



Health Impact Assessment of Rainier RapidRide Bus Rapid Transit Project

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Editors:

Melanie Brown
Louie Leiva
Ariel Scholten

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The University of Washington Health Impact Assessment authors:

Lauren Ballinger, Maria Blancas, Bridget Boyle, Emily Brown, Melanie Brown, Britta Cedergren, Jess Chuang, Isabella Colpo, Dennise Drury, Leah Grodinsky, Daysha Gunther, Yang He, Sharon Hwee, Ly Huynh, Jahn Jaramillo, Mallory Kennedy, Louie Leiva, Wes Loven, Celia McTigue, Ali N'Simbo, Daniel Osterhage, Farzana Rahman, Tatiana Sarkhosh, Ariel Scholten, Ambyr Travis, Pauline Trinh, Gabriela Wagener-Sobrero, and Stephen Walston.

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Course Instructor:

Andrew L. Dannenberg, MD, MPH

Affiliate Professor

Department of Environmental & Occupational Health Sciences, School of Public Health

Department of Urban Design and Planning, College of Built Environments

University of Washington

Course Collaborators:

Arthur M. Wendel, MD, MPH

Medical Officer

HHS Region 10, Division of Community Health Relations, Seattle

Agency for Toxic Substances and Disease Registry

Edmund Seto, PhD, MS

Associate Professor

Department of Environmental & Occupational Health Sciences, School of Public Health

University of Washington

Alison Townsend, AICP

Transit Strategic Advisor

Project Development Division

City of Seattle Department of Transportation

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1.0 EXECUTIVE SUMMARY

Background

The Seattle Department of Transportation (SDOT) is overseeing the project proposal to upgrade Metro Route 7's to RapidRide bus rapid transit by 2021. The Rainier RapidRide Line will connect Downtown Seattle, Chinatown-International District, Mt. Baker and Rainier Beach. Metro Route 7 currently has one of the highest rates of ridership in Seattle serving approximately 11,000 riders on a daily basis. RapidRide seeks to provide fast, frequent, and easy to use public transportation services. The shift to RapidRide along the Rainier corridor is made in efforts to address consistent delays during peak hours alongside prioritizing improvements to walking and biking conditions. These improvements will also address safety as Rainier Ave S has the highest number of crashes of any corridor in the City of Seattle.

The Rainier Corridor, located between the Martin Luther King Jr. Way S in Mt. Baker and S Henderson St in Rainier Beach, faces a series of social challenges that typically warrant a health impact assessment. Like the greater City of Seattle as a whole, the neighboring community currently being serviced by Metro Route 7 is growing. The Rainier Corridor is home to large minority and lower-income populations, many of whom are transit dependent and may have limited English proficiency. Improvement of transit service can have positive impacts on health and equity and is intended to meet local and regional efforts to improve mobility.

A primary goal of RapidRide is to integrate the facets of Metro Route 7 that function best in this community, while also improving amenities and providing better connections to Link light rail stations (SDOT Project Overview). Rainier RapidRide is part of a Seattle's greater RapidRide Expansion Program. This collaborative effort between the City of Seattle and King County Metro will implement seven new RapidRide Corridors by 2024. Rainier, like other corridors selected for RapidRide's expansion, were chosen through analysis of transit performance data and input from community members and partnering agencies. The project proposal to replace King County Metro Route 7 with RapidRide along the 8-mile stretch has implications that should be addressed using an equity lens to support the health and mobility of Rainier Corridor's most vulnerable populations and their overall quality of life.

HIA Methods & Process

Health Impact Assessment (HIA) is defined as a "systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects." (National Research Council of the National Academies, 2011). HIA is a six step process including screening, scoping, assessment, recommendations, reporting, and monitoring.

Screening

Prior to the beginning of the class, instructor Dr. Andrew Dannenberg assessed the feasibility and usefulness of conducting an HIA on the new Rainier RapidRide Route. In collaboration with Alison Townsend of SDOT, they determined that the scope and importance of this project were appropriate for the conduct of an HIA.

Scoping

In an interactive session facilitated by course instructor, the HIA Team identified five topics to examine through a lens of public health and equity: Health and human services, Mobility, Infrastructure, Community and development, and Environmental conditions.

Assessment

Assessment was conducted using literature review, reports provided by SDOT and the City of Seattle, discussions with Alison Townsend from SDOT, and a field visit to the Rainier RapidRide corridor.

The following questions helped guide each group's thought process and focused areas of concern:

- Health & Human Services
 - How is the accessibility of health services and community resources changed due to the Rainier RapidRide's implementation?
 - How will the RapidRide affect passenger and bus driver health and safety?
- Mobility
 - How will the Rainier RapidRide change travel for pedestrians, bicyclists, motorists and transit users?
- Infrastructure
 - What supportive infrastructure is required to ensure Rainier RapidRide is safe and effective for all?
- Community & Development
 - How will the RapidRide project enhance or mitigate current issues such as gentrification and economic development within the Rainier corridor?
- Environmental Conditions
 - What improvements can the RapidRide program offer the communities of the Rainier corridor to combat the variety of pollution types currently found in the area?

Our findings indicate the conversion of the Metro Route 7 to the proposed Rainier RapidRide route will have an overall positive health impact on both residents and visitors of the Rainier Corridor. Increased mobility and reliability of transit will improve connectivity for residents to local health services, community resources, and job opportunities.

The Rainier RapidRide project also has an opportunity to foster increased levels of community pride and environmental awareness if collaborative efforts are made between SDOT, King County Metro and the communities in the Rainier RapidRide corridor.

This report includes impact tables concerning the expected positive and negative health impacts of the Rainier RapidRide project for each of the above focus areas, along with their respective magnitudes of impact and distribution.

Reporting

On May 31, 2018, the UW HIA team presented their findings and recommendations to SDOT staff and were provided with feedback that was subsequently incorporated into the final report. The HIA team hopes that SDOT will post this report on their website so that the community members will have access and can use this information to facilitate discussions that take health into consideration as RapidRide lines expand within Seattle.

Monitoring

The UW HIA team encourages SDOT and King County Metro to consider the recommendations provided in this report and to periodically review these recommendations as the project proceeds. The team does not have capacity for ongoing monitoring.

Recommendations

The HIA team recommends SDOT proceed with the proposed Rainier RapidRide project because improved transportation options are favorable to health. The team asks that SDOT consider the following recommendations, as well as others listed in Section 10 of the full HIA report, to further promote health equity along the proposed route:

1. SDOT should consider reducing the speed limit along Rainier Ave S from 30 MPH to 25 MPH to reduce the number of motor vehicle crashes and pedestrian/bicyclist injuries on the route.
2. SDOT should consider ensuring the maximum distance between Rainier RapidRide stops is no greater than 0.5 miles for all stops.
3. SDOT should consider designing the Rainier RapidRide bus route to align with local businesses and large employment hubs, and should consider avoiding bus stop placements adjacent to liquor and recreational marijuana stores so as not to encourage consumption.
4. SDOT should consider using materials in the bus stop and areas of added pavement designed to minimize road traffic noise.
5. SDOT should consider prioritizing the cohesiveness of Rainier Beach and other neighborhoods by working to connect the Rainier RapidRide with current and future Light Rail stations.
6. SDOT and King County Metro should consider collecting additional community feedback on existing RapidRide lines and on Rainier line when complete to help guide future decisions
7. SDOT, King County Metro and local community organizations should consider working together to provide site appropriate trash receptacles, creative signage, and programs to promote environmental awareness and discourage behaviors that increase litter.
8. SDOT and King County Metro should consider partnering with the healthcare, mental health and substance services centers located in Rainier Valley to communicate transportation changes.
9. SDOT and King County Metro should consider prioritizing community outreach with information on RapidRide service changes, especially in regions of the Rainier Corridor with higher concentrations of families without vehicle access and the Prentice Loop neighborhood.
10. King County Metro should consider ensuring that 100% of Rainier RapidRide buses are equipped with cameras with both audio and visual feed to improve real and perceived security on buses.

