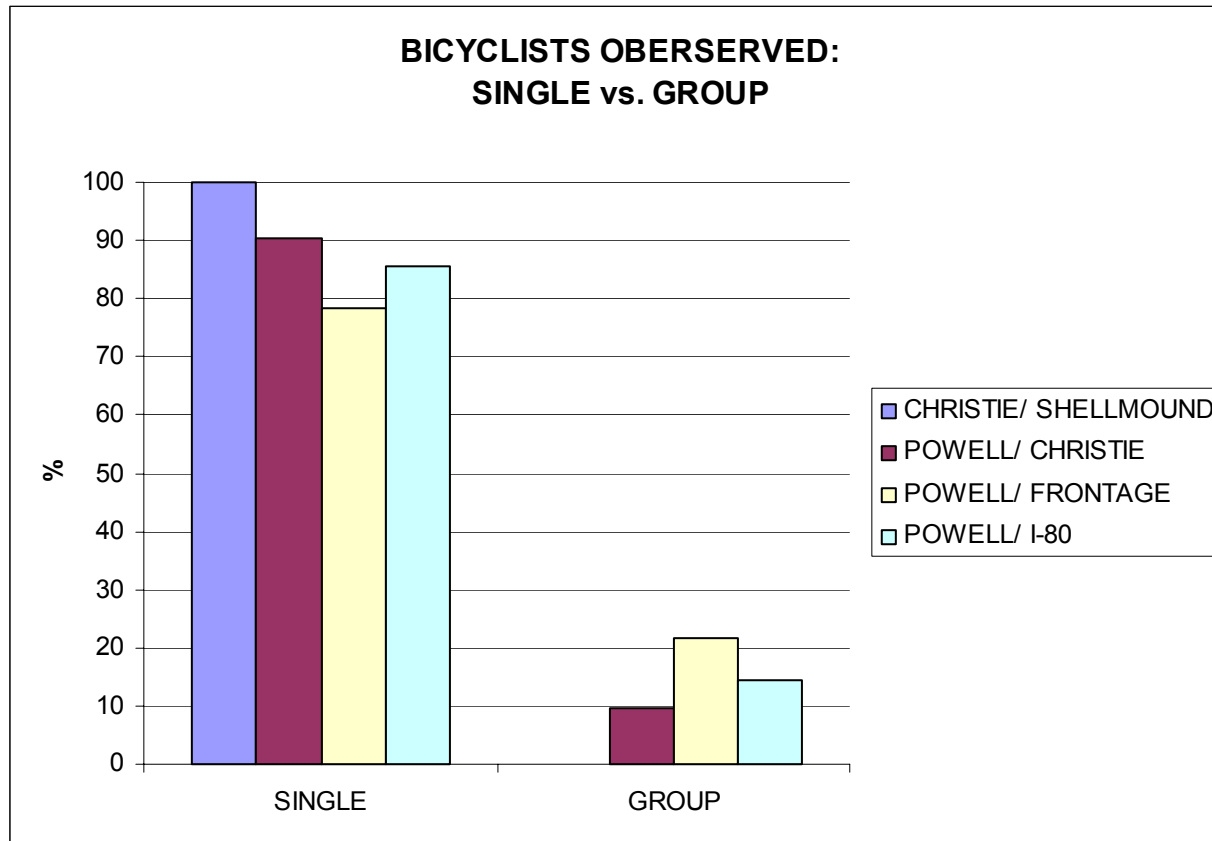


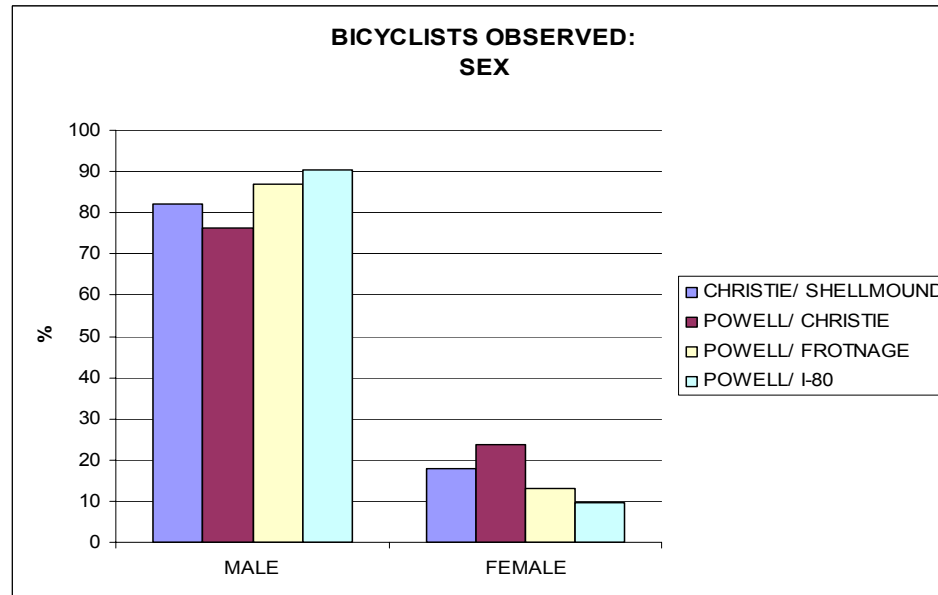
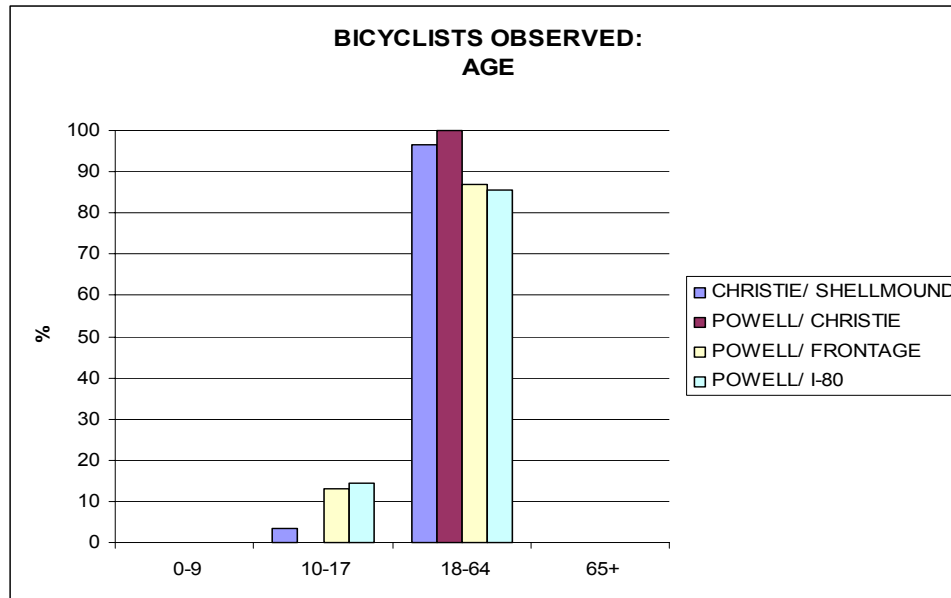