Conclusion

The Rainier RapidRide project as currently designed is generally favorable to health. If implemented, the recommendations listed in this report may help further promote health equity and mitigate negative health outcomes along the Rainier RapidRide route and the larger Rainier Corridor.

2.0 INTRODUCTION

Social determinants of health are an important component of the health and safety of the general public as they include factors like socioeconomic status, education, health status, employment, neighborhood and physical environment, and social support networks. Transportation systems have a large impact on these determinants, both by directly providing mobility to transit users and indirectly by impacting physical activity, air quality, injury risk, social capital, mental health, social equity and environmental conditions. The Rainier RapidRide, one component of Seattle’s Vision Zero Plan which aims to reduce the frequency of traffic related accidents and promote public safety, is proposed to replace the existing King County Metro Route 7 bus service within the Rainier Corridor and has expected positive health impacts on the residents and visitors of the area.

The Metro Route 7 bus now serves the Rainier Corridor (Figure 2.1) that is home to approximately 9% of Seattle’s population and an ethnically diverse area with a higher percentage of low income residents as compared to Seattle. Figure 2.2 provides further information on demographics within the area. As shown by the “Zero Vehicle Households” row, the rate of transit-dependent households within the Rainier Corridor is also much higher than in Seattle overall (SDOT, 2018).

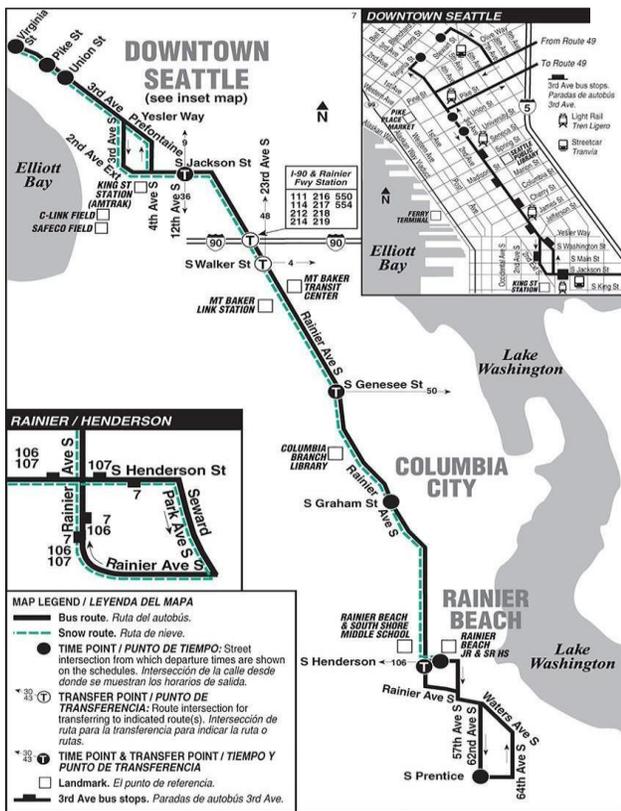


Figure 2.1 Map of the current Metro Route 7

| | STUDY AREA | | CITY OF SEATTLE | |
|--|------------|---------|-----------------|---------|
| | NUMBER | PERCENT | NUMBER | PERCENT |
| Population | 58,817 | 100.0 | 653,017 | 100.0 |
| Minority Population | 34,966 | 59.4 | 222,932 | 34.1 |
| Black or African-American | 11,626 | 19.8 | 46,391 | 7.1 |
| American Indian and Alaska Native | 830 | 1.4 | 3,695 | 0.6 |
| Asian | 13,631 | 23.2 | 92,332 | 14.1 |
| Native Hawaiian or Other Pacific Islander | 196 | 0.3 | 2,509 | 0.4 |
| Hispanic or Latino (Of All Races) | 5,263 | 8.9 | 42,490 | 6.5 |
| Other ^a | 3,420 | 5.8 | 35,515 | 5.4 |
| Low-Income Population ^b | 14,385 | 25.8 | 85,764 | 13.5 |
| Limited English Proficiency (LEP) ^c | 6,528 | 11.7 | 26,425 | 4.3 |
| Youth (under 18) | 8,445 | 14.4 | 100,548 | 15.4 |
| Senior (Over 65) | 7,563 | 12.9 | 75,797 | 11.6 |
| Households | 26,873 | 100.0 | 296,633 | 100.0 |
| Zero Vehicle Households | 8,598 | 32.0 | 48,678 | 16.4 |

Figure 2.2 Demographics of the Rainier Corridor vs City of Seattle

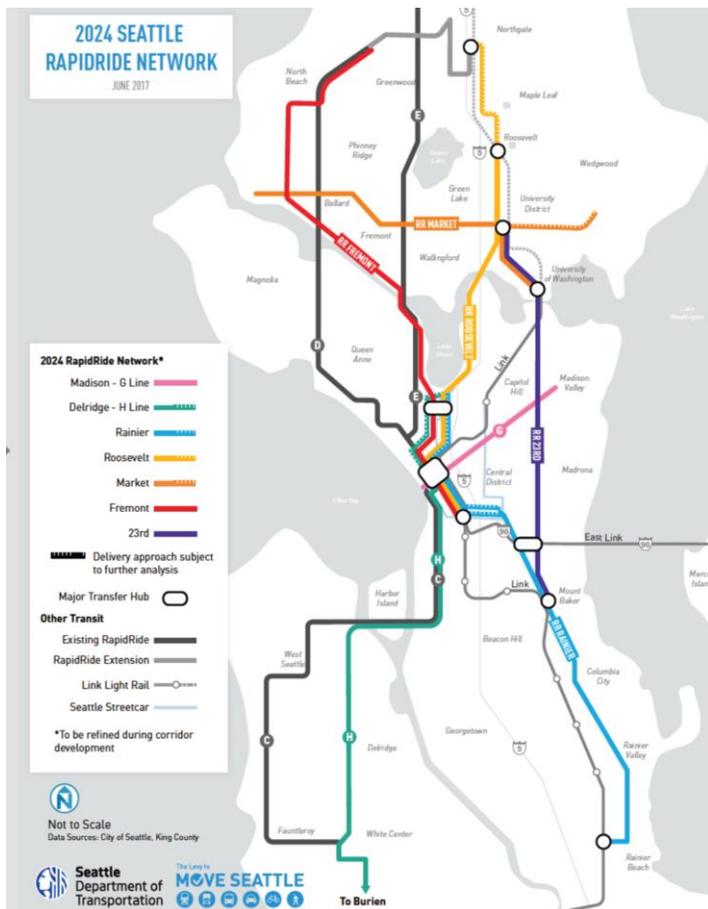


Figure 2.3 Expected Seattle RapidRide Network by 2024

The Rainier RapidRide route will be 8 miles long, from downtown Seattle to Rainier Beach. The route is expected to have 23,800 daily boardings and serve 107,000 Seattle residents. The impact of this route has a wide breadth, and as such, examining the potential health impacts of this project is valuable.

Developed as a partnership between the City of Seattle and King County Metro in 2010, the RapidRide program aims to “deliver reliable, convenient, high-quality transit options to Seattle’s growing population” (SDOT, 2018). The introduction of RapidRide Routes throughout Seattle is part of an effort to connect neighborhoods throughout the city to employment, shopping, educational opportunities, transit hubs and services. In Figure 2.3, the projected 2024 Seattle RapidRide Network is shown with the proposed Rainier RapidRide depicted in blue. Here, the Rainier RapidRide’s connection to five other RapidRide routes, including Roosevelt, Madison-G Line, 23rd, Delridge-H Line, and Fremont is depicted as well as the existing C, D, and

E RapidRide routes.

The expansion of the RapidRide program throughout Seattle aims to create an efficiently run transportation network with the following as goals:

- 10-15% decrease in length of travel times
- 10-minute or better headways for daytime service
- 15- to 30-minute or better headways for nighttime and weekend service
- Increase in ridership of 50% within 5 years
- 85% on-time arrival

RapidRide routes typically include features not found on most King County Metro bus routes. Additional amenities common to RapidRide routes include:

- Dedicated bus lanes
- Enhanced bus stops including improved shelters and waste collection amenities
- Off-board fare collection
- Specialized, fuel-efficient buses
- Smart signals
- Bike and pedestrian connections to transit

3.0 BACKGROUND & SCREENING

Health Impact Assessment (HIA) is defined as the “systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects.” (National Research Council of the National Academies, 2011). HIAs provide a platform for different professions such as urban planning, public health, and transportation to work together and can be used as a tool by decision makers to make choices that will positively impact the community and promote safety and health equity.

HIA Goals

The goals of this HIA were to help SDOT and the impacted community:

1. Examine potential implications for public health related to the Rainier RapidRide
2. Mitigate negative impacts of the Rainier RapidRide on the health of the community by providing recommendations
3. Highlight positive impacts on the community of the proposed project

HIA Team

Graduate students at the University of Washington, in partnership with the City of Seattle Department of Transportation (SDOT) and with faculty guidance, conducted a voluntary HIA for the Rainier RapidRide corridor over 10 weeks, from March 28 through June 7, 2018.

HIA Process

The following six categories outline the process used to conduct this HIA:

- *Screening:* Prior to the beginning of the class, Dr. Andrew Dannenberg assessed the feasibility and usefulness of conducting an HIA on the proposed Rainier RapidRide Route. In collaboration with Alison Townsend of SDOT, they determined the scope and importance of this project was appropriate for the conduct of an HIA.
- *Scoping:* In an interactive session, the HIA Team identified five areas to examine through a lens of public health and equity: Health and human services, Mobility, Infrastructure, Community and development, and Environmental conditions.
- *Assessment:* The assessment used information from various sources including a literature review, a report on pre-existing conditions and other data provided by SDOT, previous HIAs related to transportation projects, and a field visit by team members to the Rainier RapidRide corridor led by Alison Townsend of SDOT.
- *Recommendations:* Recommendations were provided for each health assessment category within the scope of the project and were created with consideration of the feasibility of the recommendations and involvement of relevant stakeholders.
- *Reporting:* The report was compiled by members of the class and presented to Alison Townsend and Louisa Galassini of SDOT on May 31st, 2018. Their comments and feedback were incorporated during final report editing after the presentation.
- *Monitoring:* Due to the time constraints of the project, the UW team is unable to monitor the impacts of the HIA on the RapidRide project.

4.0 HIA SCOPE

The main goals of this HIA entailed identifying potential short and long-term health impacts, both negative and positive, the replacement of the Metro Route 7 with the Rainier RapidRide would have on the Rainier corridor's residents and visitors as well as informing SDOT and other stakeholders of possible opportunities for improvement to both enhance positive outcomes and ameliorate negative ones.

The Rainier Corridor considered throughout this report is depicted by Figure 4.1. The study area "include[s] a ½ mile area around the alignment between S Henderson St in the south and Valley St in the north" (SDOT, 2018).

On April 5th, 2018, Alison Townsend of SDOT presented a comprehensive report to the HIA Team (the EnvH/UrbDP 536 class) covering the existing conditions of the Rainier RapidRide project. This presentation included a project description as well as explanations of the corridor's existing conditions of land use and zoning, environmental conditions, population demographics and employment, transit, pedestrian facilities, bicycle facilities, parking, roadway, safety, and freight.

The following week, on April 12th, 2018, the HIA Team collaboratively identified five determinants of health to focus on for the HIA of the Rainier RapidRide project: Health and human services, Mobility, Infrastructure, Community and development, and Environmental conditions. The HIA Team then broke into 5 smaller groups of approximately 5-6 individuals to address each of these topics. A combination of literature review, SDOT data, and a field visit led by Alison Townsend, conducted May 3rd, 2018, were the primary methods of research used for this report.

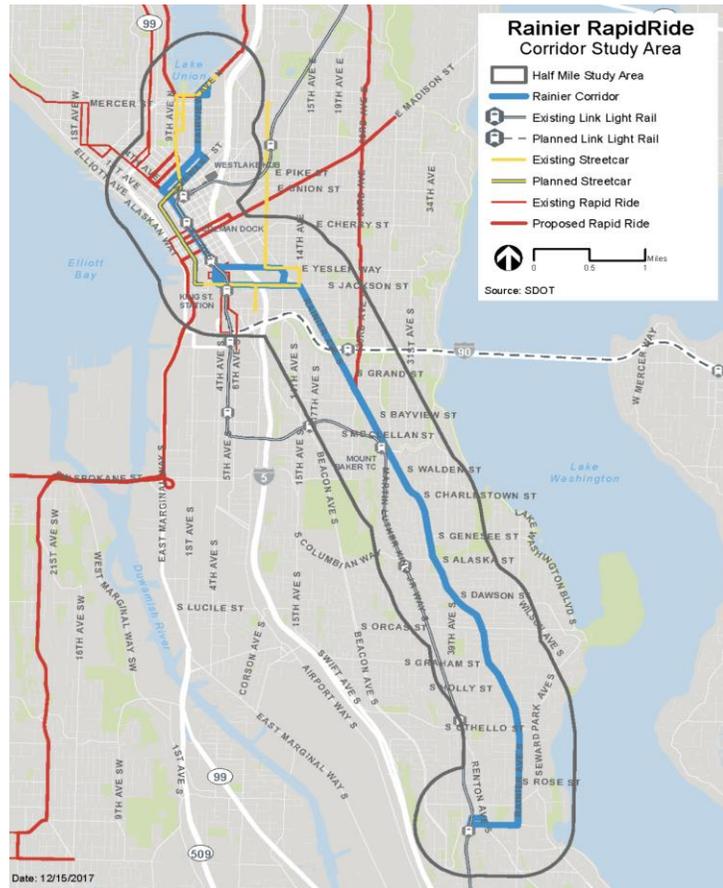


Figure 4.1 Map of the Rainier RapidRide Corridor Study Area

5.0 ASSESSMENT: HEALTH & HUMAN SERVICES

Introduction

One of the goals for the conversion of the Metro Route 7 to Rainier RapidRide include allowing public transit users to reach their destinations in a faster and safer manner. Here, we discuss the potential impacts this transition may have to the quality of life of community members. Quality of life factors are salient at the individual, family and community level and considers equity throughout the population as a primary factor when evaluating potential strategies for change. For this section, it is important to also consider the social determinants of health. As defined by the World Health Organization, social determinants of health are “conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels.”

This chapter discusses the positive and negative effects of access to health services and community resources, equitable enforcement of King County Metro rules and regulations, and the health and safety of community and bus drivers in relation to the Vision Zero Goals. Access to physical and behavioral health facilities, social services, and recreation are all vital aspects of quality of life and reduced access has the potential for vulnerable populations to suffer a reduction in quality of life thereby increasing stress and its physical, social and emotional side effects.

The proposed Rainier RapidRide route traverses one of the most ethnically diverse neighborhoods in Seattle and includes several resources that are accessed by Seattle-wide residents. This section will provide an overview of the positive and negative impacts of this proposal.

5.1 ACCESS TO HEALTH SERVICES

Overview

Access to healthcare is important in both the prevention and treatment of illness. Medical, mental health, and dental care visits are essential for positive health outcomes with some factors such as chronic conditions, pregnancy, and altered mental status which require more frequent healthcare visits. Consequently, accessibility of health care services should be a crucial consideration for both frequent and occasional users of the proposed Rainier RapidRide.

Existing Conditions

One of the key healthcare facilities that provides services to the residents of the Rainier Corridor is NeighborCare Health (Figure 5.1). NeighborCare Health is a community health center that provides primary care, dental care, and behavioral health services to underserved populations including Medicaid and sliding-fee scale patients (NeighborCare website). NeighborCare Health is one of the primary locations for people to access prenatal care including the Women, Infants, and Children (WIC) national program.