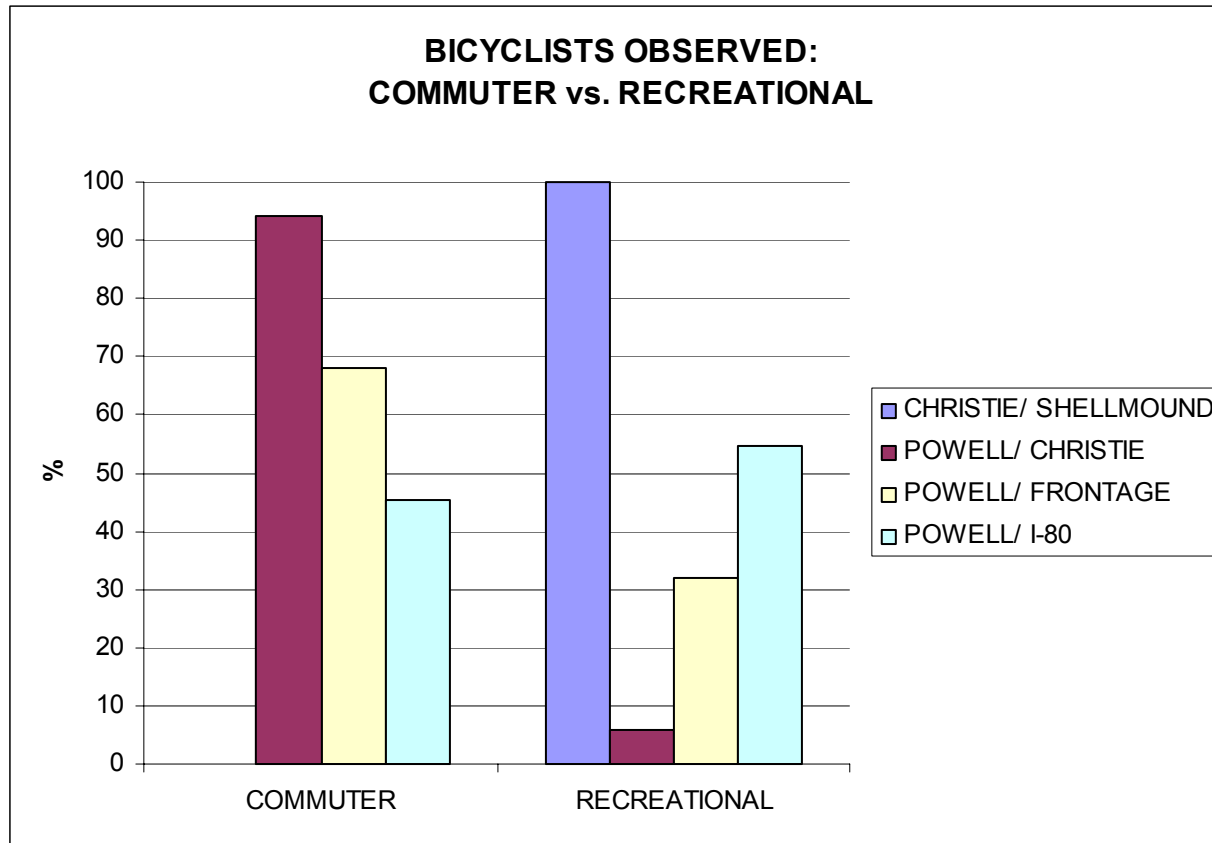


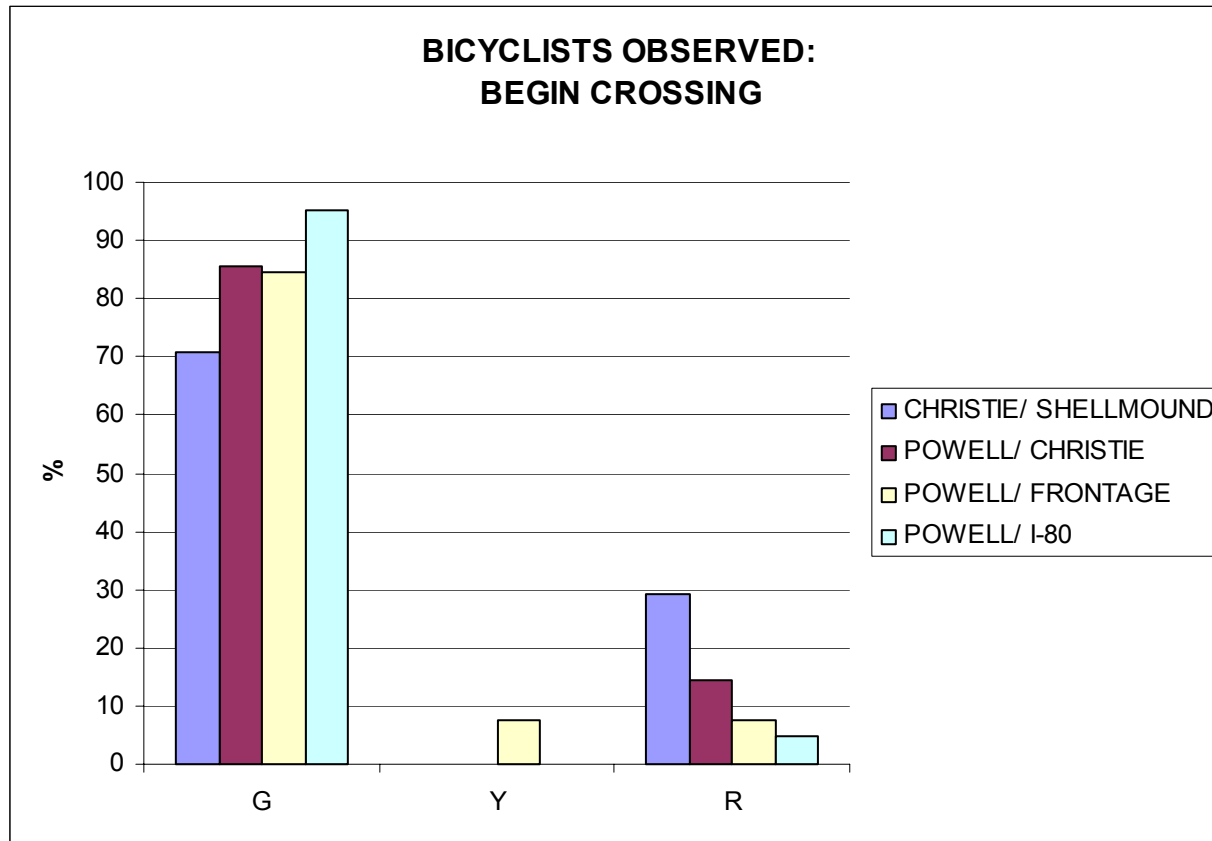


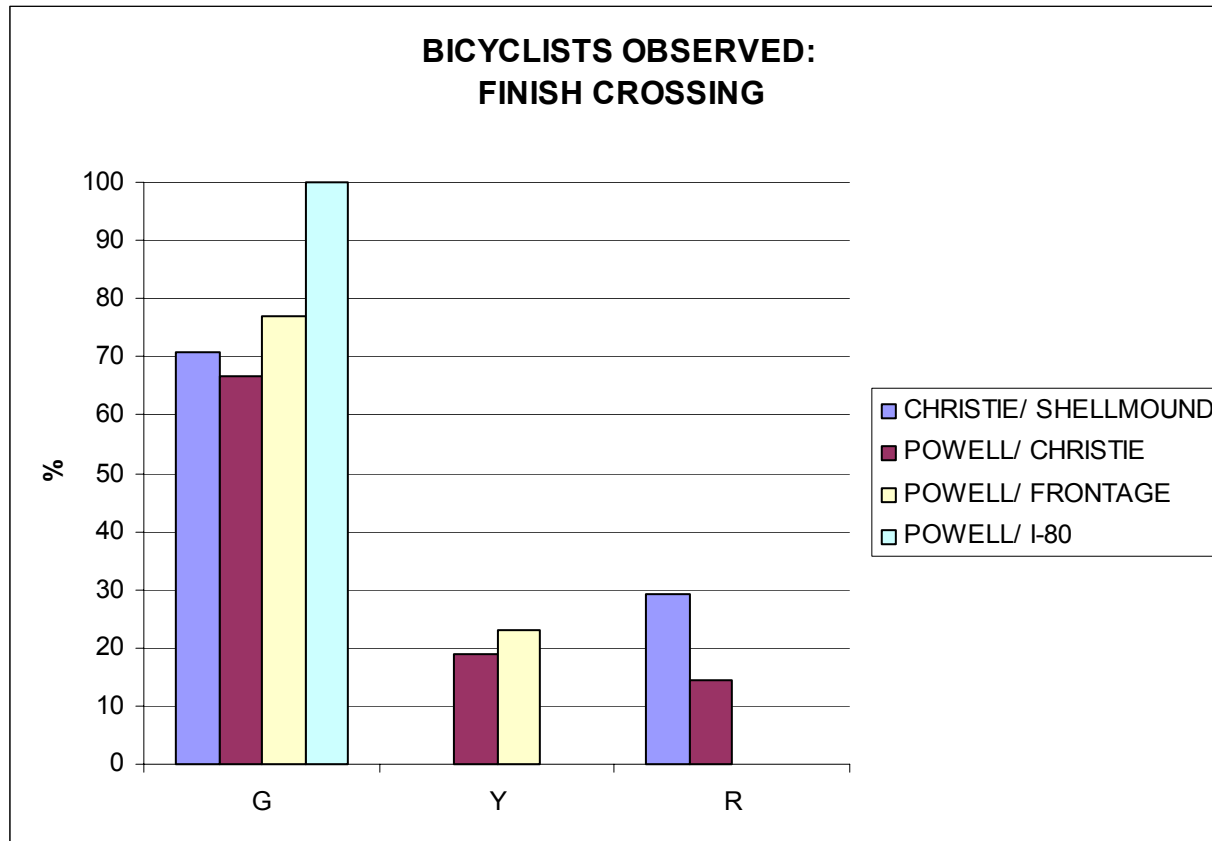


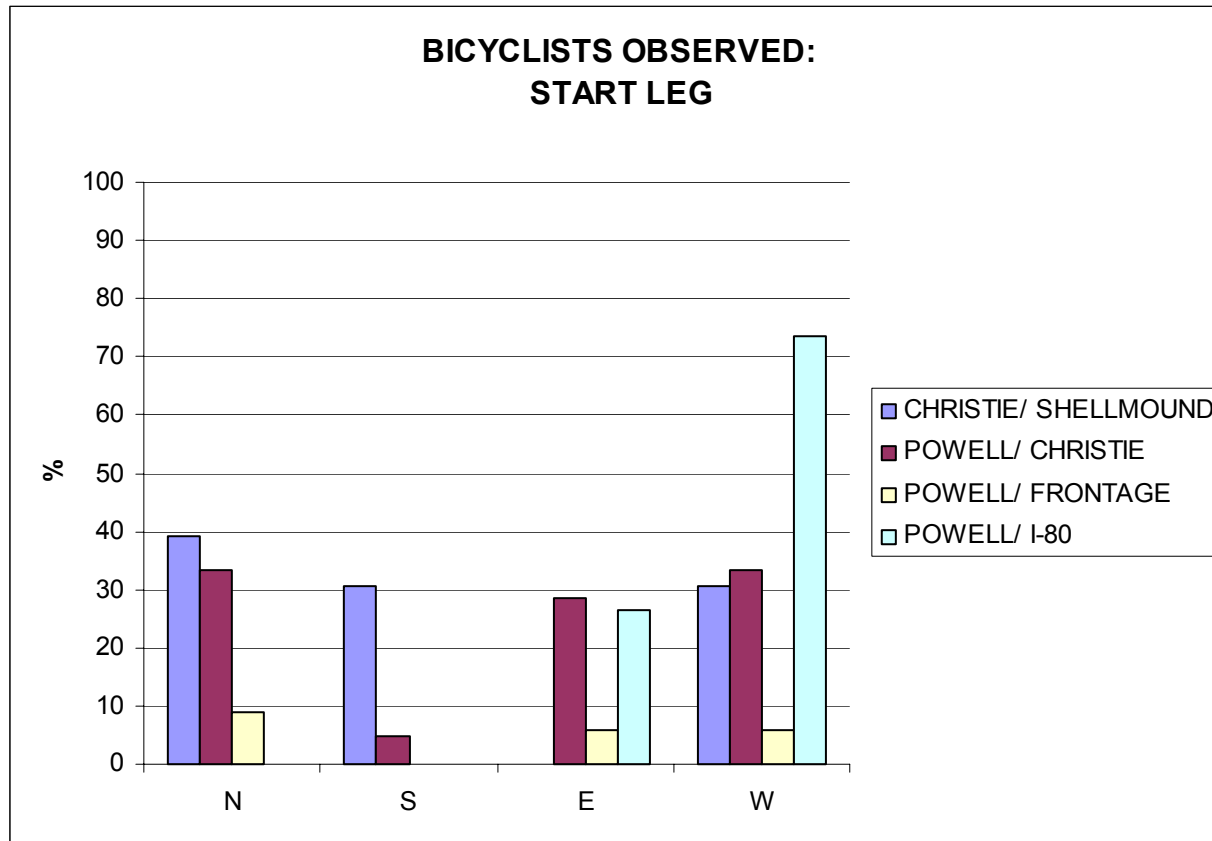


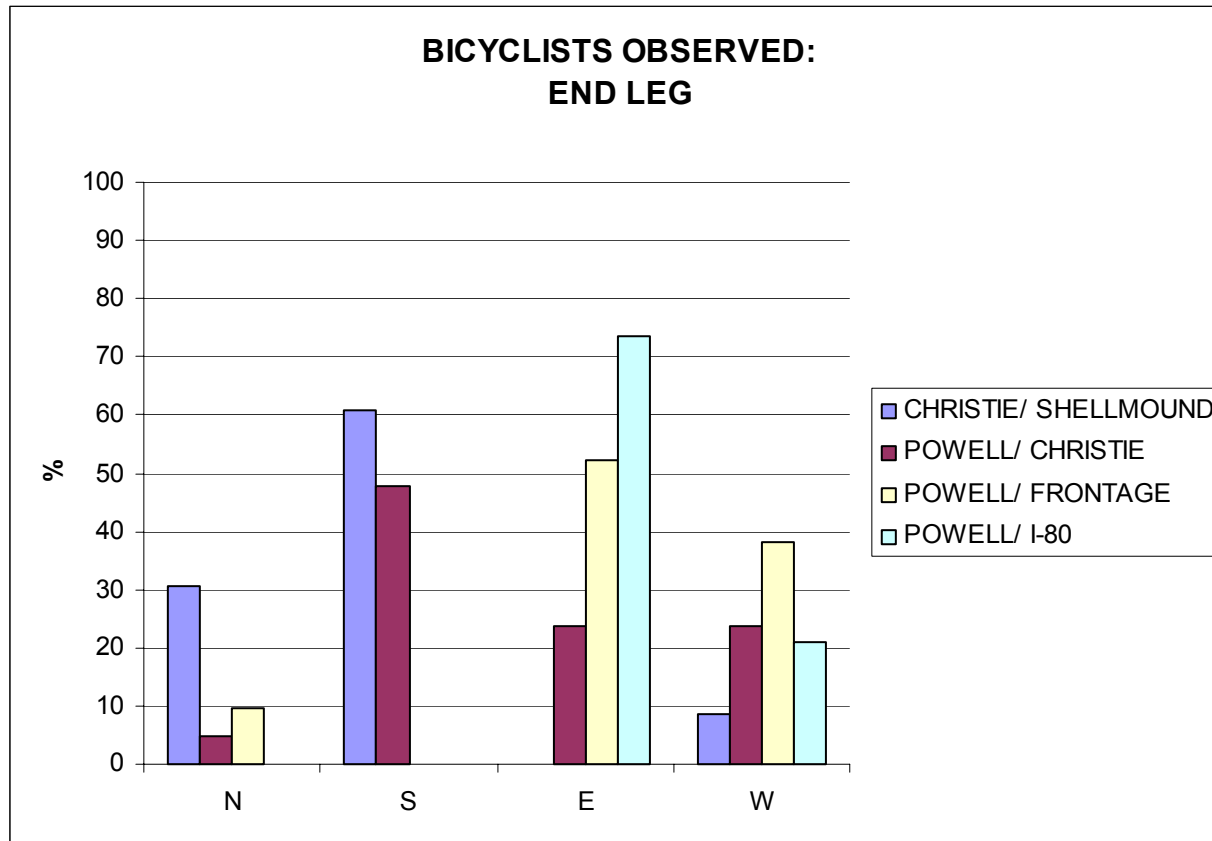


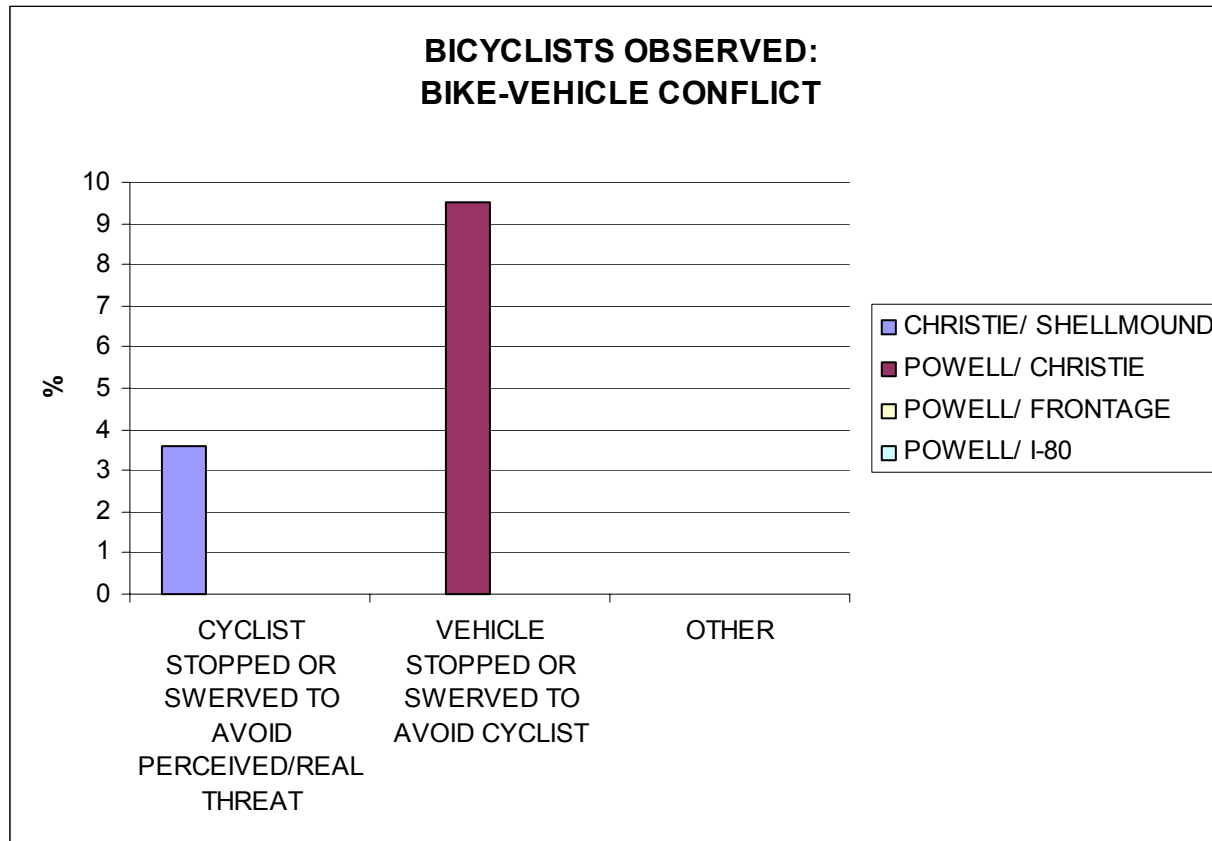


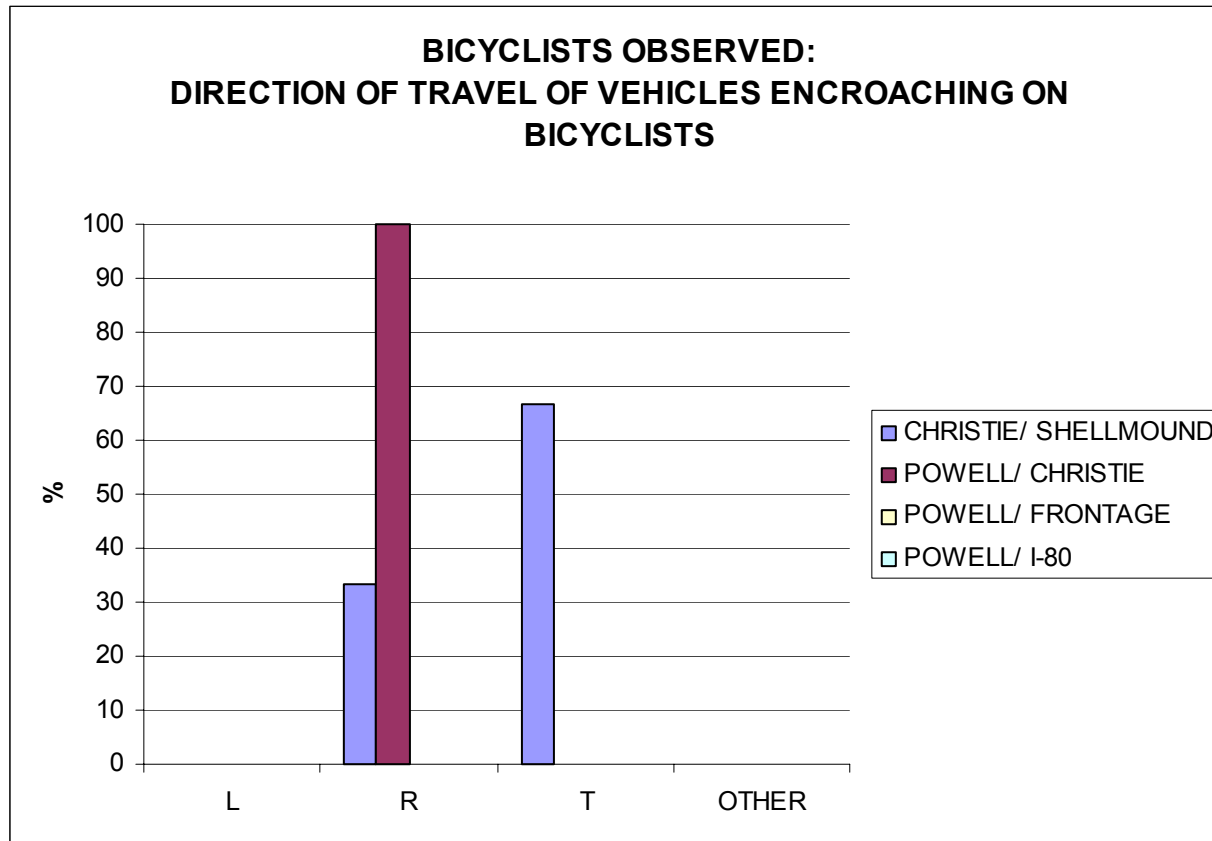


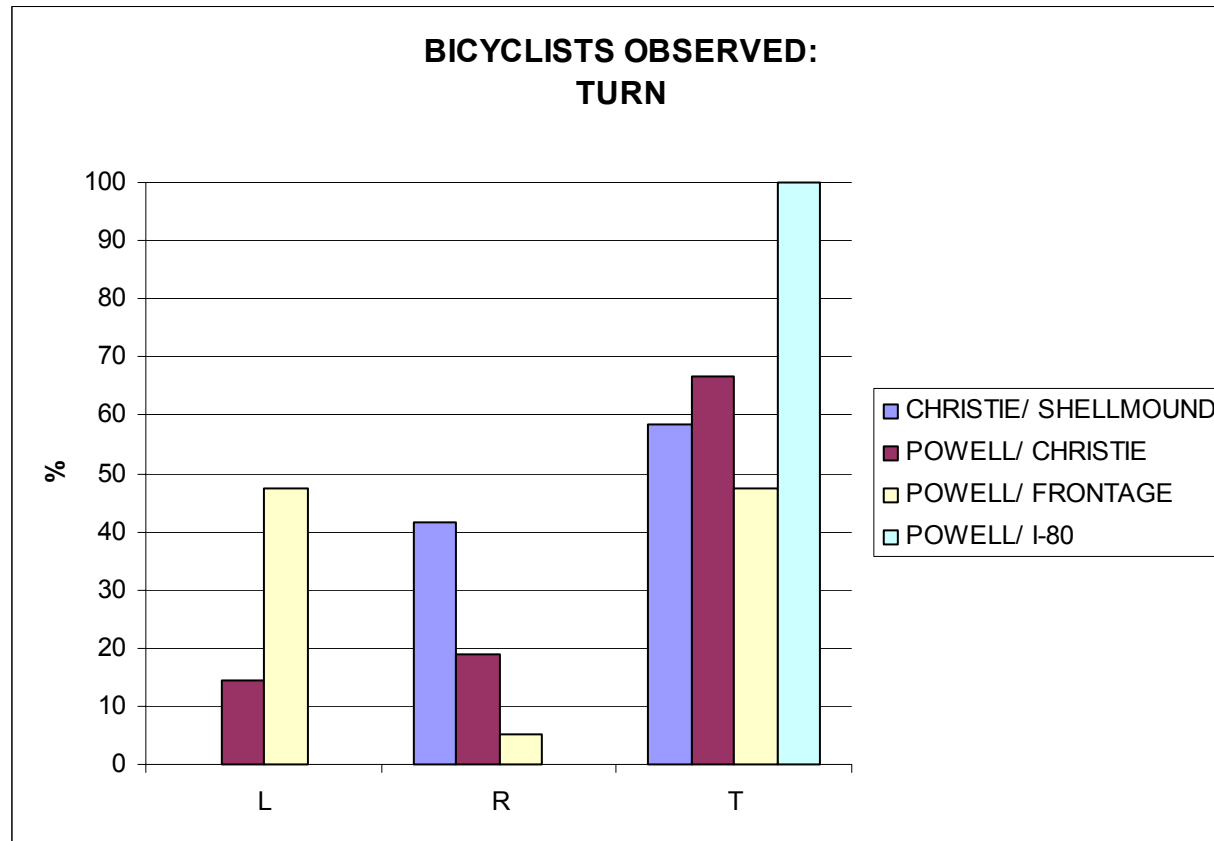


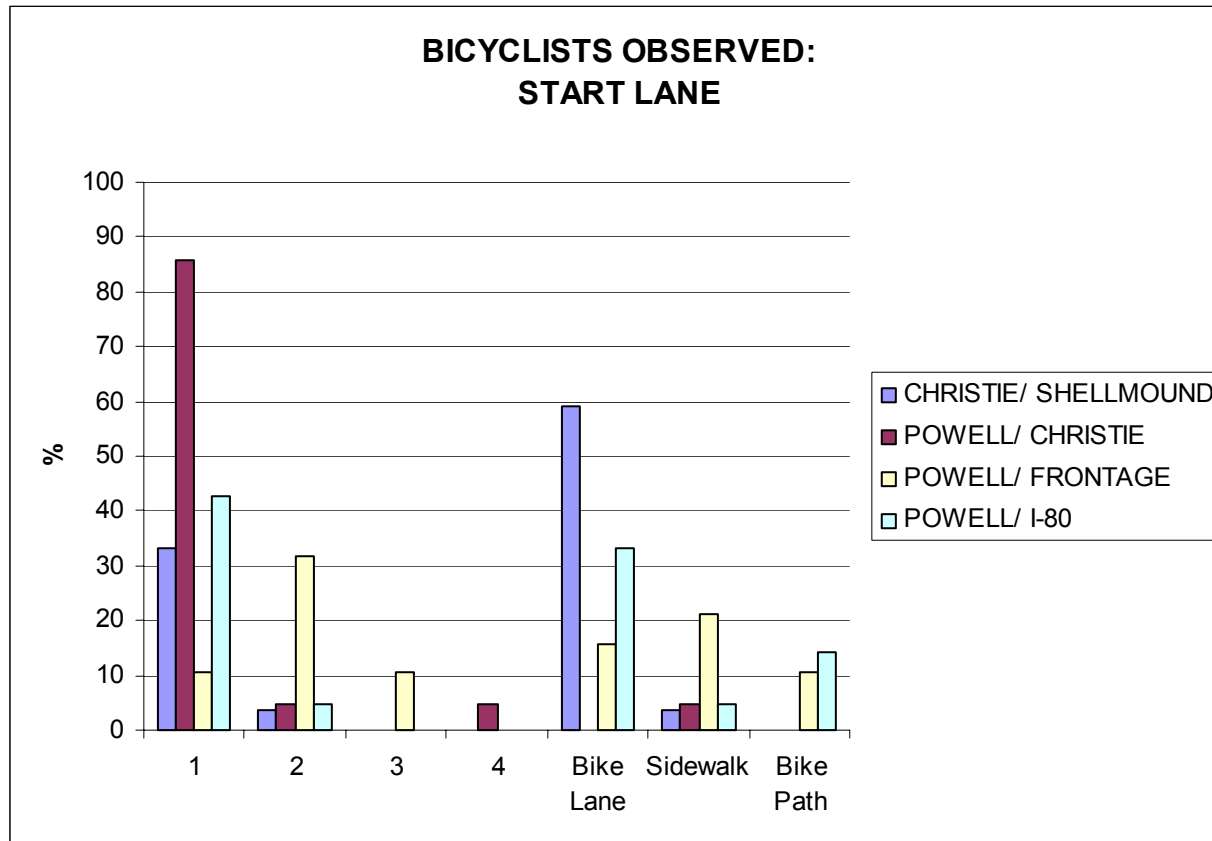


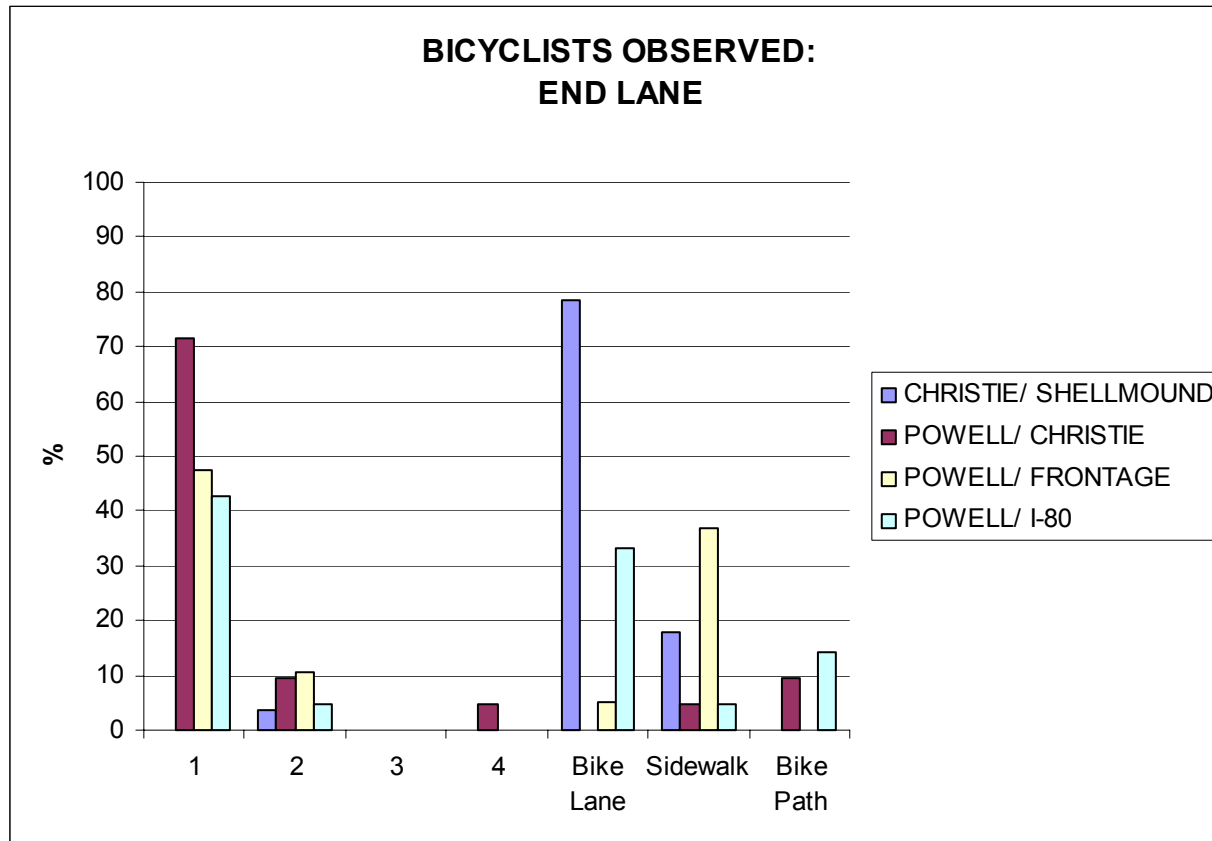


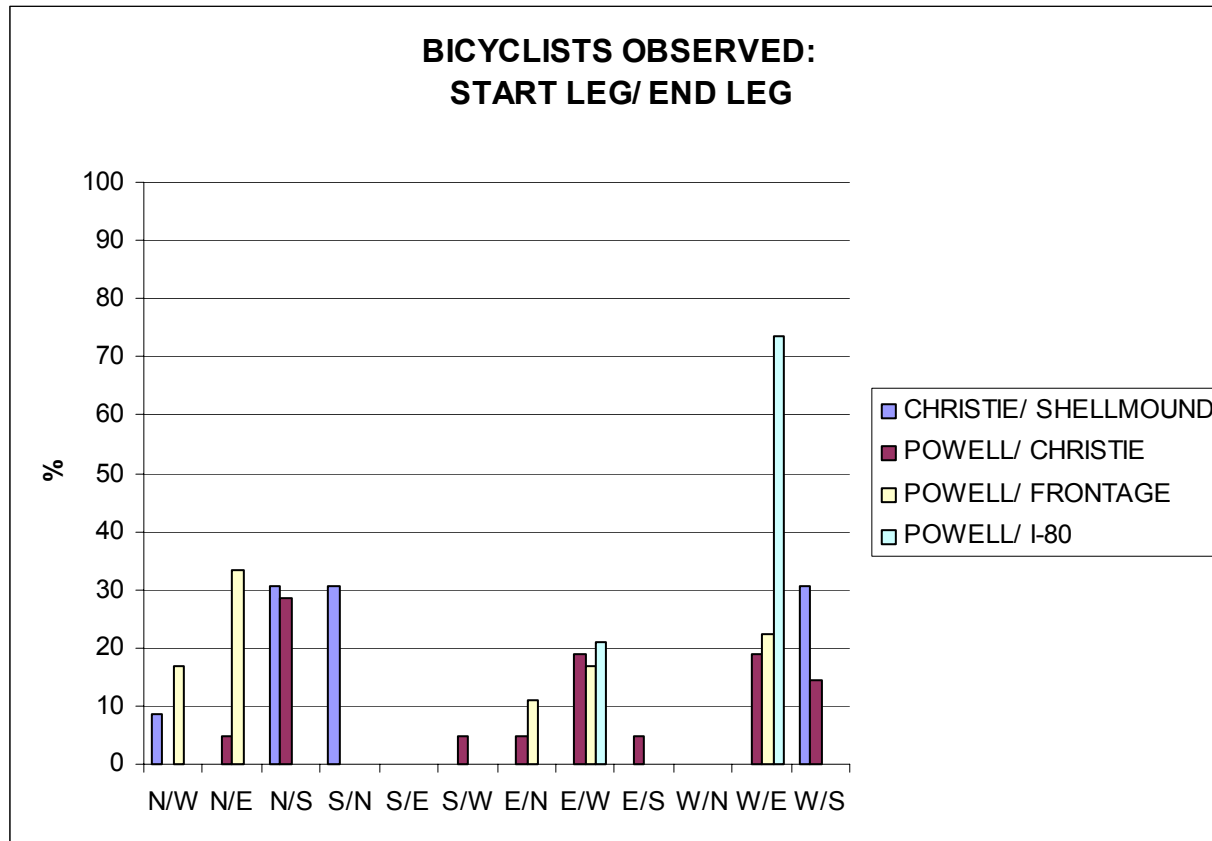












11.4. APPENDIX D: INFRASTRUCTURE OBSERVATIONS

Field Inspection Elements

- Striping, crosswalk and advance limit lines
- Lane configuration
- One-way streets
- Traffic signals
- Traffic restrictions (e.g. no right turn on red, no U-turn)
- Pedestrian signals and countdown signals
- Pedestrian safety specific signs
- Detectable boundary between sidewalk and street
- Parking locations
- Street light locations
- Possible sight obstructions
- Curb ramps
- Items protruding into travel routes
- Sidewalk width
- Driveway locations
- Posted speed limits
- Bus stop locations
- Median islands
- Adjacent land uses

Accessibility Survey Checklist						
Intersection: POWELL & FRONTAGE						
Date:						
Crossing/Connector:		North:	South:	East:	West:	
1	Confirm striping, xwalk & advance limit lines (clear(C) or faded (F))	E	F	C	N	C
		W	F		S	C
	Number of Lanes					
	Lane Configuration (Left Turn) (count of lanes)	E			N	
		W			S	1
	Lane Config (Through) (count of lanes)	E	2		N	2
		W	1	1	S	2
	Lane Config (Right Turn) (count of lanes)				N	
						2
2	One-Way (y/n)					
	Traffic Signals (and restrictions), Signalized (y/n)					
	Left-turn Phase (y/n)					
	No Right Turn on Red Restriction (y/n)					
	No U-Turn (y/n)					
	Pedestrian signal head (y/n)	E	N		N	
		W	Y	Y	S	Y
3	Pedestrian signal head, countdown (y/n)					
4	Ped signal timing (4ft/sec), 2.5 ft/sec covers 95 of peds (N/A)	E			N	
		W			S	
5	Street crossing design should ensure that the boundary between the sidewalk and the street is detectable. Pedestrian crossing information should be available to all users. (tactile strips, etc.) (y/n)	E	Y		N	
		W	Y		S	
6	Level of ped traffic outside crosswalk or against signal (N/A)	E			N	
		W			S	
7	Parking locations & Approx locations from intersection, meters & towaways (distance, ft)	E			N	
		W			S	
8	Street light exist/adequate (y/n)	E			N	
		W			S	
9	Possible sight (LOS) obstructions (y/n)	E	Y		N	
		W			S	
10	ADA compliant curb ramps, w>=3ft, crosslopes 2%, level landing (y/n)	E	Y	Y	N	Y
		W	Y	Y	S	Y
11	Is foot of a curb ramp contained within the crosswalk markings (y/n)?	E			N	
		W			S	

12	Do Street furniture, plantings, and other fixed items protrude into travel routes? (y/n) (Bad for	E			N		
		W			S		
13	Sidewalks passable for wheelchairs? w>=3ft, 5ft (60 in) turning/passing (mobility)	E	Y	Y	N		Y
		W	Y		S		Y
14	Sidewalk obstructions, plantings furniture, etc. inhibit ped and wheelchair mobility? 3ft-5ft (y/n)	E			N		
		W			S		
15	Curb return radius <20 ft? encourage high speed and long crossing (y/n)	E			N		
		W			S		
16	Driveway entrances within 100 ft of intersection (y/n)	E			N		
		W			S		
17	Posted speed limits nearby? Where?						
18	Are Pedestrian facilities on and along sidewalks accessible? Signal actuating buttons, drinking fountains, telephones, kiosks, and other pedestrian elements should meet accessibility criteria for approach and maneuvering space, reach range, and controls and operation. (y/n/NA)	E			N		
		W			S		
19	Bus stop locations (shelters, other struct. If within 100 feet =yes, otherwise no)	E	N	N	N	N	N
		W			S		
20	Existing median (size) ? (in feet) Is median suitable for a refuge? (y/n)	E					
		W					
21	Possible 4ft median insert w/10ft lanes (lane reduction) (y/n)?						
22	Potential for curb bulbs (towaways, bus stops, utilities, drains, poles)	E			N		
		W			S		
23	Adjacent land uses (up to 2 blocks away) Residential, Commercial, Industrial, School, Government (R, C, I, S, G) comma delimited	E			N		
		W			S		

Accessibility Survey Checklist						
Intersection: POWELL & I-80						
Date: 7/31/04						
Crossing/Connector:		North:	South:	East:	West:	
1	Confirm striping , xwalk& advance limit lines (clear(C) or faded (F))	E	C	C	N	C
		W	C	C	S	C
	Number of Lanes					
	Lane Configuration (Left Turn) (count of lanes)	W	1	1		
	Lane Config (Through) (count of lanes)	W	1	3	N	3
	Lane Config (Right Turn) (count of lanes)	W	2		N	1
2	One-Way (y/n)					
	Traffic Signals (and restrictions), Signalized (y/n)		Y	Y		Y
	Left-turn Phase (y/n)					
	No Right Turn on Red Restriction (y/n)					
	No U-Turn (y/n)					
	Pedestrian signal head (y/n)	W		Y	N	Y
3	Pedestrian signal head, countdown (y/n)					
4	Ped signal timing (4ft/sec), 2.5 ft/sec covers 95 of peds (N/A)	E			N	
		W			S	