Figure 5.1 NeighborCare Health Rainier Beach Medical & Dental Clinic

One of the many strengths of the Rainier Valley neighborhood is the availability of culturally and linguistically appropriate mental health and substance use services for the diverse residents. These include Consejo Counseling and Referral Services, NeighborCare Health, Asian Counseling and Referral Services. Many of the individuals who seek services at the previously mentioned mental health and substance use locations are members of vulnerable populations with such as attributes as English as a Second Language and limited-English speaking, immigrant or refugee status, low-income, and under- or uninsured. These locations serve those within their direct vicinity as well as many individuals from the greater Seattle area who travel to Rainier Valley to seek care from these locations.

Another important unique resource center located in Rainier Valley is The Lighthouse for the Blind, Inc. This is a private organization that provides training and employment support to community members who are blind, Deaf-Blind, and blind with other disabilities. This facility is currently located within 3 blocks from Rainier Ave South and South Plum St and is serviced by the current Metro Route 7. While we have no data on how many individuals use this center, it is currently undergoing rapid workforce growth indicating it is a highly used resource within the community.

Impact on Health Status

Reliable access to health care is one of the key determinants of health outcomes. Access to the primary care services which can be obtained at NeighborCare Health are essential in managing individual and family health and preventive care measures help to avoid many illnesses as can easy access to mental health and substance use services. For the socioeconomically disadvantaged, lack of adequate insurance, lack of financial resources and time away from work, in addition to social stigmas, cultural and linguistic barriers and structural inaccessibility all play a role in keeping many individuals disconnected from much needed health care services.

Assessment

The proposed Rainier RapidRide route will allow for easier connections to be made to the Rainier Beach Light Rail station and thus will improve the accessibility of the Rainier corridor and its healthcare resources to those traveling to and from the area. However, this change in service from the Metro Route 7 to the Rainier RapidRide will affect Metro bus south of Henderson St which includes part of Seward Park Ave S. While this reroute will only affect an area of about 3-4 blocks, it will require these community members to identify alternative routes to NeighborCare Health. Also, it is imperative that the changes to the Metro Route 7 be clearly communicated to current Metro Bus 7 riders that frequent The Lighthouse for the Blind facility, as these customers typically rely on routine to identify their appropriate buses and stops.

5.2 ACCESS TO COMMUNITY RESOURCES

Overview

The Rainier Valley and neighborhood along the proposed Rainier RapidRide is home to many cultural and population-based services along several primary and secondary schools. Continued access to these services and locations are essential for residents, including members of immigrant and underserved communities. These centers provide opportunity for community cohesion, learning, growth and improved quality of life.

Existing Conditions

Currently, the Metro Route 7 bus provides access for over 11,000 riders per year from downtown Seattle to Rainier Beach. Sixteen elementary, middle and high schools are served by the Metro Route 7 based on the parameters of including schools within a two-mile radius of the current Rainier Ave route. This

route serves thousands of families by providing access to education centers when traditional transportation (such as school buses and family vehicles) for school children fall short. In addition to primary and secondary public schools, there are a number of preschools, magnet schools and after-school tutoring centers as well as a variety of educational access programs with cultural and community connections including language immersion and art education.

The City of Seattle is continuing their youth ORCA card program for low-income students for the 2018-2019 school year. This program provides low-income students that do not receive District funded transportation with ORCA cards to ensure reliable transport to and from their schools. For high school students, individuals are eligible if they live farther than 2 miles from their high school; middle school students are eligible if their place of residence is farther than 1.5 miles.

Impact on Health Status

The opportunity for increased access to education and athletic services is very important for youth, specifically in underserved or lower socio-economic areas. Access to safe, timely transportation allows flexibility for students, teachers, staff, and families.

Assessment

The Rapid Ride proposal would continue to serve high schools on Metro Route 7 route, however, Seattle's open district high school plan is to be taken into consideration. Students from all over the Seattle area can apply to different high schools outside of their traditional district area to pursue programs, sports or vocations that are not offered by their current school. Having reliable service on the Metro Route 7 line guarantees that students continue to have access to educational opportunities along the Rainier Avenue corridor.

5.3 COMMUNITY & TRANSIT SAFETY

Overview

The safety of commuters on the sidewalks and roadways is an important consideration for both mental and physical health. In a healthy community, residents should have the infrastructure and services to get to their destination in a safe, affordable, and timely manner. To improve safety for all travelers, the city of Seattle has launched Vision Zero. This plan strives to eliminate fatalities and severe injuries on the roadways by improving education on safety, designing safer roadways, and observing the adherence to traffic laws. Within the Rainier corridor, the primary safety concerns for commuters result from speeding and traffic congestion, limited protection of bike lanes, and insufficient crosswalks. The safety and health of commuters can be improved within the Rainier RapidRide corridor by increasing the presence and safety of crosswalks, consolidating routes with heavy non-motor vehicle transit, and investing in additional infrastructure for cyclists.

Existing Conditions

It is estimated that up to 26,000 vehicles and 11,000 transit trips are made on Rainier Ave S each weekday (Seattle Met, 2014). With such a large volume of traffic and a growing population, it is important to identify solutions for all commuters to get around safely, whether traveling by vehicle, bicycle, or on foot. Last year there was over 16,000 traffic fatalities and severe injuries in the Seattle area alone (SDOT, Vision Zero). Of these areas, the Rainier Corridor is one of the of the most dangerous based on both residential accounts (Crosscut Daily News) and traffic accident data (SDOT, Rainier Corridor).

The Rainier corridor has a history of high motor vehicle collision rates. Contributing factors include frequent patterns of speeding and high traffic volume. The areas with most vehicle collisions occur on

Rainier Ave. Most of the car, bike, and pedestrian accidents occur at intersections and are primarily caused by cars (2016 Vision Zero Progress Report).

Rainier Ave S has limited infrastructure for bicyclists and does not offer a continuous bike route from Rainier Beach to downtown Seattle. Many of the bike routes that are available are unprotected and unsafe. Most of the bike lanes along Rainier Ave S currently consist of buffered bike lanes and sharrows (painted lanes along the streets). There is a separated bikeway available from Rainier Beach to Othello and up to Columbia City but it does not go north of Mount Baker (SDOT Bike Route Map).

Several locations on the Rainier Corridor have heavy pedestrian activity during the morning and evening peak hours, particularly around transit centers and in the downtown area. Along Rainier Ave., pedestrian safety is a concern because of the fast-moving traffic and insufficient crosswalks. Curb ramps are missing from numerous crosswalks along Rainier Ave. making it more challenging for pedestrians to cross.

Impact on Health Status

The design of roadways and sidewalks in a community can positively impact health by ensuring a safe passage for all pedestrian, bicyclist, and motor vehicle commuters. A community needs safe options for whichever they choose to travel to work, school, or to the market. The considerations mentioned above were selected based on increasing the overall well-being and quality of life for the community. A good community design can increase accessibility and reduce collision injury (Miranda-Moreno et. al., 2011). A safer environment with less frequent accidents will reduce the stress associated with commuting, particularly for pedestrians and bicyclists. For the changes to be inclusive to the entire community, safety changes must be accompanied by modifications to increase accessibility modifications for vulnerable communities such as people with disabilities and the elderly. If there will be less stops as a result of the RapidRide, targeted communications to this community can help improve their quality of life.

Assessment

The new Rainier RapidRide is proposing changes to the existing Metro Route 7 to improve the flow of traffic, increase frequency of buses, and improve on-time arrival. In Chinatown/International District, stop consolidation is proposed to improve the flow of traffic and decrease travel time. Reducing the number of stops along Jackson St. could reduce accessibility for the elderly in the area, who comprise about 25% of the population (SDOT Current Conditions Report). However, an increase in traffic and congestion has been associated with more frequent accidents (2016 Vision Zero Progress Report). If stop consolidation is selected, the impact on elderly and disabled riders could be reduced by informing them of alternative services offered by Metro Access buses.

Another change proposed for Rainier Rapid Ride would include designated land use changes on Rainier Ave., from S Bayview St. to S. Jackson St., for bus-only lanes, protected bike and bike lanes, or a combination of bus and protected bike lanes. From these options, the second would provide the most benefits for safety by improving crossings for pedestrians and offering protected lanes for bicyclists. Improving roadway safety could reduce the number of accidents and subsequently improve traffic flow by eliminating or reducing time spent required to clear accidents.

The final major change would include removing the Prentice service loop and adding protected bike lanes to the south end of the route on Henderson St. Adding a protected bike lane would result in 50% less street parking but would improve the bikeability of the street.

Approximately 36% of the commuters in the area use some form of public transit, biking, or walking to commute, which each require some level of crosswalk access (SDOT Current Conditions Report).

However, there are a limited number of the proposed changes that specifically name intersections along the route they aim to improve. Crosswalk safety improvements should be considered at Rainier Ave. S and Henderson St. (high pedestrian activity), Andover St. and Rainier Ave. S (dangerous intersection), and Rainier Ave. S and S Charlestown St (lacks crosswalk). Studies show pedestrian safety can be drastically improved by evaluating bus stops with high activity for the safety of their crossings (2018, PEDS).

5.4 OCCUPATIONAL HEALTH & WELLNESS

Overview

Research shows that transit workers experience both physical and psychological occupational health conditions. Due to the nature of their shifts, many bus and transit operators work long hours and with limited relief or meal breaks (Wei et al. 2017). Assuring a healthy workforce is a means of encouraging improved service both in transit and interactions with riders. Although this is common among bus drivers and transit workers, these issues may become more intensified with modifications proposed by the RapidRide. Careful consideration to improvements to improve ergonomics and reduce stress levels may need to be implemented with the new RapidRide project.

Existing Conditions

Since 2014, King County has been taking measures to add more transit service, which has expanded the number of operating hours for transit workers. It is estimated that an additional 270,000 hours of annual bus service has been added to 68 bus routes since that time. However, with Seattle's rapid increase of transit use, these may not be enough. Although incentives to keep working and retain jobs, such as "Transit Driver Appreciation Day" and "Driver of the Month" programs have been put in place, these do not target some of the stress and physical dangers imposed upon transit drivers. Several health impacts aside from need for organizational support and additional training may impede on the safety and health of transit drivers.

Impact on Health Status

Some of the physical conditions associated with transit drivers are fatigue, neck injury, and low back pain, cardiovascular disease, gastrointestinal disorders, and musculoskeletal problems. A common physical condition that plagues the transit sector is low back and neck pain due to the "whole-body vibration[s] that occur when a vehicle encounters bumps in the road" (Bovenzi and Zadini 1992). However, improvements to seating conditions can prevent lower-back pain in drivers.

Several psychological occupational health conditions associated with rapid transit include higher job strain, less support from co-workers, fewer rewards and greater signal conflict while driving (Gomez-Ortiz et al. 2018). With the new RapidRide implementation, these conditions may be further aggravated, as time pressures increase on transit drivers. Additionally, transit workers have shown a high prevalence of occupational musculoskeletal disorders, which have been associated with psychosocial risk factors (Wei et al. 2017).

Assessment

For the Rapid Ride transit bus from Downtown to Rainier Beach, the physical health of drivers could potentially be impacted. In 2015, King County Metro conducted research to determine the cost-effectiveness of improving seating conditions for drivers, which could reduce the incidence of lower-back pain. According to the study, "...the adoption of active-suspension seats may both improve driver health and reduce claims costs at the agency..." but were not implemented (Gregerson 2015). With faster routes

in the RapidRide, the lack of active-suspension seats could result in drivers' experiencing more strain in their lower backs.

In terms of the psychosocial occupational health issues, rotating shifts and providing relief may be more difficult to implement as the project is a rapid transit project. This could lead to more pronounced stress, fatigue, and lack of support.

5.5 PUBLIC SAFETY

Overview

Social and built environments have significant impacts on a community's sense of public safety. When addressing the change and possible improvement of transit infrastructure, it is pertinent to understand the real and perceived effects on community safety. Individuals who feel unsafe in their neighborhoods are less likely to use transit and are more likely to opt for single car use (Appleyard & Ferrell 2017). Perceptions of lack of safety can attribute to stress, reduced physical activity, and lack of social cohesion (Stafford, Chandola, & Marmot 2007).

Rainier Valley, which will be served by the new RapidRide is categorized as the South Precinct by the Seattle Police Department. The South Precinct encompasses zip codes such 98178, 98108, 98144 and 98118, the latter being one of the most diverse zip codes in the US. Area residents belong to a variety of cultures and languages. Ethnic and racial minorities face higher victimization due to their background (Pain, 2000). Considering that Rainier Valley is host to a sizeable number of vulnerable communities, prioritizing the safety of these individuals and their community is of utmost importance.

Existing Conditions

In a 2017 public safety survey conducted by researchers at Seattle University, participants were asked to rank their top five safety concerns. Respondents from the South Precinct indicated residential burglary (856), car prowling (792), street robberies (721), shots fired (666), gun violence/shots fired/drive-by shootings (474) as areas of concern (Helfgott & Parkin 2017). Gun violence and particularly firearm-related deaths are higher in Rainier Valley (13.3 per 100,000) compared to the county average (7.1 per 100,000) (Community Health Indicators). Residents of the neighborhood are also 3.3x more likely to be a victim of homicide.

Despite these concerns, the South Seattle Crime Prevention Crime Council found that area residents are less likely than those in the rest of Seattle to report crime. Surveyors estimate only 10-25% of crime is reported due to a multitude of barriers (South Precinct). Firstly, the many languages and cultural practices in the neighborhood raise difficulty in verbally reporting crime. Secondly, residents who belong to communities of color may have mistrust in the police due to historical and present-day trauma in interfacing with law enforcement officials. Lastly, some residents may avoid reporting to protect against retaliation or shame.

Perceptions of safety on the Metro Route 7 in its current condition are low. In response to a number of assaults in 2016, Metro announced a safety plan to install cameras onto all 1406 metro buses. In the same year, bus operators of Metro Route 7 reported 270 security incidents, ranking it the third highest only behind the RapidRide E line. The line is one of the busiest in Seattle and is known by many riders and operators alike as challenging. Some potential riders state avoiding the bus due to fear of assault or altercations while on or waiting for the bus. Figure 5.2 reported by an investigation by KIRO7 graphically displays serious incidents which do not include minor offenses such as fare evasion. Passenger

disturbances and operator assaults are among the highest compared to other routes in the city which raise concern for the status of safety.

Lighting at bus stops and along the corridor is also a highly stated concern among participants in an online survey about the Metro Route 7. Lighting at many areas is shrouded by trees or does not engage walkways connecting bus stops.

Impact on Health Status

Fear of crime is linked with poorer mental health, reduced physical activity, and lower quality of life (Stafford, Chandola, & Marmot 2007). Stress, anxiety, and depression are among the effects felt by residents living in areas of high crime. The link between decreased physical activity and fear stem from a lower utilization of public spaces. Walking through or using a public space exposes one to increased risk for the victimization of crime. Living in an area with high crime rates significantly reduces engagement in physical activity among youth and ethnic minorities (Pain, 2000). Residents are less likely to use public spaces and make social trips if they fear crime may occur while using such spaces. In addition, perceptions of crime can dissuade passengers from using transit for recreation and socializing.

A systematic review published in 2007 finds mixed results on whether lighting decreases rates of crime but does conclude that across most studies, improved lighting increases the perception of safety (Welsh and Farrington 2007). The review also states that increased perceptions of safety follow high use of public spaces.

A systematic review published in 2007 finds mixed results on whether lighting decreases rates of crime but does conclude that across most studies, improved lighting increases the perception of safety (Welsh and Farrington 2007). The review also states that increased perceptions of safety follow high use of public spaces.