5	Street crossing design should ensure that the boundary between the sidewalk and the street is detectable. Pedestrian crossing information should be available to all users. (tactile strips, etc.) (y/n)	E	N		N	
		W	N	Y	S	
6	Level of ped traffic outside crosswalk or against signal (N/A)	E			N	
		W			S	
7	Parking locations & Approx locations from intersection, meters & towaways (distance, ft)	E			N	
		W			S	
8	Street light exist/adequate (y/n)	E			N	Y
		W	Y	Y	S	Y
9	Possible sight (LOS) obstructions (y/n)	E			N	
		W			S	
10	ADA compliant curb ramps, w>=3ft, crosslopes 2%, level landing (y/n)	E			N	
		W			S	
11	Is foot of a curb ramp contained within the crosswalk markings (y/n)?	E	Y		N	
		W			S	

12	Do Street furniture, plantings, and other fixed items protrude into travel routes? (y/n) (Bad for	E	N	N	N	N	N
		W			S		
13	Sidewalks passable for wheelchairs? w>=3ft, 5ft (60 in) turning/passing (mobility)	E	Y	Y	N	Y	Y
		W			S		
14	Sidewalk obstructions, plantings furniture, etc. inhibit ped and wheelchair mobility? 3ft-5ft (y/n)	E			N		
		W	N		S		
15	Curb return radius <20 ft? encourage high speed and long crossing (y/n)	E			N		
		W	N		S		
16	Driveway entrances within 100 ft of intersection (y/n)	E			N		
		W	N		S		
17	Posted speed limits nearby? Where?		N				
18	Are Pedestrian facilities on and along sidewalks accessible? Signal actuating buttons, drinking fountains, telephones, kiosks, and other pedestrian elements should meet accessibility criteria for approach and maneuvering space, reach range, and controls and operation. (y/n/NA)	E	Y		N		
		W			S		
19	Bus stop locations (shelters, other struct. If within 100 feet =yes, otherwise no)	E	N		N		
		W	N		S		
20	Existing median (size) ? (in feet) Is median suitable for a refuge? (y/n)						
21	Possible 4ft median insert w/10ft lanes (lane reduction) (y/n)?						
22	Potential for curb bulbs (towaways, bus stops, utilities, drains, poles)	E			N		
		W			S		
23	Adjacent land uses (up to 2 blocks away) Residential, Commercial, Industrial, School, Government (R, C, I, S, G) comma delimited	E			N		
		W			S		

Accessibility Survey Checklist						
Intersection: POWELL & CHRISTIE						
Date: 7/31/04						
Crossing/Connector:		North:	South:	East:	West:	
1	Confirm striping , xwalk& advance limit lines (clear(C) or faded (F))	E		N		
		W		F	S	F
	Number of Lanes					
	Lane Configuration (Left Turn) (count of lanes)	E	2	S	1	2
	Lane Config (Through) (count of lanes)	E	1	S	2	1
	Lane Config (Right Turn) (count of lanes)	E	1	S	1	2
2	One-Way (y/n)					
	Traffic Signals (and restrictions), Signalized (y/n)					
	Left-turn Phase (y/n)					
	No Right Turn on Red Restriction (y/n)					
	No U-Turn (y/n)					
	Pedestrian signal head (y/n)					
	3	Pedestrian signal head, countdown (y/n)				
4	Ped signal timing (4ft/sec), 2.5 ft/sec covers 95 of peds (N/A)	E		N		
		W		S		
5	Street crossing design should ensure that the boundary between the sidewalk and the street is detectable. Pedestrian crossing information should be available to all users. (tactile strips, etc.) (y/n)	E	Y	N		
		W		S		
6	Level of ped traffic outside crosswalk or against signal (N/A)	E	LOW	N		LOW
		W		S		
7	Parking locations & Approx locations from intersection, meters & towaways (distance, ft)	E	N/A	N		N/A
		W		S		
8	Street light exist/adequate (y/n)	E	Y	N	Y	Y
		W		S		
9	Possible sight (LOS) obstructions (y/n)	E	N	N	N	N
		W	N	N	S	N
10	ADA compliant curb ramps, w>=3ft, crosslopes 2%, level landing (y/n)	E	Y	N		
		W		S		
11	Is foot of a curb ramp contained within the crosswalk markings (y/n)?	E	Y	N	Y	Y
		W		S		

12	Do Street furniture, plantings, and other fixed items protrude into travel routes? (y/n) (Bad for	E			N		
		W			S		
13	Sidewalks passable for wheelchairs? w>=3ft, 5ft (60 in) turning/passing (mobility)	E			N		
		W			S		
14	Sidewalk obstructions, plantings furniture, etc. inhibit ped and wheelchair mobility? 3ft-5ft (y/n)	E			N		
		W			S		
15	Curb return radius <20 ft? encourage high speed and long crossing (y/n)	E			N		
		W			S		
16	Driveway entrances within 100 ft of intersection (y/n)	E			N		
		W			S		
17	Posted speed limits nearby? Where?					30	30
18	Are Pedestrian facilities on and along sidewalks accessible? Signal actuating buttons, drinking fountains, telephones, kiosks, and other pedestrian elements should meet accessibility criteria for approach and maneuvering space, reach range, and controls and operation. (y/n/NA)	E			N		
		W			S		
19	Bus stop locations (shelters, other struct. If within 100 feet =yes, otherwise no)	E			N		
		W			S		
20	Existing median (size) ? (in feet) Is median suitable for a refuge? (y/n)						
21	Possible 4ft median insert w/10ft lanes (lane reduction) (y/n)?						
22	Potential for curb bulbs (towaways, bus stops, utilities, drains, poles)	E			N		
		W			S		
23	Adjacent land uses (up to 2 blocks away) Residential, Commercial, Industrial, School, Government (R, C, I, S, G) comma delimited	E			N		
		W			S		