Assessment

Upgrades to the route via new busses and infrastructure may potentially increase feelings of safety among Rainier Valley residents. If the Rapid Ride increases the reliability of arrival times and decreases time spent at bus shelters, residents may feel safer and increase transit facilitated visits to amenities and recreation spaces. The change in metro buses to less crowded and more frequent RapidRides may potentially decrease altercations and assaults as passengers are able to enter through various doors instead of bottlenecking through the front. Equipping all RapidRides that serve the corridor with cameras may increase perceptions of safety and decrease the likelihood of altercations.

Improved lighting at shelters and along walkways would greatly improve perceptions of safety and improve ridership. If safety in general is increased by the conversion to the RapidRide, passengers may feel less stress and anxiety using public transit and see an increase in quality of life.

One concern regarding RapidRide changes coming to Metro Route 7 is the presence of fare enforcement officers. Considering that riders belong to a wide array of ethnic and racial minority groups that face

Metro routes with highest #s of security incidents

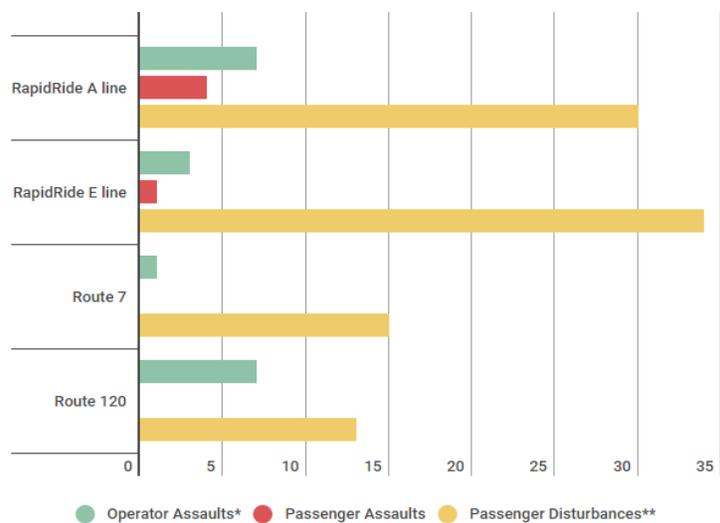


Figure 5.2 Metro Routes with the highest number of security incidents

disproportionate discrimination misconduct by law enforcement, introducing transit security may increase added stress or dissuade ridership on the line.

5.6 CUSTOMER SERVICE & FARE ENFORCEMENT

Overview

Customer service and satisfaction will be necessary components for the success of the Rainier RapidRide, and for ensuring that the needs, expectations, and concerns of consumers are addressed. Customer feedback therefore helps to determine the quality of service; identify perceived and potential problems that need improvement; and make changes to improve services. Understanding and anticipating the health needs, potential environmental risk factors, and health-related concerns of riders through measures that focus on customer attitudes of current services quality, affordability, availability, and preferences, is a necessary step in safeguarding healthier cities and communities.

Existing Conditions

In recent customer satisfaction surveys, 89% of customers reported that it was easy for them to get into and out of the bus, while less than half reported that the seats were comfortable and there was enough space. Most respondents were in the 50-65 age bracket. These elements of being a transit rider can be stressful; especially for customers with greater health needs or concerns who may require assistance to board on and off the bus. Literature shows that the built environment plays a significant role in supporting older adults in aging and can promote and maintain positive mental and emotional health. Surveys on RapidRide Lines D and F also revealed improvement areas pertaining to customer service needs months after implementation of the upgraded lines that directly linked health and well-being. These areas include personal safety especially while waiting for the bus at night; concerns over the behavior of other people at waiting areas; protection from weather at bus waiting areas; being able to sit down while waiting; and being able to get a seat once on the bus. Surveys on Orca Lift users have also pointed to gaps in satisfaction in: price and affordability; instruction on how and where to load money to the Orca Lift card; transfer times; and card functionality.

Impact on Health Status

Modifiable risk factors relating to physical violence or the threat of violence, second-hand smoke, standing for long periods of time, intense weather conditions on (e.g. exposure to humidity or varying degrees of cold air from the air conditioning unit), bus vibrations, and off (exposure to harsh weather conditions) the bus can generate stressors and pain on the body leading to injuries. These considerations can be especially troublesome and worrying particularly for those at high risk for injury with pre-existing health conditions. Lack of comfort of the passengers due to rigidly fixed seat arrangements and bus vibrations transmitted through seat bases have been shown to cause health difficulties and mental stresses for individuals. Other studies point to chronic rhinitis and pharyngitis, throat irritation and hoarseness from sudden changes in temperature and humidity and its effect on the respiratory system. Since 10% of all Orca Lift users depend on the reduced fare program for medical appointments, gaps relating to information, access, constraints between bus transfers, and issues with card scanners have direct implications on the health of users, not only for the those aged 19 to 64 years who qualify for the reduced fare program, but also for ORCA youth card users (children 6 through 18), regional reduced fare permit (RRFP) users (those 65 and older and/or with disabilities), and homeless individuals. Those experiencing homelessness are three to four times more likely to die prematurely than their housed counterparts and experience an average life expectancy as low as 41 years.

Assessment

As fare enforcement expands with the expansion of RapidRide and off-board payment, potential health impacts on financially vulnerable individuals can potentially increase and affect more people. On regular non-RapidRide routes, drivers are responsible for checking fare payment at the front door of buses, but do not issue citations. The lack of payment alone would not lead to direct contact with the criminal justice system, whereby those who may not have the ability to pay could potentially be pardoned. However, RapidRide's new fare enforcement significantly reduces the interaction individuals can have and their ability to negotiate with drivers, exposing them to contracted private security officers with the authority to cite them and further compound their likelihood of adverse health outcomes.

5.7 EXPECTED IMPACTS

Based on the team's findings, the following health impacts are expected:

| Health Outcome / Determinant | Direction of Impact | Magnitude | Quality of Evidence | Distribution |
|---|---------------------|-----------|---------------------|--|
| Access to health care centers | - | ▲▲▲ | ** | Equally distributed |
| Access to mental health and substance use centers | o | ▲ | ** | Vulnerable populations will be most impacted |
| Access to community based organizations | - | ▲▲ | ** | Equally distributed |
| Access to K-12 schools | o | ▲▲ | * | Equally distributed |
| Access to recreational spaces | o | ▲ | * | Equally distributed |
| Roadway safety | + | ▲▲ | * | Equally distributed |
| Bicyclist safety | + | ▲▲ | ** | Equally distributed |
| Pedestrian safety | + | ▲▲ | * | Equally distributed |
| Perception of safety | + | ▲▲ | ** | Equally distributed |
| Interpersonal conflict | + | ▲ | * | Equally distributed |
| Security measures on buses | + | ▲▲ | ** | Equally distributed |
| Physical conditions for transit drivers | - | ▲▲ | * | Drivers will be most impacted |
| Ergonomics of bus | - | ▲ | ** | Drivers will be most impacted |
| Psychological health of transit drivers | - | ▲▲ | * | Drivers will be most impacted |
| Operations | + | ▲ | * | Drivers will be most impacted |
| Fare enforcement | + | ▲▲ | ** | Equally distributed |
| Accessibility and affordability | o | ▲▲ | ** | Equally distributed |
| Customer Service | o | ▲▲ | ** | Equally distributed |

Key:

Direction: + = increase, - = decrease, o = inconclusive or no impact

Magnitude: ▲ = minor impact, ▲▲ = moderate impact, ▲▲▲ = severe impact

Quality of Evidence: * = some evidence, ** = moderate evidence, *** = robust evidence

6.0 ASSESSMENT: MOBILITY

Introduction

Mobility, the ease with which people can get from one place to another, must be considered as SDOT updates or removes current Metro Route 7 stops, especially in considering the individuals who use the southernmost stops towards Rainier Avenue S. The communities living along the corridor are more racially/ethnically diverse and of lower socioeconomic status than Seattle as a whole (“Rainier RapidRide Existing Conditions”). Studies indicate that communities of color and low socioeconomic status, such as those living along the corridor, typically bear the brunt of unintended health consequences of transportation projects similar to the proposed RapidRide project (Handy 2002). Other concepts related to mobility include the accessibility and connectivity of public transportation to community centers, places of worship, workplaces, food stores, and other destinations.

Mobility has important health-related impacts, especially as it relates to public transportation. In the economic sphere, the ability to access places of employment has impacts on socioeconomic status, as low socioeconomic status and poverty has been correlated with higher rates of cardiovascular disease, mental health issues, and health care utilization (World Health Organization). Increased mobility and public transportation ridership create a more interconnected transportation network allowing more on-time reliability and transportation choices, which may lead to increased access to places of worship, parks, community centers, schools, and other places that promote socialization with community members, which has significant influence on mental health and social cohesion (American Public Health Association; Stewart et al. 2017). Physically, promoting mobility and active transportation such as walking can decrease rates of hypertension; a 1999 study, found that adding 20 minutes of walking to work was related to a reduction in the risk for incident hypertension (Hayashi 1999).

It is also important to examine the relationships between mobility and an improved public transportation system that is timely and reliable through a social justice and equity lens. The Rainier RapidRide project has the potential to exert positive impacts on mobility and to improve the timeliness and reliability of bus transit to and from Downtown Seattle through the Rainier corridor. For example, the Rainier RapidRide project has the potential to increase accessibility for people using wheelchairs by making it faster and easier for them to board the bus without assistance from the bus driver. However, such infrastructure changes also have the potential to disproportionately impact poorer communities and communities of color negatively. Adding transportation may incentivize housing developers to build expensive units along the Rainier RapidRide line, displacing current residents because they can no longer afford to live there. SDOT should consider that changes such as removal of stops in poorer areas, typically in the Hillman City, Rainier Valley, and Dunlap neighborhoods, decreases the mobility of already disenfranchised communities, and should work to mitigate possible harms.

Changing the Metro Route 7 to a Rainier RapidRide system can impact mobility in the following ways: impacts to pedestrians; impacts to vehicles, including commercial and family vehicles, bicycles, and buses; and impacts to people with disabilities. We anticipate that, in general, the Rainier RapidRide project will exert positive impacts on mobility through the following mechanisms: increased pedestrian and cyclist safety; improved bicycle, pedestrian, bus, and light rail connections; decreased risk of collisions between motorists, pedestrians, and cyclists; and improved accessibility for people regardless of their level of ability. We also highlight potential negative impacts to mobility, which are likely to be more pronounced if SDOT does not incorporate concepts of equity into project implementation. We highlight this concern in our discussion of potential impacts to individuals with disabilities, as well as in our discussion of how particular changes to the route might affect the low-income and racially/ethnically diverse communities living along the corridor.

6.1 PEDESTRIAN MOBILITY & WALKABILITY

Overview

Increasing the ability of people to reliably get from place to place is one of the primary reasons SDOT wants to change the Metro Route 7 to RapidRide. Increasing the extent to which an area promotes walking to bus stops to access the Rainier RapidRide is a critical element to consider. It is important that all pedestrians and transit users can access and use a well-connected transportation system that continues to connect them to work, home, and play. Elements to consider include: the quality of the current sidewalk infrastructure, the extent to which lighting is sufficient for pedestrians at all times, and the safety of areas around the bus stops. In terms of increasing walkability along the route, SDOT should consider how changes will impact walking distance between stops, the impact of geography on pedestrian mobility, aesthetics, and the extent to which safety and noise along the Rainier corridor will be impacted.

Existing Conditions

Metro Bus Route 7 currently travels from Downtown Seattle on Third Avenue to Rainier Beach on Rainier Ave, spanning approximately 7.5 miles across 76 bus stops. This route is one of the busiest in the King County Metro Transit network with approximately 11,000 riders per day, with the bus running every 7.5 minutes during peak periods and every 10-15 minutes during non-peak periods (Townsend 2018; Fesler 2018; Rainier RapidRide Existing Conditions). In addition to the high ridership of this route, it only arrives on time about 76% of the time northbound and 78% southbound. The high number of vehicle accidents on the south side of the Rainier corridor and bus bunching in many sections contribute to buses running late. Within a half-mile of the current Rainier corridor on which Metro Route 7 currently runs, there are more residents who belong to racial and ethnic minority groups compared to the greater Seattle area at 59% and 34%, respectively; there are more low-income residents along the Rainier corridor with 26% and 14%, respectively; and people who live in this corridor are more transit dependent than those who live within city of Seattle, with 32% and 16% zero vehicle households, respectively. It is clear that there is a high number of people who ride Metro Route 7 on a daily basis living within a half mile of the corridor, warranting increased pedestrian facilities and mobility, especially as the population in Seattle continues to grow.

Impact on Health Status

Pedestrian facilities are in a varied state along the Rainier corridor. Sidewalks are in good condition closer to Downtown Seattle and tend to be narrower and in disrepair as the route moves South. Curb ramps are at all intersections, however, many along Rainier Avenue South are only provided in one direction due to unsafe crosswalks (unmarked or not signalized) or high traffic volumes. In addition, many sidewalks are missing outside of the downtown area, especially west of Rainier Avenue between South State Street & Oregon Street between the North Beacon Hill and Columbia City neighborhoods. The poor pedestrian-supporting infrastructure outside of downtown (e.g., sidewalks are uneven in some areas, busy traffic creates noise for pedestrians walking on the sidewalks) also contributes to a lack of pedestrian connectivity in the south part of the area.

The sidewalk conditions and safety conditions along the southernmost areas of the route (near South Lake High School at the South Henderson Street & Rainier Ave South Stop) seem the most in need of updates and are also where more communities of color live. There seem to be more abandoned buildings on this route near the Rainier Valley and Columbia City neighborhoods, which might result in safety issues to and from the bus stops. Uneven sidewalks are seen in higher proportion in these areas. In many busy and high vehicle traffic areas, crosswalks are few, thus limiting safe connections for pedestrians.

Assessment

The Metro Route 7 has a high daily ridership and provides transportation to a multitude of diverse people and their communities. These communities depend on buses to provide a consistent, dependable and safe way to get around town, which necessitates improvements in pedestrian mobility-supporting infrastructure.

SDOT's current plan as it relates to pedestrian mobility includes:

- Reducing the frequency of stops and improving boarding times compared to local bus service to increase on-time rides;
- Removing or updating bus stops to go from 29 pairs of stops on the current Metro 7 to 19 pairs in the Rainier RapidRide, thus increasing the distance between stops to the RapidRide average of 0.3 to 0.5 miles;
- Improving pedestrian crossings;
- Adding transit-only or business access and transit lanes; and
- Adding smart signals at priority locations.

Based on reports by SDOT, we estimate that changing the Metro Route 7 route to the Rainier RapidRide will make moderate to significant positive improvements to pedestrian mobility through 1) having a more consistent and on-time bus system may incentivize pedestrians to walk more to use this service, and 2) increasing comfort and safety as SDOT hopes to make changes to improve pedestrian crossings along the route. Because Metro Route 7 has high ridership and serves more transit dependent communities, it is estimated to increase pedestrian mobility by increasing connectivity through transit. Improved pedestrian crossings could encourage others to walk and use newer, higher capacity RapidRide buses.

Since the RapidRide system stops less frequently to increase on-time arrival, removing more stops may become a barrier to accessing stops by walking. A 0.5 mile walk for an able-bodied person walking at a moderate pace on good terrain is between 8-10 minutes; this time can quickly increase for individuals who are not able-bodied or for areas along the route that have poor infrastructure or steep hills. Additionally, there are no current plans to improve sidewalks along the route. Making updates to bus stops and nearby crossings is beneficial, however, if sidewalks to get to them continue to be uneven, poorly lit, and unfriendly to pedestrians, these benefits might be limited.