Accessibility Survey Checklist Intersection: CHRISTIE & SHELLMOUND Date: 7/31/04							
Crossing/Connector: _____		North: _____		South: _____		East: _____ West: _____	
1	Confirm striping , xwalk& advance limit lines (clear(C) or faded (F))	E			N		F
		W			S		
	Number of Lanes						
	Lane Configuration (Left Turn) (count of lanes)				N	1	2
					S	1	
	Lane Config (Through) (count of lanes)	E	2	2			1
	Lane Config (Right Turn) (count of lanes)	E		1	N	1	2
2	One-Way (y/n)						
	Traffic Signals (and restrictions), Signalized (y/n)						
	Left-turn Phase (y/n)						
	No Right Turn on Red Restriction (y/n)						
	No U-Turn (y/n)						
	Pedestrian signal head (y/n)						
	3	Pedestrian signal head, countdown (y/n)	E		Y	N	
4	Ped signal timing (4ft/sec), 2.5 ft/sec covers 95 of peds (N/A)	E			N		
		W			S		
5	Street crossing design should ensure that the boundary between the sidewalk and the street is detectable. Pedestrian crossing information should be available to all users. (tactile strips , etc.) (y/n)	E	Y		N		
		W			S		
6	Level of ped traffic outside crosswalk or against signal (N/A)	E			N		
		W			S		
7	Parking locations & Approx locations from intersection, meters & towaways (distance, ft)	E			N		
		W			S	90	110
8	Street light exist/adequate (y/n)	E	Y	Y	N	Y	Y
		W			S		
9	Possible sight (LOS) obstructions (y/n)	E			N		
		W			S		
10	ADA compliant curb ramps, w>=3ft, crosslopes 2%, level landing (y/n)	E			N		
		W		Y	S	Y	Y
11	Is foot of a curb ramp contained within the crosswalk markings (y/n)?	E	Y	Y	N	Y	Y
		W			S		

12	Do Street furniture, plantings, and other fixed items protrude into travel routes? (y/n) (Bad for	E			N		
		W			S		
13	Sidewalks passable for wheelchairs? w>=3ft, 5ft (60 in) turning/passing (mobility)	E	Y	Y	N	Y	Y
		W			S		
14	Sidewalk obstructions, plantings furniture, etc. inhibit ped and wheelchair mobility? 3ft-5ft (y/n)	E			N		
		W			S		
15	Curb return radius <20 ft? encourage high speed and long crossing (y/n)	E			N		
		W			S		
16	Driveway entrances within 100 ft of intersection (y/n)	E			N		
		W			S		
17	Posted speed limits nearby? Where?						
18	Are Pedestrian facilities on and along sidewalks accessible? Signal actuating buttons, drinking fountains, telephones, kiosks, and other pedestrian elements should meet accessibility criteria for approach and maneuvering space, reach range, and controls and operation. (y/n/NA)	E			N		
		W			S		
19	Bus stop locations (shelters, other struct. If within 100 feet =yes, otherwise no)	E			N	Y	
		W			S		
20	Existing median (size) ? (in feet) Is median suitable for a refuge? (y/n)						
21	Possible 4ft median insert w/10ft lanes (lane reduction) (y/n)?						
22	Potential for curb bulbs (towaways, bus stops, utilities, drains, poles)	E			N		
		W			S		
23	Adjacent land uses (up to 2 blocks away) Residential, Commercial, Industrial, School, Government (R, C, I, S, G) comma delimited	E			N		
		W			S		

11.5. APPENDIX E: CROSSING DISTANCE AND SIGNAL TIME

Crossing Distance and Pedestrian Signal Time Analysis

Crossing/Connector	Description	Crossing Distance (1)	Crossing time measured (2)	Crossing Time given (3)			Time to cross at 4 feet/second (4)	complies?	Time to cross at 3.5 feet/second (5)	complies?	Time to cross at 3.5 feet/second (6)	complies?	Time to cross at 2.5 feet/second (7)	complies?
				W	FRH	W + FRH								
Intersection 1: Powell and Frontage														
Crossing 1:	North side of Powell across Frontage from the NE corner of intersection to pedestrian island	33	No Signal	n/a	n/a	No Signal	8	n/a	9	n/a	9	n/a	13	n/a
Crossing 2:	North side of Powell across Frontage from pedestrian island to NW corner of the intersection	71	21	5	16	21	18	NO	20	NO	20	YES	28	NO
Crossing 3:*	West side of Frontage across Powell	92	21	7	14	21	23	NO	26	NO	26	NO	37	NO
Crossing 4:	South side of Powell across the southbound I-80 on-ramp	23	10	5	5	10	6	NO	7	NO	7	YES	9	YES
Intersection 2: Powell and I-80														
Crossing 5:	North side of Powell across the northbound I-80 on-ramp	49	19	7	12	19	12	YES	14	NO	14	YES	20	NO
Crossing 6:	South side of Powell across the northbound I-80 exit ramp	43	19	7	12	19	11	YES	12	YES	12	YES	17	YES
Intersection 3: Powell and Christie														
Crossing 7:	North side of Powell across Christie (blocked)	56	No Signal	n/a	n/a	No Signal	14	n/a	16	n/a	16	n/a	22	n/a
Crossing 8:	West side of Christie across Powell	94	30	5	24	29	24	YES	27	NO	27	YES	38	NO
Crossing 9:	South side of Powell across Christie	87	25	7	18	25	22	NO	25	NO	25	YES	35	NO
Intersection 4: Christie and Shellmound														
Crossing 10:	North side of Christie across Shellmound (unmarked)	64	No Signal	n/a	n/a	No Signal	16	n/a	18	n/a	18	n/a	26	n/a
Crossing 11:	West side of Shellmound across Christie	80	24	7	18	25	20	NO	23	NO	23	YES	32	NO
Crossing 12:	South side of Christie across Shellmound	83	24	7	18	25	21	NO	24	NO	24	YES	33	NO
Crossing 13:	East side of Shellmound across Christie	69	24	7	18	25	17	YES	20	NO	20	YES	28	NO

*This crossing has a median but not a true refuge

(1) Curb to curb distance minus 6 ft. 6 ft was used rather than half of lane width as a reasonable distance to finish crossing during yellow phase because lanes are extremely wide, possibly too wide to finish crossing during yellow.

(2) Based on calculation in field.

(3) Signal timing provided by the City of Emeryville.

(4) This is a standard pedestrian walking speed, often used to calculate the minimum crossing time needed during the Flashing Red Hand phase.

(5) This is a moderate walking speed, recommended to use to calculate crossing time needed during the Flashing Red Hand phase.

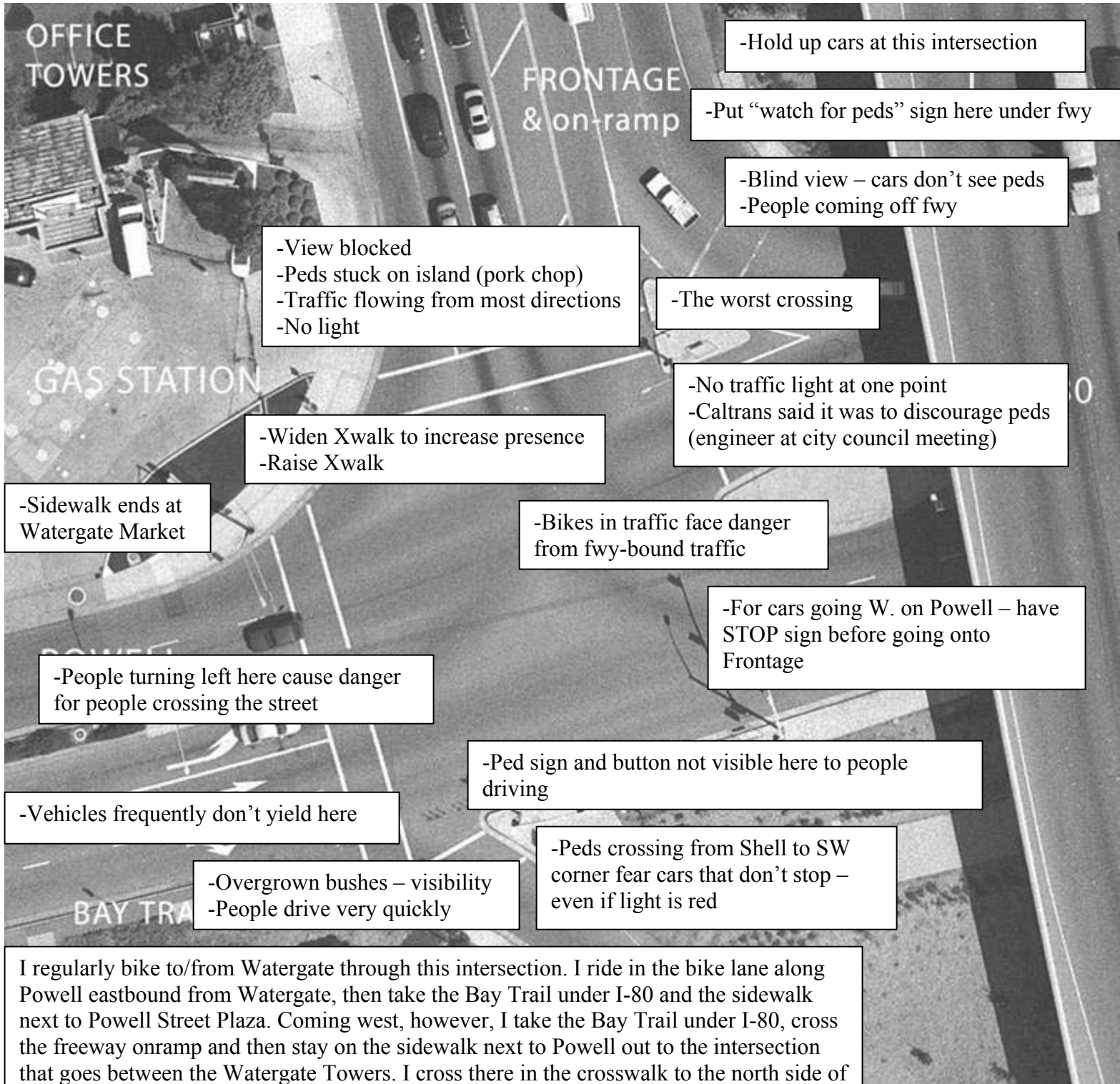
(6) This is a moderate walking speed, recommended to use to calculate the minimum total crossing time needed for Walk + Flashing Red Hand phases.

(7) This is a slow walking speed, often used to calculate the time needed for seniors or disabled persons to cross during the Walk + Flashing Red Hand phases.

11.6. APPENDIX F: COMMUNITY MEETING RESULTS

a. Watergate

Powell and Frontage



-Hold up cars at this intersection

-Put “watch for peds” sign here under fwy

-Blind view – cars don’t see peds
-People coming off fwy

-View blocked
-Peds stuck on island (pork chop)
-Traffic flowing from most directions
-No light

-The worst crossing

-No traffic light at one point
-Caltrans said it was to discourage peds (engineer at city council meeting)

-Widen Xwalk to increase presence
-Raise Xwalk

-Sidewalk ends at Watergate Market

-Bikes in traffic face danger from fwy-bound traffic

-For cars going W. on Powell – have STOP sign before going onto Frontage

-People turning left here cause danger for people crossing the street

-Ped sign and button not visible here to people driving

-Vehicles frequently don’t yield here

-Overgrown bushes – visibility
-People drive very quickly

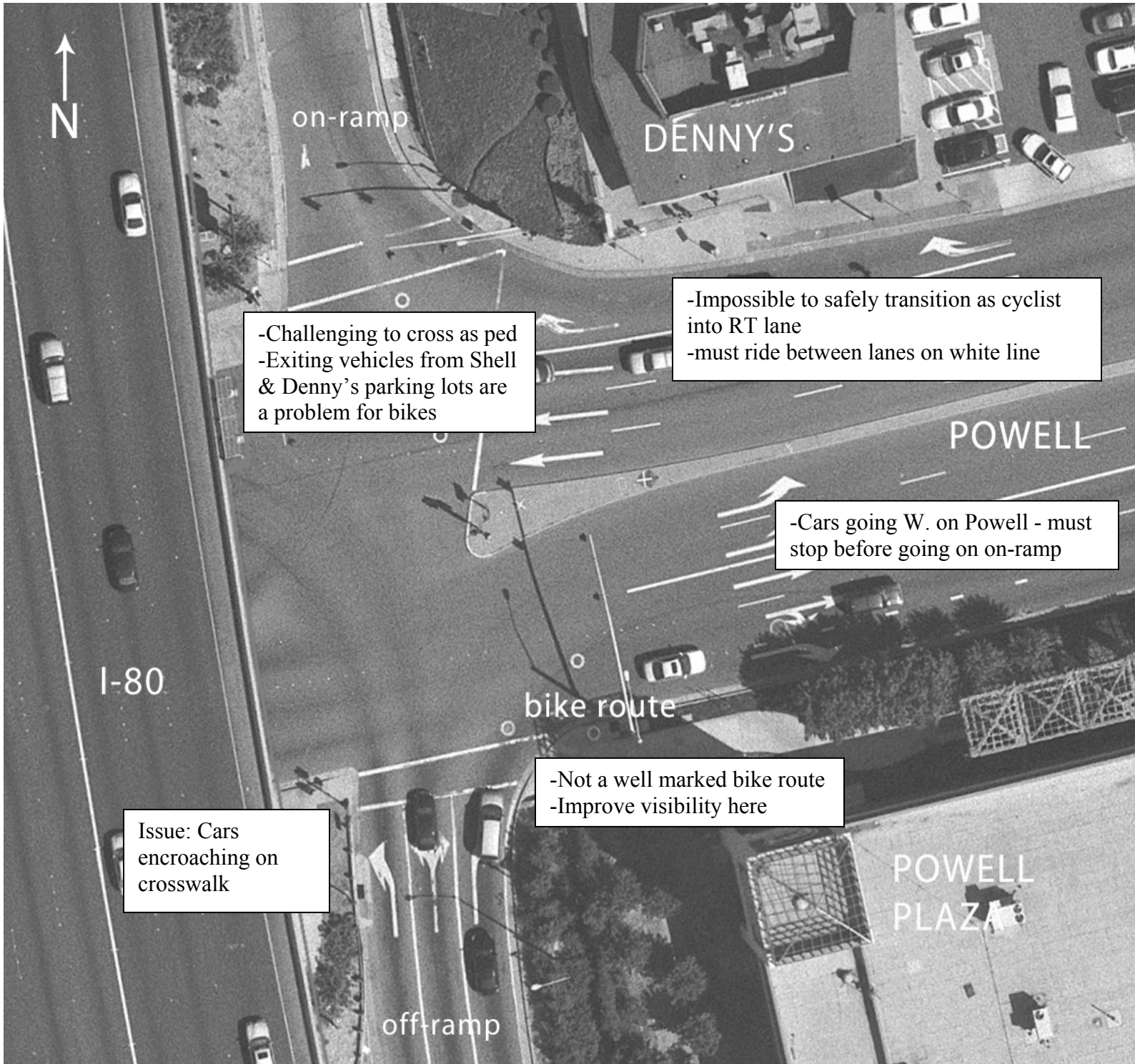
-Peds crossing from Shell to SW corner fear cars that don’t stop – even if light is red

I regularly bike to/from Watergate through this intersection. I ride in the bike lane along Powell eastbound from Watergate, then take the Bay Trail under I-80 and the sidewalk next to Powell Street Plaza. Coming west, however, I take the Bay Trail under I-80, cross the freeway onramp and then stay on the sidewalk next to Powell out to the intersection that goes between the Watergate Towers. I cross there in the crosswalk to the north side of Powell and continue on to Watergate. This is safer than trying to cross to the North side of Powell back at the Powell and Frontage intersection. If the sidewalk was widened on South side of Powell, this would work better for bikes.

Powell and Frontage

- Bay trail ends at Shell Station
- Create viable extension
- Peds don't behave unsafely. Obey signals. Makes it more frustrating.
- Lighting and visibility – main problem here
- For bikes: adjust trip to turn on Frontage Rd. and turn into gas station
- Cars don't stop because not up against other cars
- Light crosswalks
- Living in Watergate and going across freeway – gets worse later

Powell and I-80



-Challenging to cross as ped
-Exiting vehicles from Shell & Denny's parking lots are a problem for bikes

-Impossible to safely transition as cyclist into RT lane
-must ride between lanes on white line

-Cars going W. on Powell - must stop before going on on-ramp

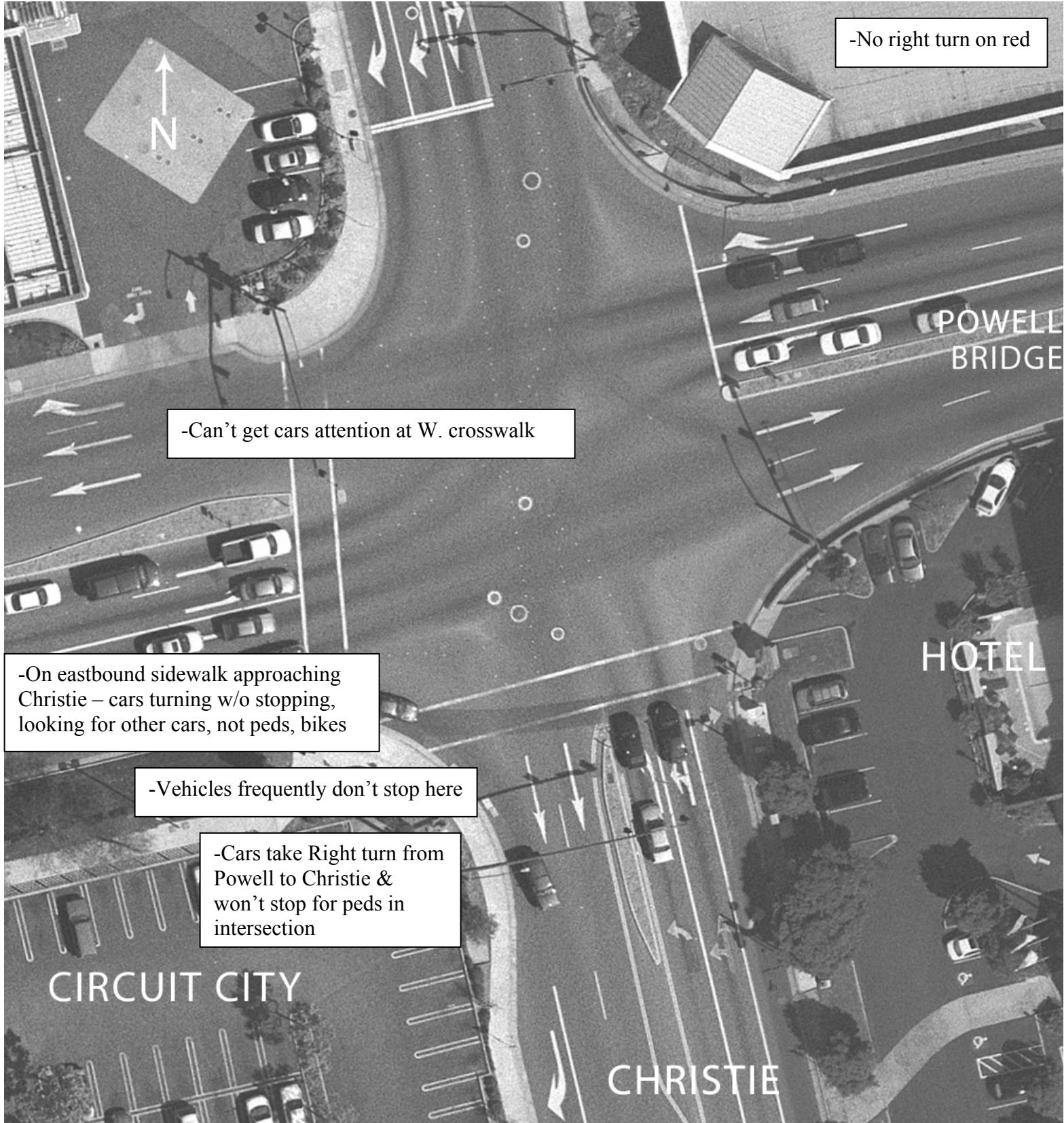
-Not a well marked bike route
-Improve visibility here

Issue: Cars encroaching on crosswalk

Powell and I-80

- Cars coming off freeway go fast, don't watch for peds, don't obey lights
- Visibility for peds/bikes
- On Northside, going west, ped sign useless
- Person crossing South intersection crosswalk have to go out into intersection to get by cars sitting in crosswalk
- Denny's to Watergate: Need to cross 2 lanes of traffic on bike to get across it
- Reach out to Arts Commission, PD + engineering, put banners up encouraging safety
- Planned art project for under freeway to improve safety lighting
- Lighted ped crosswalks
- 2 right turns = big problem

Powell and Christie



-No right turn on red

-Can't get cars attention at W. crosswalk

-On eastbound sidewalk approaching Christie – cars turning w/o stopping, looking for other cars, not peds, bikes

-Vehicles frequently don't stop here

-Cars take Right turn from Powell to Christie & won't stop for peds in intersection

POWELL BRIDGE

HOTEL

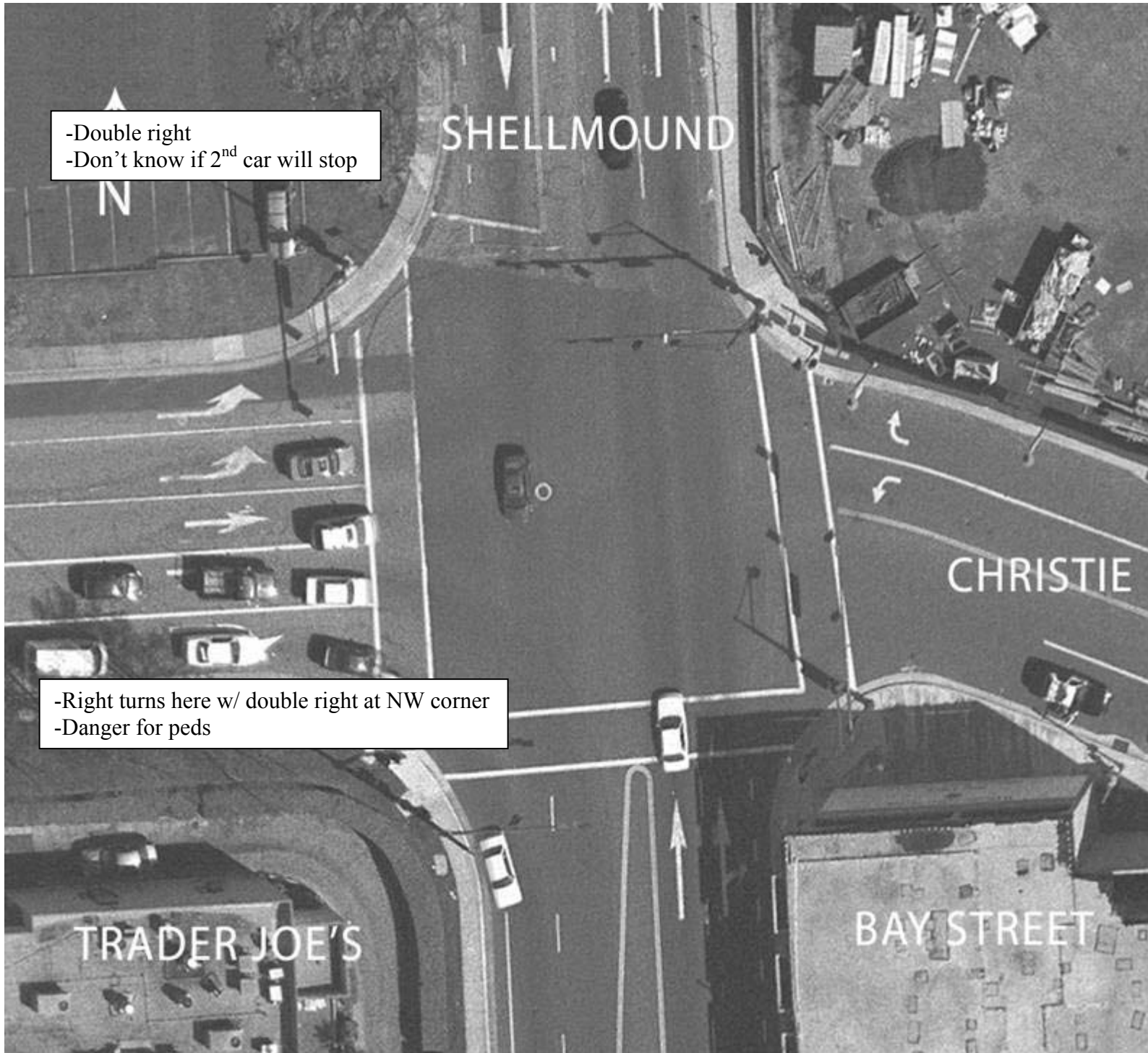
CIRCUIT CITY

CHRISTIE

Powell and Christie

- Groups of cars turning Left onto Christie run red lights. Culture of RLV. Hopefully cameras will help.
- Aggressive Right turns so peds choose not to cross Powell
- No Right on red will back up traffic on S-bound Christie. Countdown signals have improved situation
- Police stings
- Square off corners. Too wide radius.
- Traffic laws for peds

Shellmound and Christie



Christie and Shellmound

- Shoppers – aggressive drivers
- Signal's phases not synchronized
- Signals at South crosswalk takes a long time
- From Shellmound to Watergate, what's best way to go (on bike)?
- Educate peds
- Flashing ped-operated crosswalk signals

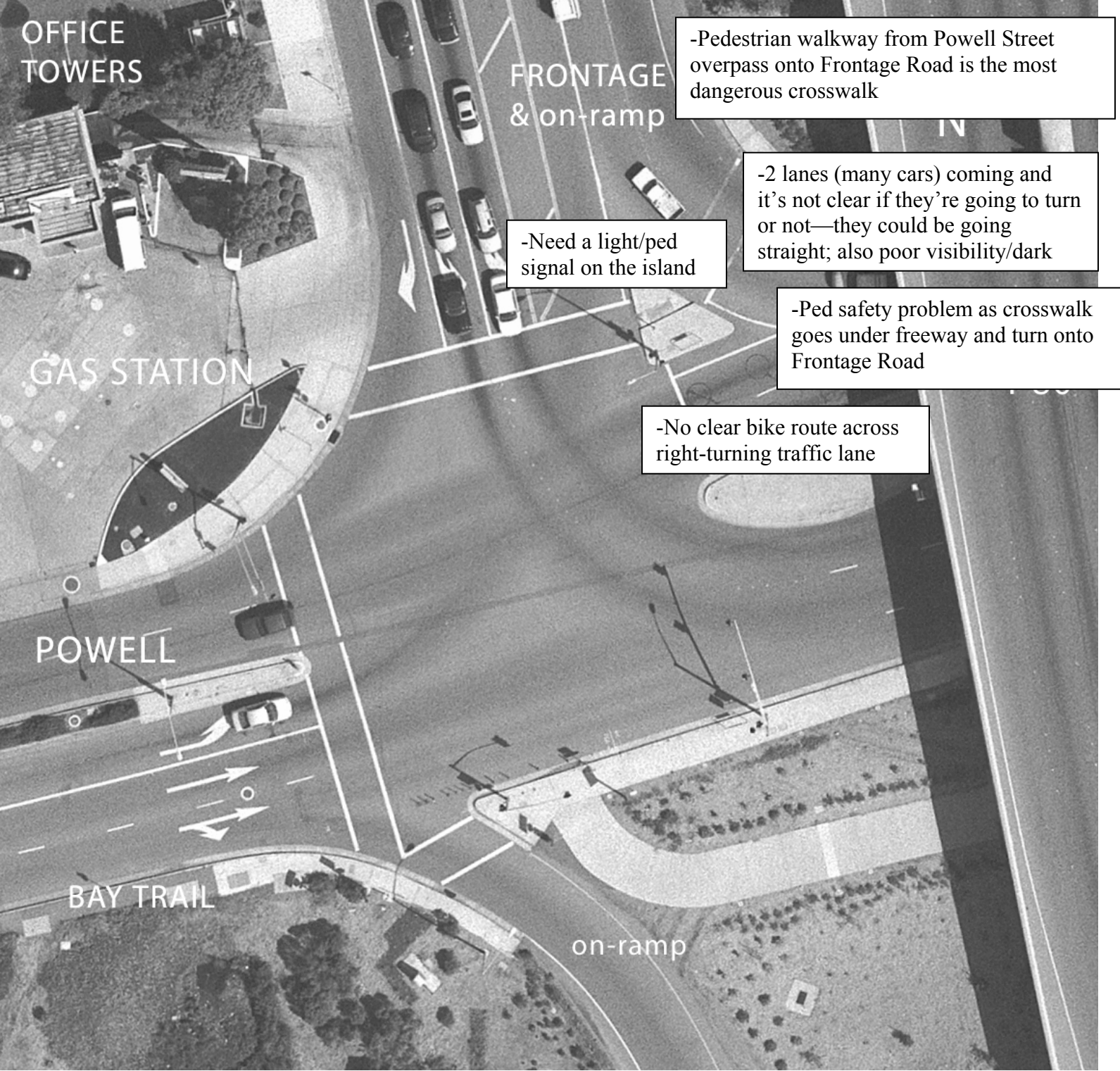
All Crosswalks

- Designate walkways clearly
- Red light arrows, as well as green right arrows
- Evaluate interventions
- Traffic patrols
- Arts commission to get messages to people
- Lights from shopping center very bright

APPENDIX F: COMMUNITY MEETING RESULTS, CONT.

b. Pacific Park Plaza

Powell and Frontage



OFFICE TOWERS

FRONTAGE & on-ramp

-Pedestrian walkway from Powell Street overpass onto Frontage Road is the most dangerous crosswalk

-2 lanes (many cars) coming and it's not clear if they're going to turn or not—they could be going straight; also poor visibility/dark

-Need a light/ped signal on the island

-Ped safety problem as crosswalk goes under freeway and turn onto Frontage Road

GAS STATION

-No clear bike route across right-turning traffic lane

POWELL

BAY TRAIL

on-ramp

Powell and Frontage

- Yield sign does not prevent cars from going through crosswalk in front of peds/bikes.

Powell and I-80



-Remove restriction to cross to pedestrian trail across from here straight through

-Wall here obstructs cars view of peds

-Cyclists must stand in the middle of traffic due to the 2 right turn-only lanes (at Frontage)

-Motorists are too busy looking left when their vehicles are turning right

DENNY'S

POWELL

I-80

bike route

POWELL PLAZA

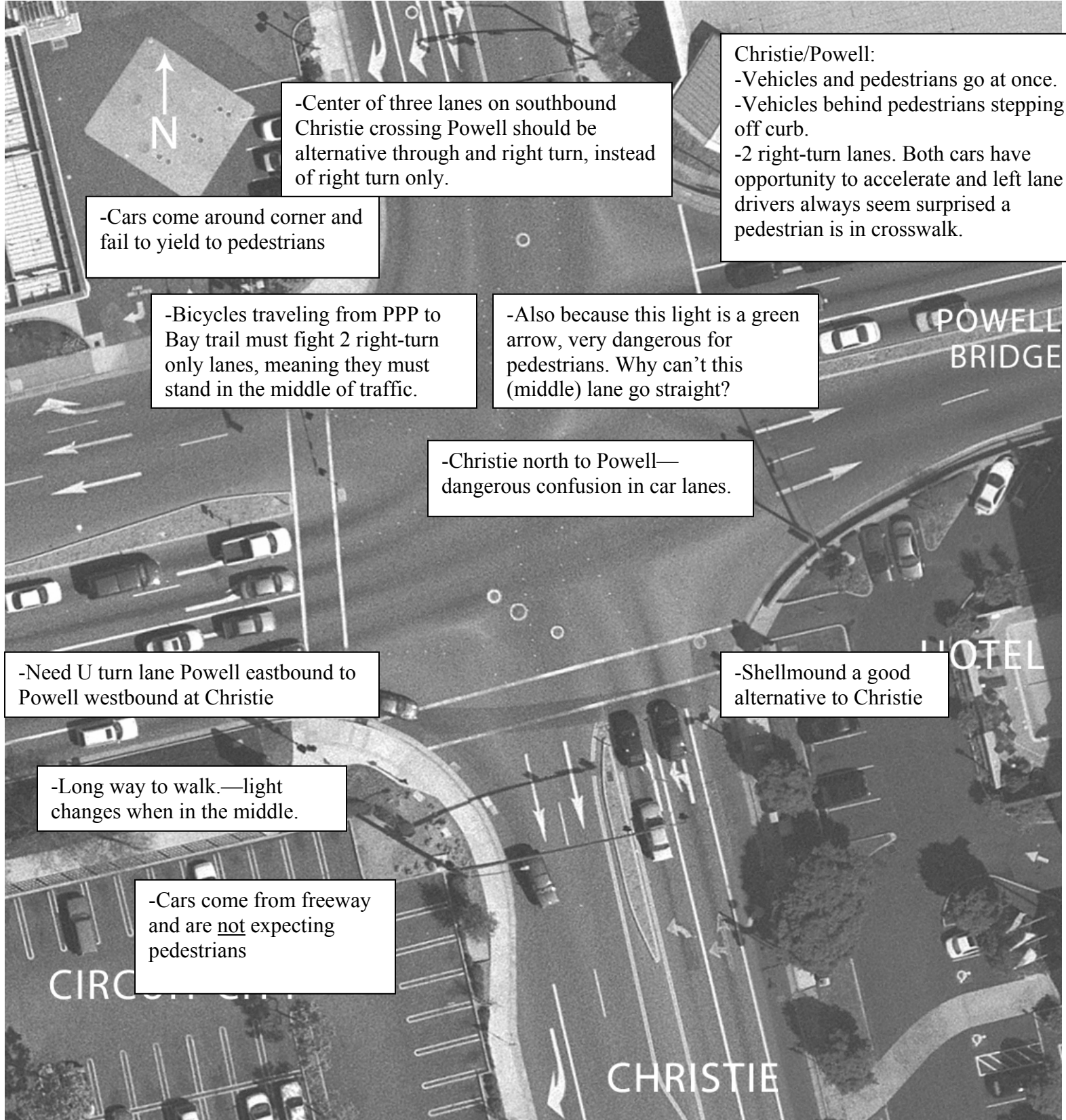
off-ramp



Powell and I-80

- Collision on bike at SE corner (designated bike route on south sidewalk)
- Cars existing off-ramp don't stop before turning right
- Use tunnel/bridge instead
- Cars turning right from off-ramp aren't looking for peds/bikes
- Poor visibility on SE sidewalk because of embankment, foliage
- Denny's curb: poor visibility both for cars and peds because of ADA rail. Make curb sharper/square off.
- Bikes going west/through on Powell need to move to through lane: are placed in the middle of the road.

Powell and Christie



Christie/Powell:
-Vehicles and pedestrians go at once.
-Vehicles behind pedestrians stepping off curb.
-2 right-turn lanes. Both cars have opportunity to accelerate and left lane drivers always seem surprised a pedestrian is in crosswalk.

-Center of three lanes on southbound Christie crossing Powell should be alternative through and right turn, instead of right turn only.

-Cars come around corner and fail to yield to pedestrians

-Bicycles traveling from PPP to Bay trail must fight 2 right-turn only lanes, meaning they must stand in the middle of traffic.

-Also because this light is a green arrow, very dangerous for pedestrians. Why can't this (middle) lane go straight?

-Christie north to Powell—dangerous confusion in car lanes.

-Need U turn lane Powell eastbound to Powell westbound at Christie

-Shellmound a good alternative to Christie

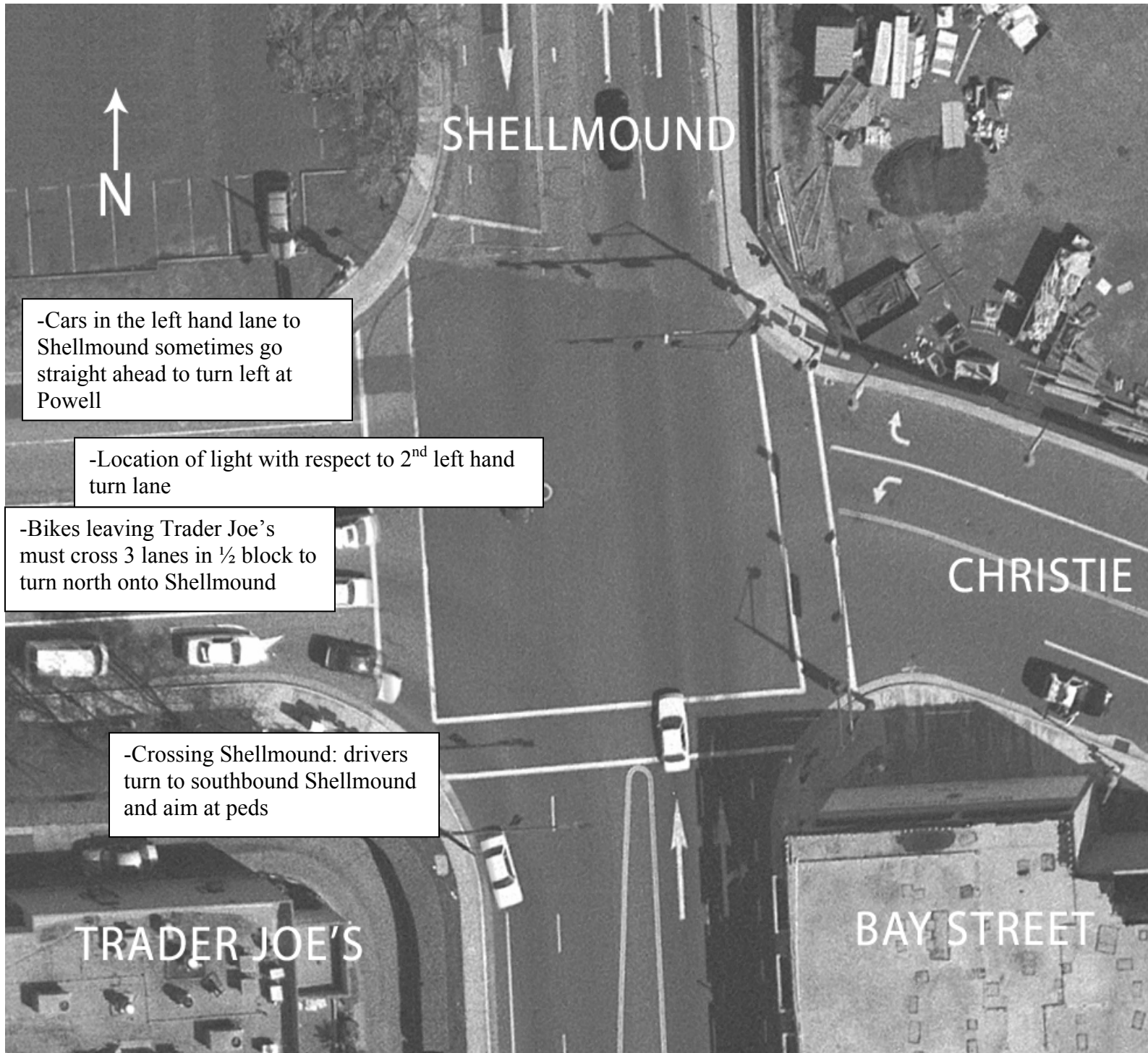
-Long way to walk.—light changes when in the middle.

-Cars come from freeway and are not expecting pedestrians

Powell and Christie

- Bikes turning right from SB Christie have to move to center of road, then change lanes again.
- Hard to cross Powell (west side): EB cars have freeway mentality—aren't expecting peds.
- WB cars also go fast, possibly because they're far back from crosswalk.
- SB cars are held far back from corner—peds can't see them, and cars have a lot of time to accelerate—especially cars in middle lane. Bulbout also increases distance between cars and peds, reducing visibility and increasing speeds.
- Intersections are so bad, and no reason to bike east of freeway—not worth the risk.
- SB cars going to Powell Plaza/Trader Joe's:
 - cars in center lane go straight and through
 - cars in through lane have to move over 2 lanes
- Make center SB lane a through lane
- Lights are not well coordinated between Christie Way and SB Christie at Powell
- Move SB limit line forward (south), or stagger forward.
- Need more direct route for cars from freeway to AMC, Trader Joe's, etc.
- Make eye contact with drivers—helps
- West crosswalk is dangerous—signal is too short, can't start right away because of right-turning cars; cars aren't paying attention. Especially hard with groceries.
- Consider raising crosswalks (about 1.5 inches) and using colored paving
- Many 1st time shoppers in area.
- Volume of traffic is increasing with new construction
- SB, right-turning cars: 1st car blocks view of pedestrian so that 2nd car can't see them
- Police-triggered signal pre-emption doesn't allow for full ped crossing time
- Right turn on red should be restricted:
 - EB Powell onto SB Christie
 - WB Powell onto NB on-ramp

Shellmound and Christie



-Cars in the left hand lane to Shellmound sometimes go straight ahead to turn left at Powell

-Location of light with respect to 2nd left hand turn lane

-Bikes leaving Trader Joe's must cross 3 lanes in 1/2 block to turn north onto Shellmound

-Crossing Shellmound: drivers turn to southbound Shellmound and aim at peds

Shellmound and Christie

- Long crossings
- Right hand turns (WB Christie onto NB Shellmound) vehicles are going fast, don't see peds
- Can't get out to start crossing because of vehicles; then don't have enough time left to cross.

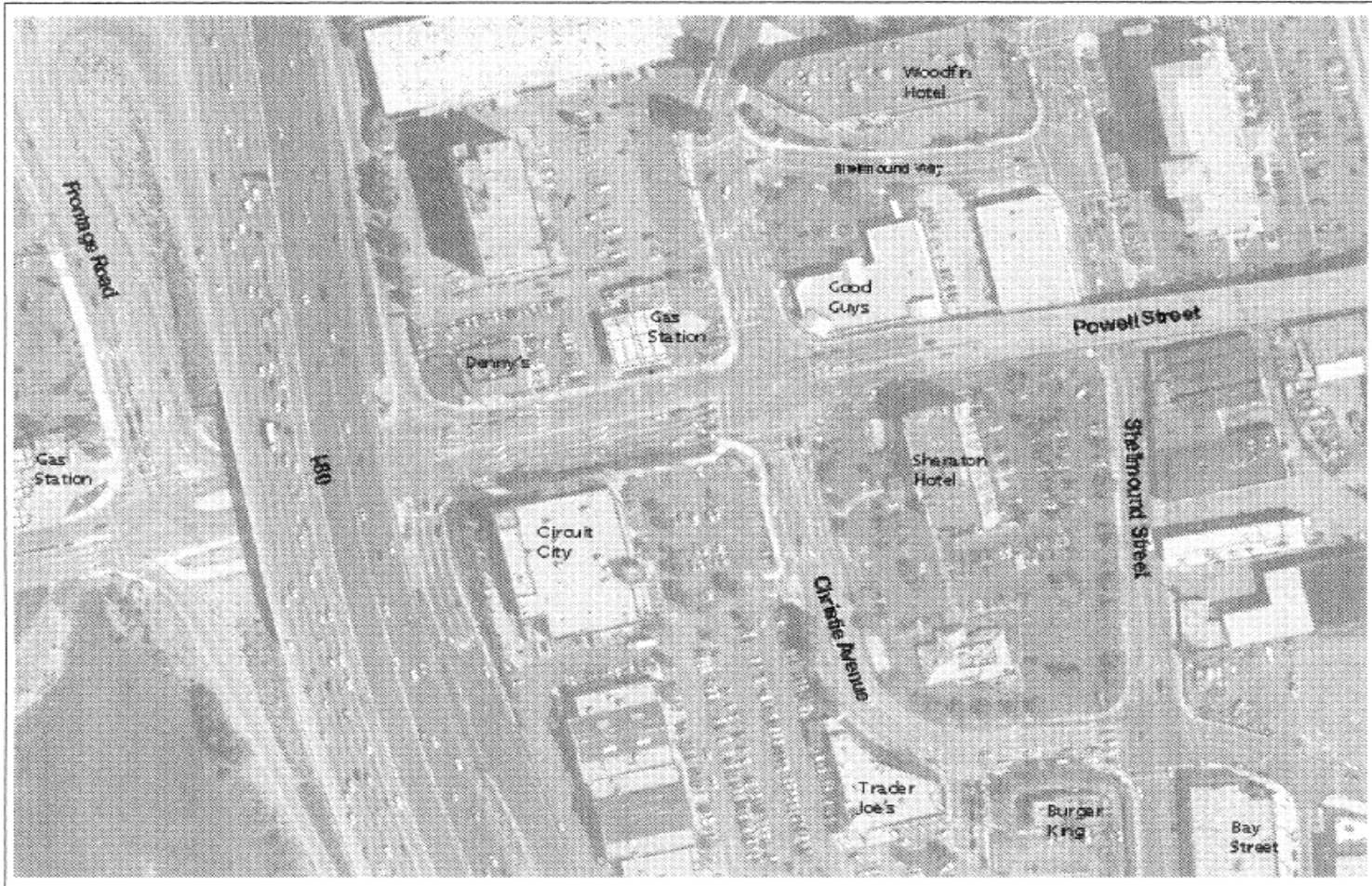
All Crosswalks

- Consider overpasses/underpasses
- Restrict right turn on red
- Delay green for cars
- Extend ped signal timing

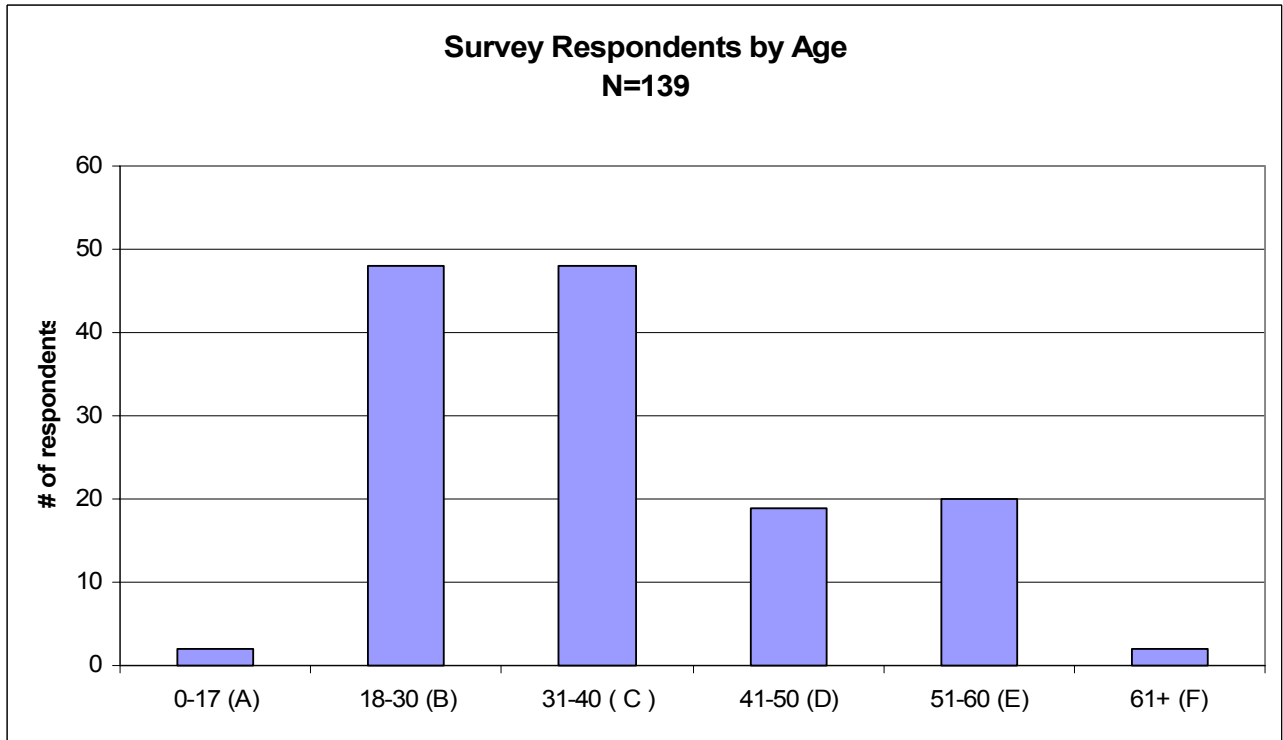
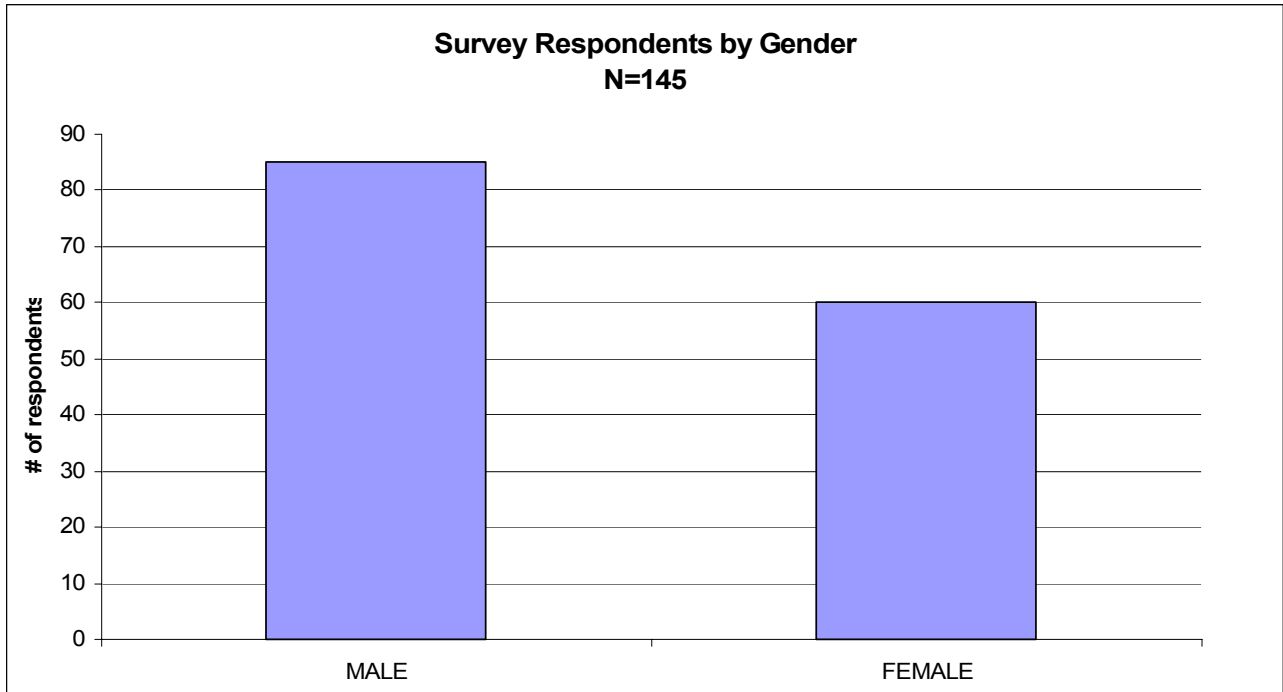
11.7. APPENDIX G: SURVEYS

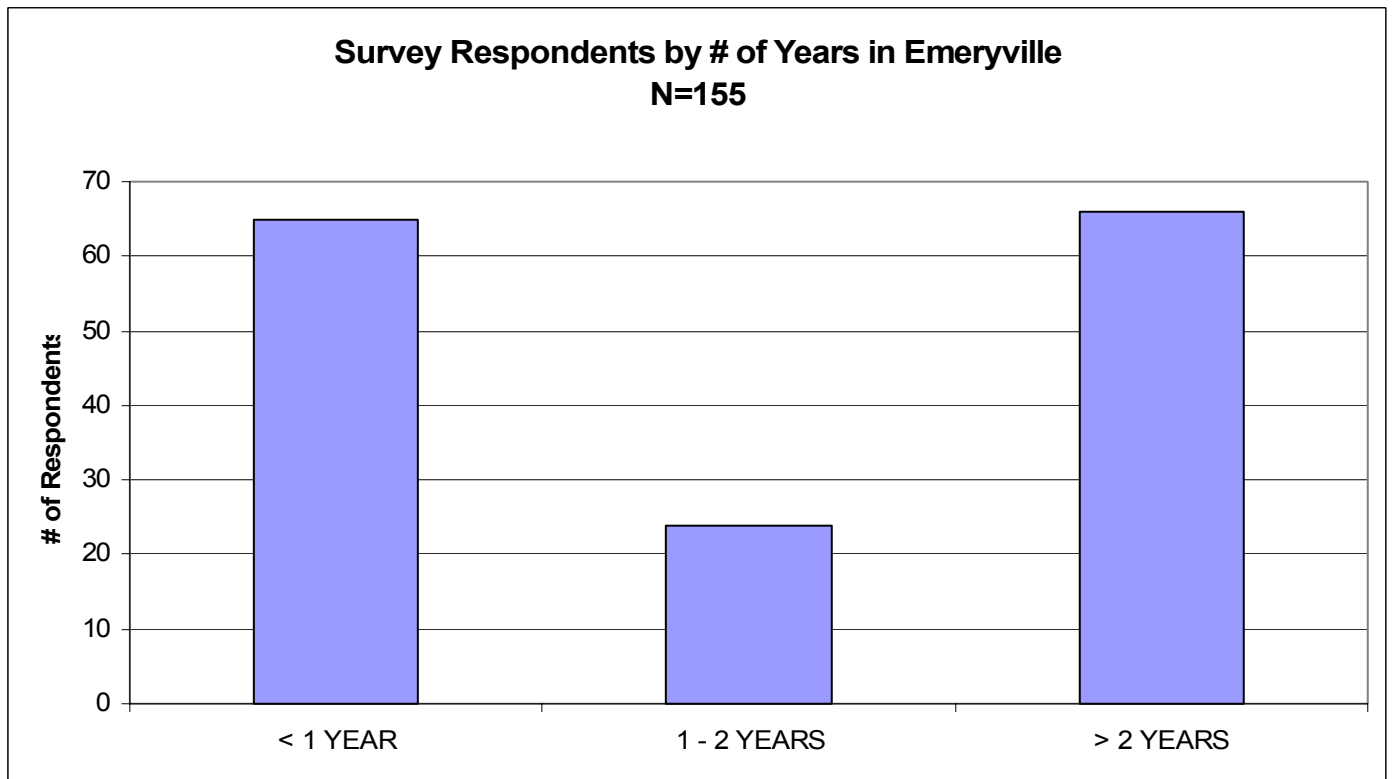
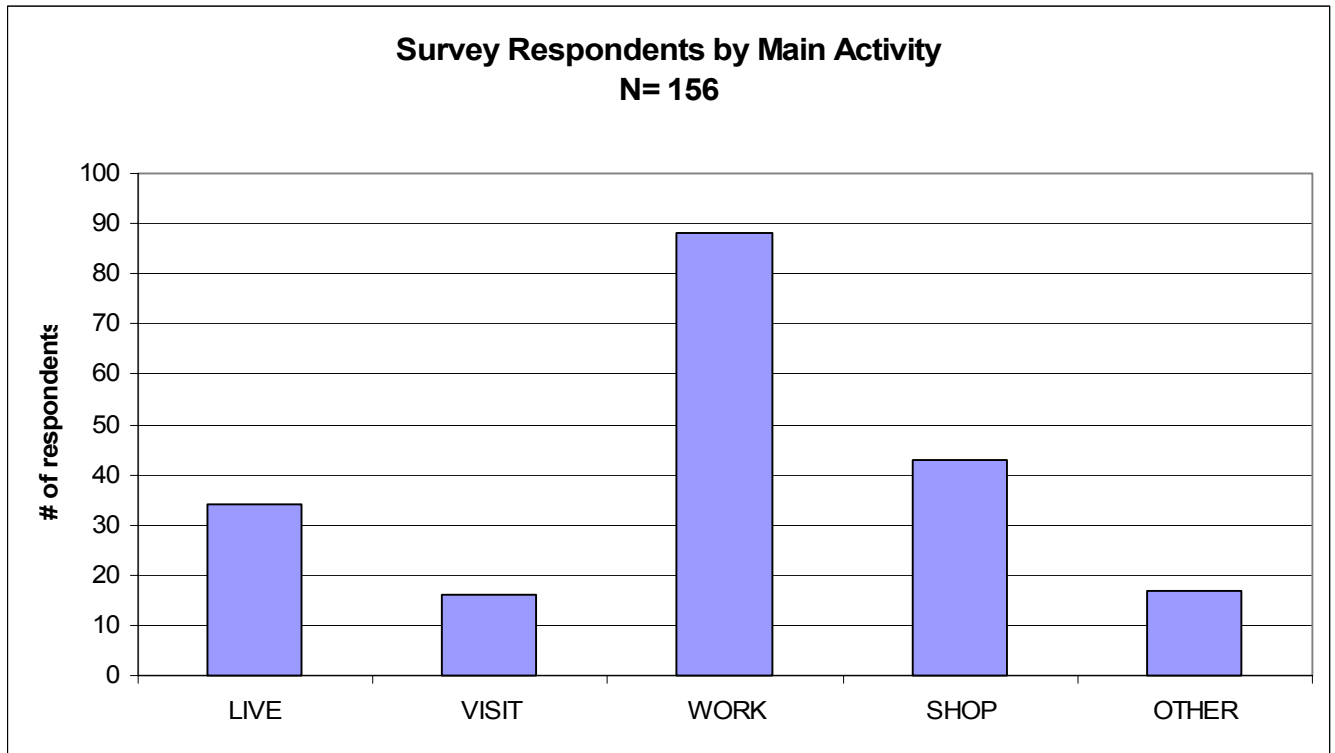
Survey Form, pg. 2

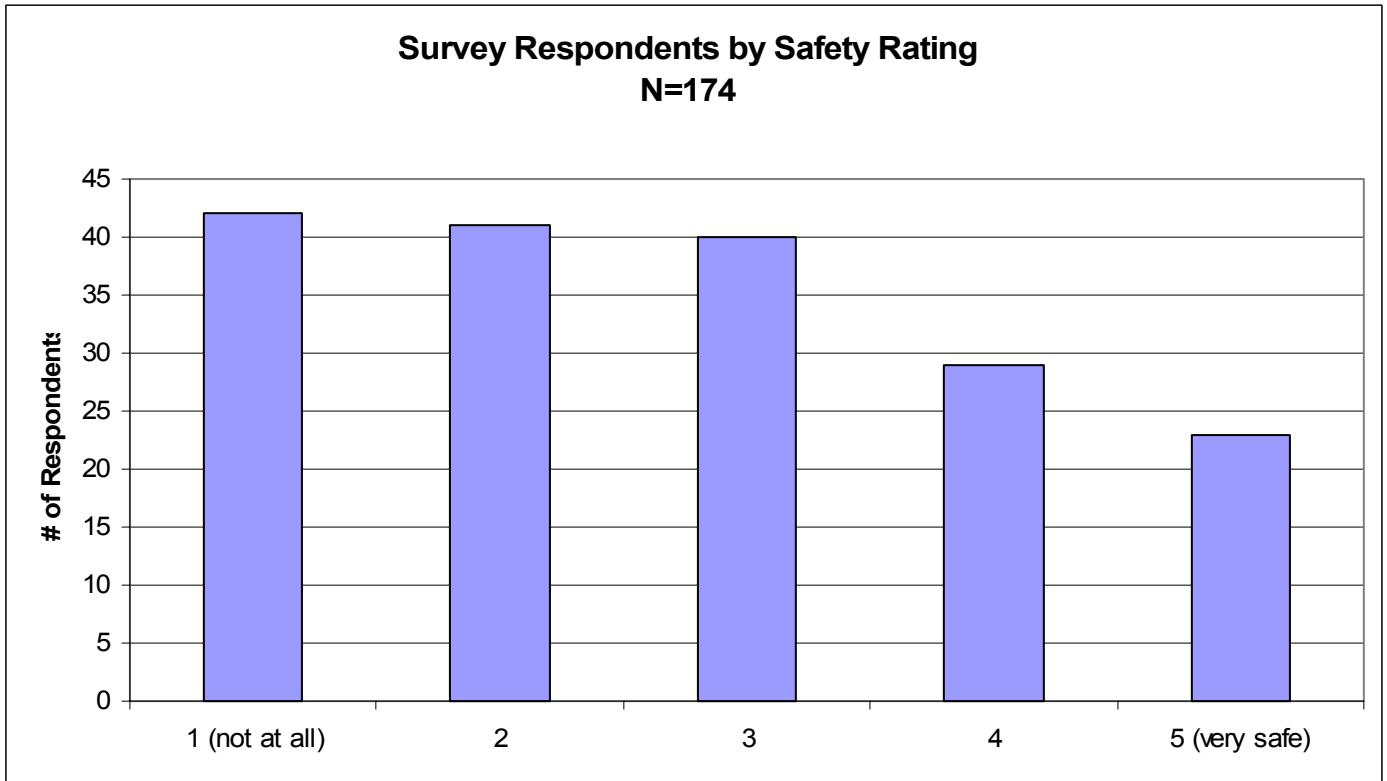
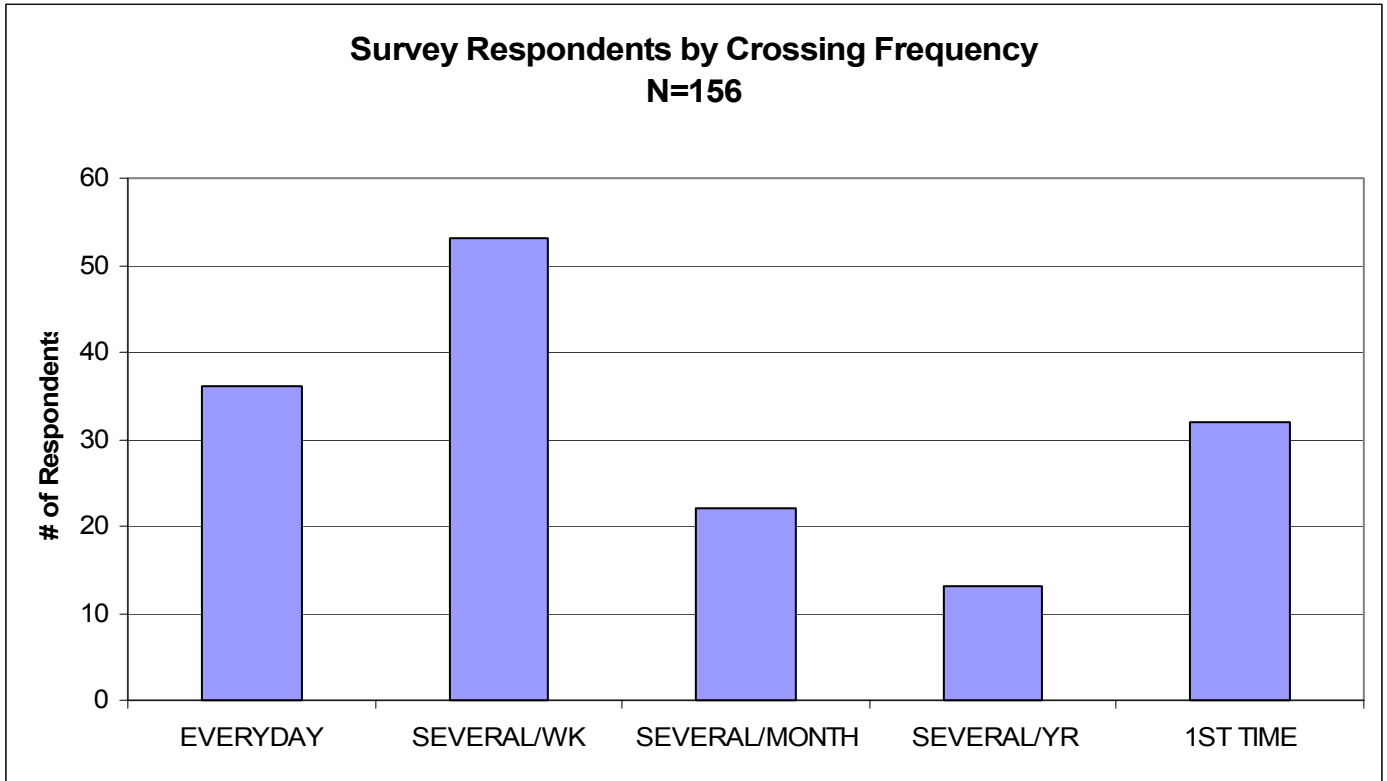
- Based on your experience, mark “1” on the location where you have the greatest chance of being hit by a motor vehicle and “2” and “3” on the second and third most dangerous locations.
- Mark with an “x” any locations you have avoided within the past month because you thought a motor vehicle might hit you.

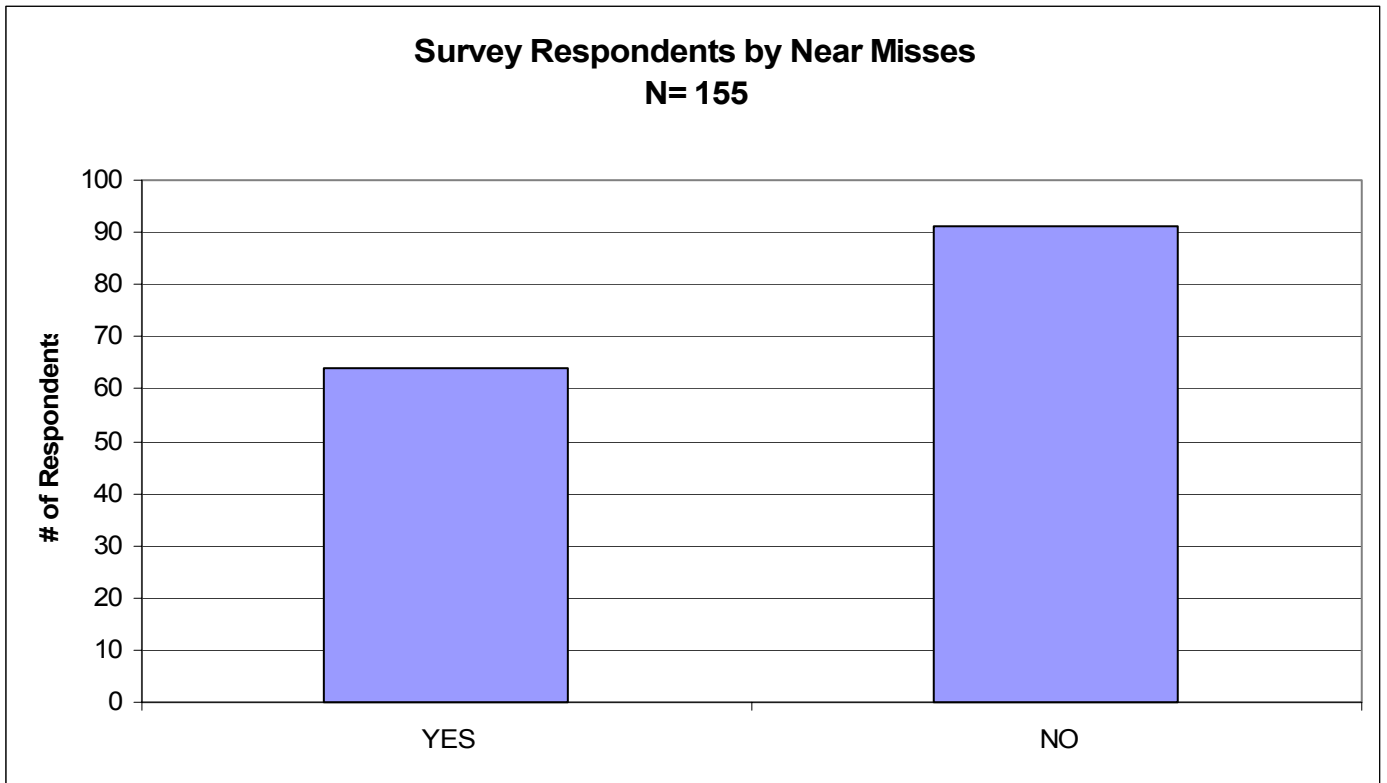


*** Thank You! ***









Powell/Frontage/I-80 Survey Data

	TOTAL	PERCENT	AVERAGE
SEX			
MALE	44	59	
FEMALE	31	41	
RESPONSES	75	100	
AGE			38
0-17 (A)	0	0	
18-30 (B)	25	35	
31-40 (C)	25	35	
41-50 (D)	11	15	
51-60 (E)	9	13	
61+ (F)	2	3	
RESPONSES	72	96	
MAIN ACTIVITY			
LIVE	19	25	
VISIT	7	9	
WORK	56	75	
SHOP	7	9	
OTHER	10	13	
RESPONSES	75	100	
YEARS IN EV			
< 1 YEAR	28	37	
1 - 2 YEARS	14	19	
> 2 YEARS	33	44	
RESPONSES	75	100	
HOW OFTEN CROSS			
EVERYDAY	26	35	
SEVERAL/WK	25	33	
SEVERAL/MONTH	11	15	
SEVERAL/YR	4	5	
1ST TIME	9	12	
RESPONSES	75	100	
SAFETY RATING			1.46
1 (not at all)	14	19	
2	11	15	
3	8	11	
4	7	9	
5 (very safe)	4	5	
RESPONSES	74	1	
NEAR MISSES			
YES	34	45	
NO	41	55	
RESPONSES	75	100	

Powell/Christie Survey Data

	TOTAL	PERCENT	AVERAGE
SEX			
MALE	25	66	
FEMALE	13	34	
RESPONSES	38	86	
AGE			35.8
0-17 (A)	0	0	
18-30 (B)	15	41	
31-40 (C)	12	32	
41-50 (D)	4	11	
51-60 (E)	6	16	
61+ (F)	0	0	
RESPONSES	37	84	
MAIN ACTIVITY			
LIVE	9	20	
VISIT	7	16	
WORK	16	36	
SHOP	19	43	
OTHER	6	14	
RESPONSES	44	100	
YEARS IN EV			
< 1 YEAR	20	45	
1 - 2 YEARS	8	18	
> 2 YEARS	16	36	
RESPONSES	44	100	
HOW OFTEN CROSS			
EVERYDAY	7	16	
SEVERAL/WK	10	23	
SEVERAL/MONTH	8	18	
SEVERAL/YR	3	7	
1ST TIME	16	36	
RESPONSES	44	100	
SAFETY RATING			2.7
1 (not at all)	9	20	
2	11	25	
3	12	27	
4	8	18	
5 (very safe)	4	9	
RESPONSES	44	100	
NEAR MISSES			
YES	18	41	
NO	26	59	
RESPONSES	44	100	

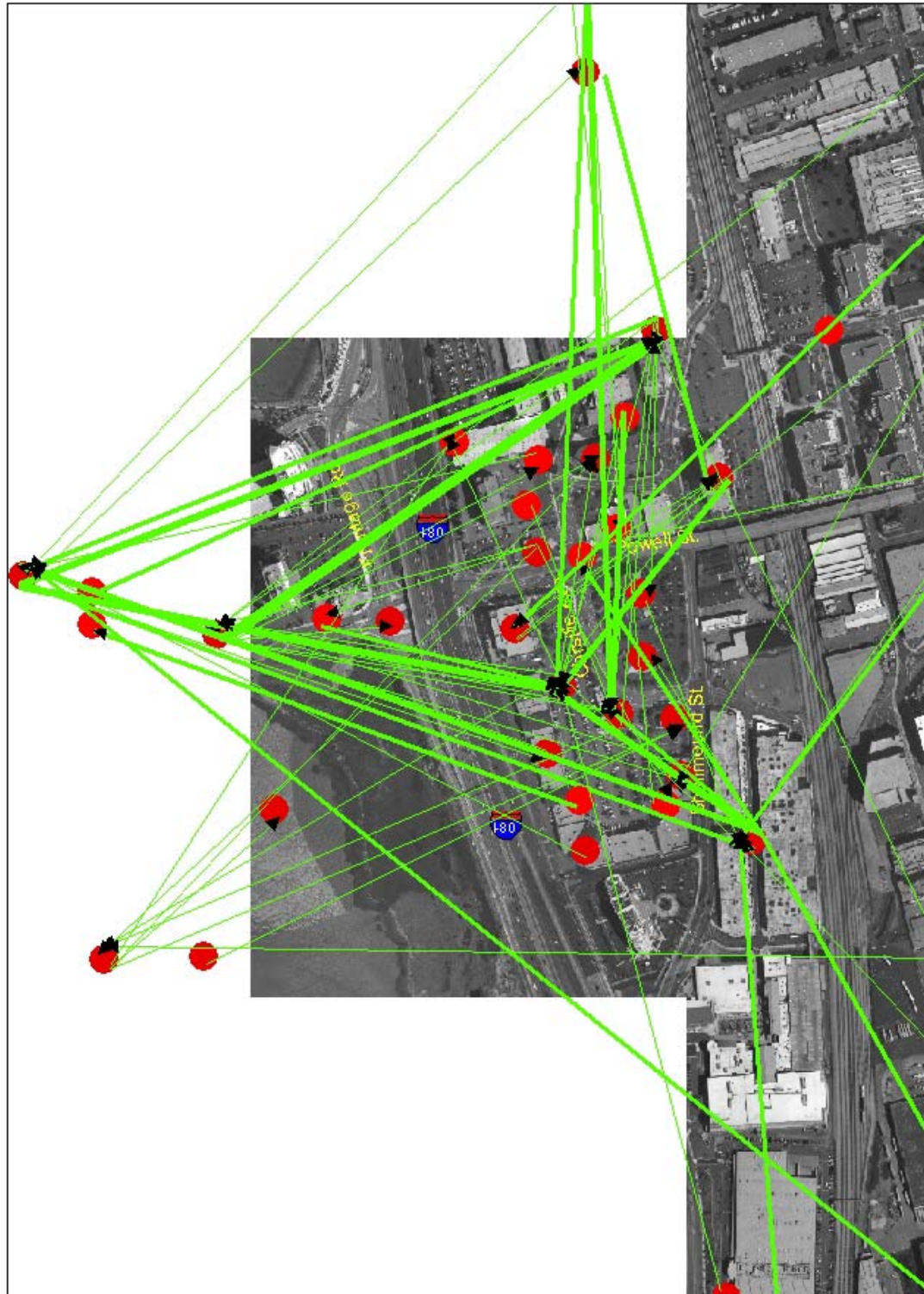
Christie/Shellmound Survey Data

	TOTAL	PERCENT	AVERAGE
SEX			
MALE	16	52	
FEMALE	15	48	
RESPONSES	31	84	
AGE			36
0-17 (A)	2	7	
18-30 (B)	8	27	
31-40 (C)	11	37	
41-50 (D)	4	13	
51-60 (E)	5	17	
61+ (F)	0	0	
RESPONSES	30	81	
MAIN ACTIVITY			
LIVE	6	16	
VISIT	2	5	
WORK	16	43	
SHOP	17	46	
OTHER	1	3	
RESPONSES	37	100	
YEARS IN EV			
< 1 YEAR	17	46	
1 - 2 YEARS	2	5	
> 2 YEARS	17	46	
RESPONSES	37	100	
HOW OFTEN CROSS			
EVERYDAY	3	8	
SEVERAL/WK	18	49	
SEVERAL/MONTH	3	8	
SEVERAL/YR	6	16	
1ST TIME	7	19	
RESPONSES	37	100	
SAFETY RATING			3.40
1 (not at all)	4	11	
2	4	11	
3	10	29	
4	8	23	
5 (very safe)	9	26	
RESPONSES	35	100	
NEAR MISSES			
YES	12	33	
NO	24	67	
RESPONSES	36	100	

ALL INTERSECTIONS			
	TOTAL	PERCENT	AVERAGE
SEX			
MALE	85	59	
FEMALE	60	41	
RESPONSES	145	93	
AGE			
0-17 (A)	2	1	36.82
18-30 (B)	48	35	
31-40 (C)	48	35	
41-50 (D)	19	14	
51-60 (E)	20	14	
61+ (F)	2	1	
RESPONSES	139	89	
MAIN ACTIVITY			
LIVE	34	22	
VISIT	16	10	
WORK	88	56	
SHOP	43	28	
OTHER	17	11	
RESPONSES	156	100	
YEARS IN EV			
< 1 YEAR	65	42	
1 - 2 YEARS	24	15	
> 2 YEARS	66	43	
RESPONSES	155	99	
HOW OFTEN CROSS			
EVERYDAY	36	23	
SEVERAL/WK	53	34	
SEVERAL/MONTH	22	14	
SEVERAL/YR	13	8	
1ST TIME	32	21	
RESPONSES	156	100	
SAFETY RATING			
1 (not at all)	42	24	2.73
2	41	24	
3	40	23	
4	29	17	
5 (very safe)	23	10	
RESPONSES	174	112	
NEAR MISSES			
YES	64	41	
NO	91	59	
RESPONSES	155	99	

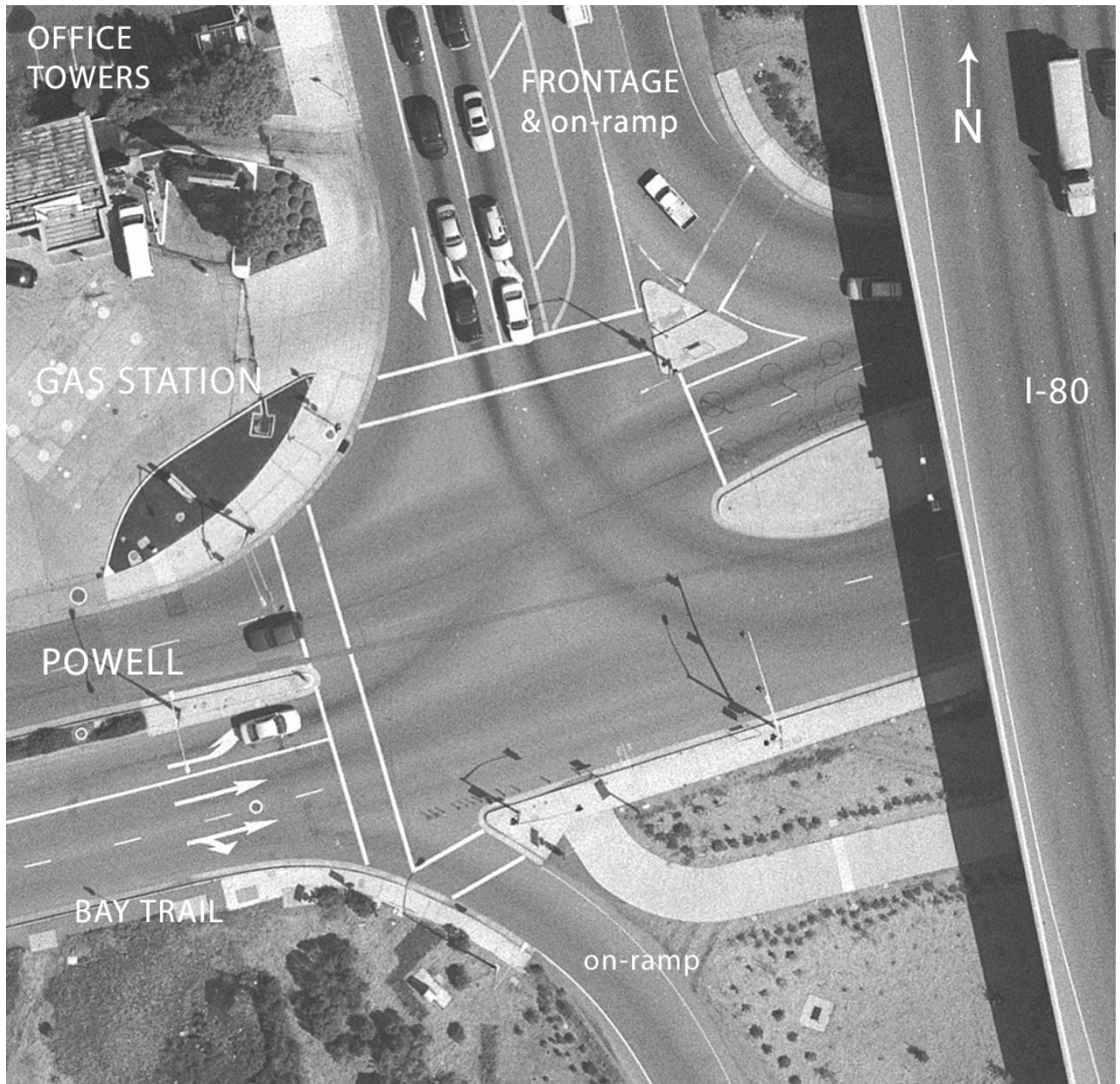
11.8. APPENDIX H: ORIGIN-DESTINATION DIAGRAM

Origin Destination Patterns: Surveyed Pedestrians



11.9. APPENDIX I: INTERSECTION AERIAL PHOTOGRAPHS

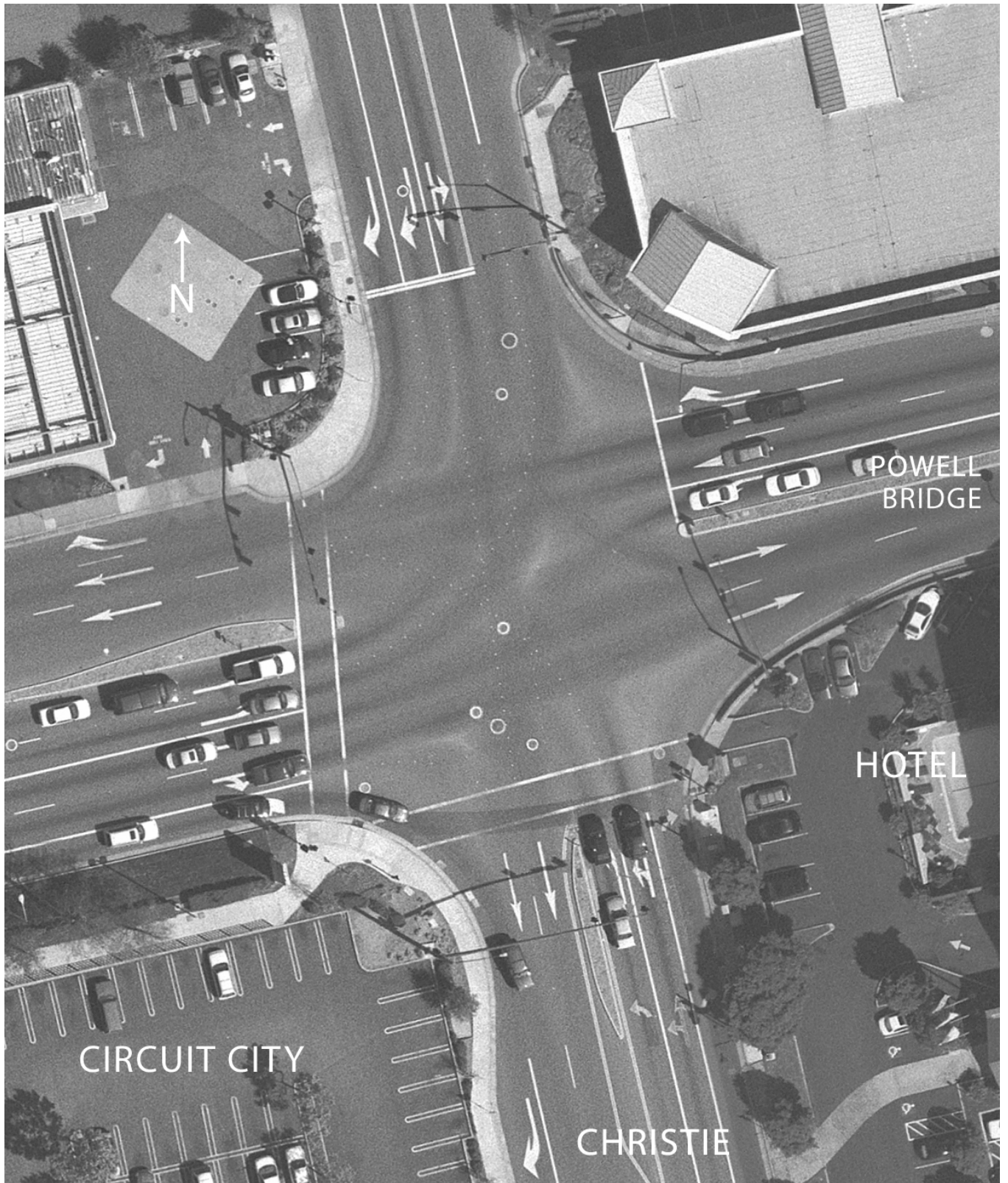
POWELL AND FRONTAGE



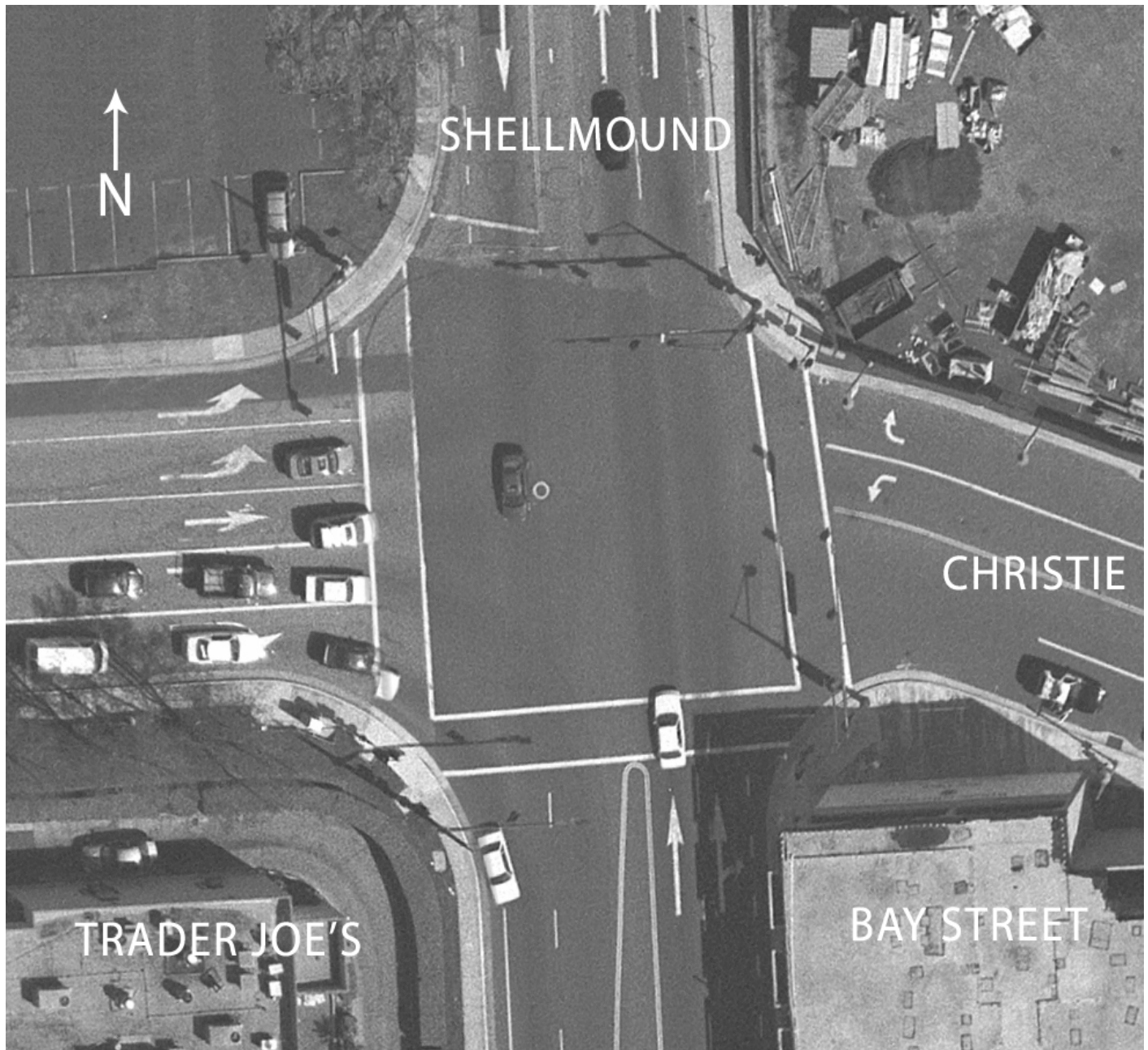
POWELL AND I-80



POWELL AND CHRISTIE



CHRISTIE AND SHELLMOUND



11.10. APPENDIX J: PRESENTATION SLIDES

Presentation made by the TSC to the Emeryville City Council on May 17th, 2005.