6.2 VEHICULAR MOBILITY

Overview

While use varies based on time of day, there are concerns about the reliability of the Metro Route 7 bus route. One area of concern for ridership is the consistency in time of arrival. Currently, Route 7's average for arriving on time ranges from 76% northbound to 78% southbound. Through RapidRide's expansion, target arrival times are set to 85% and goal ridership will be increased by 50% in a five-year timespan ("Existing Conditions Report SDOT"). Prioritizing timeliness will be key to being able to introduce the Rainier RapidRide and public transit as viable alternatives to those that are more likely to commute by single occupancy vehicles.

Existing Conditions

Parking

The parking supply along the Rainier Valley corridor is a combination of restricted, unrestricted, paid, time-limited, and restricted parking zones. Along all segments of the corridor there are portions of unrestricted parking as well as areas with no parking allowed. There are areas of paid parking and time-limited parking in Downtown Seattle and Columbia City. Within the corridor, restricted parking zones exist in small portions of the Yesler Terrace and Dunlap neighborhoods. There are also several neighborhoods with restricted parking zones directly adjacent to the corridor, including Columbia City, Mt. Baker, and North Beacon Hill. There is no carpool parking in the corridor (Rainier RapidRide Existing conditions Report).

Commercial Vehicle Mobility

According to Seattle's Freight Network Designations and Criteria, Rainier Ave S is categorized as Minor Truck Street, providing connections to and from urban villages and commercial districts as well as secondary through routes for network resiliency, with 500+ trucks per day. Freight movements along Rainier Ave S are important for supporting regional and national markets. From Rainier Ave S, trucks can access national markets via I-90 at the Rainier Ave S interchange. From either direction of I-90, freight vehicles can access Rainier Ave and other truck routes to facilitate the flow of deliveries to local businesses. A legal route for oversized vehicles is designated from S Henderson to S Dearborn. Based on crash data collected between January 2009 and May 2014, the intersection of Rainier Ave S and S Dearborn St was identified as a "High Truck Collision Location" in the Seattle Freight Master Plan (City of Seattle, 2016). Up to five crashes involving a truck occurred at this intersection.

Single Occupancy Vehicles & Other Commuting Modalities

As much as Metro route 7 is regularly used, most individuals in the area drive as their primary form of transportation. (Citation)

Table 6.1 Current Corridor Transit Travel Times from 12th & Jackson to Rainier & Henderson with bus travel times provided by King County Metro and auto travel times sourced from Google Map.

| Direction | Average Travel Time (Minutes) | | |
|-----------------------------|-------------------------------|------------------|-------------------|
| | AM Peak (5am-9am) | Midday (9am-3pm) | PM Peak (3pm-7pm) |
| Route 7 Northbound | 47.4 | 44.6 | 46.7 |
| Auto Travel Time Northbound | 24-60 | 22-55 | 22-55 |
| Route 7 Southbound | 44.0 | 48.8 | 52.5 |
| Auto Travel Time Southbound | 22-50 | 22-50 | 26-65 |

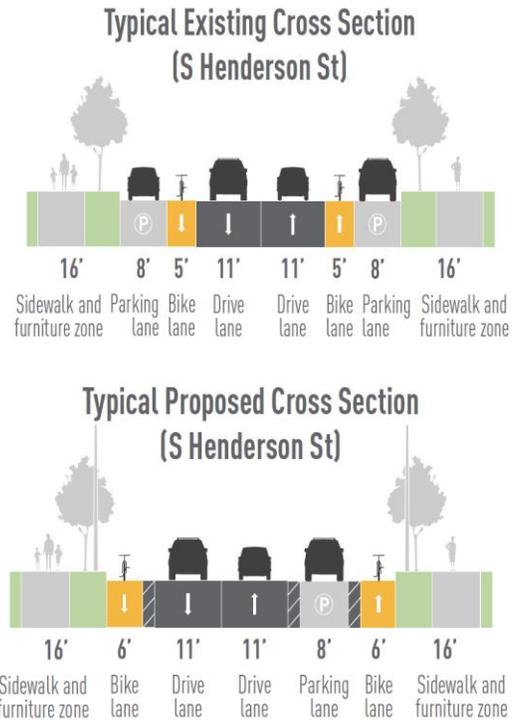


Figure 6.1 Existing and Proposed Cross Sections for S Henderson St

Assessment

Parking

Parking changes are proposed for the Rainier Beach-Henderson St segment. Within the Rainier corridor, S Henderson St is typically 45 feet wide and primarily has one travel lane in each direction; shared by buses and general-purpose auto traffic. Both sides of the street have on-street parking, and there are bicycle lanes between the parking lane and the travel lane in each direction. These bicycle lanes are not buffered on either side. The current plan proposes to add a protected bike lane with a buffer on S Henderson St, from Rainier Beach Light Rail Station to Rainier Ave S. In the plan, the current on-street parking area would be reduced to one side of the street between the drive lane and bike lane, allowing for protected bike lanes (see Figure 6.1).

Changing the Rainier Beach-Henderson St is estimated to make positive improvements to mobility through three main ways: 1) increased pedestrian and bike safety, 2) improved bike, pedestrian, bus and light rail connections and 3) lower risks of collisions for vehicles. There are also possible negative impacts to vehicle mobility. Since the plan proposes to preserve about 50% of on-street parking, those using parking alongside S Henderson St could be inconvenienced.

Commercial Vehicle Mobility

SDOT's current plan as it relates to Freight access includes:

- 11 foot travel lanes preferred for freight and transit;
- For Jackson to Bayview segment, option 3 proposes 11 foot freight access and restricted/no left turn lane; and
- Freight access for other segments would not change.

Wider lanes proposed in the plan is estimated to make positive improvements to mobility through three main ways: 1) support freight movement and allows truck traffic to blend in harmoniously and travel predictably with other roadway users, and thus makes improvements to truck mobility and access, 2) increased pedestrian and bike safety, and 3) lower risks of collisions.

SOVs & Other Commuting Modalities

Prioritizing timeliness will be key to being able to introduce the Rainier RapidRide as a viable alternative to those that are more likely to commute by SOV and maintain flow of traffic. Public health benefits of using public transit include reduced stress and anxiety most commonly attributed to dealing with unexpected delays. A 2015 study conducted in Montreal highlights commuting stress associated with selected mode of transportation. This study examines walking, driving and public transit through a large-scale travel survey and argues that by being able to identify which factors make transportation modes most stressful, public health professionals can inform the decision-making process to create safer and more enjoyable commutes. Driving is highlighted as the most stress inducing mode of travel among the three (Legrain, Eluru, and El-Geneidy, 2015).

Because stress is associated with negatively affecting individual health, recommended interventions could include public service announcements through marketing materials along the Rainier RapidRide's interior and exterior. By educating South Seattle residents about the health benefits of using public transit, there are ways to influence behavior that support goals to increase overall ridership by 50% within the designated five-year timespan (Existing Conditions Report SDOT).

While more research is needed to fully evaluate relative stress as it relates to commute modes, there are environmental and mental health benefits of using public transit along Rainier Corridor.

Table 6.2 Means of Transportation for Rainier Valley vs City of Seattle Residents

| Mode of Transportation | Study Area (Rainier Valley) | | City of Seattle | |
|-------------------------------|--------------------------------|------|-----------------|------|
| | Number | % | Number | % |
| Drove Alone | 10,288 | 49.2 | 188,318 | 50.1 |
| Carpool | 1,666 | 8.0 | 30,858 | 8.2 |
| Public Transportation – Bus | 4,005 | 19.2 | 72,317 | 19.3 |
| Public Transportation - Other | 760 | 3.6 | 3,259 | 0.9 |
| Bicycle | 543 | 2.6 | 14,178 | 3.8 |
| Walked | 2,224 | 10.6 | 36,008 | 9.6 |
| Other Means | 402 | 1.9 | 5,239 | 1.4 |
| Worked at Home | 977 | 4.7 | 25,334 | 6.7 |

6.3 ROUTE DESIGN AND INTERACTION WITH OTHER TRANSIT

Overview

Well-connected public transit and transportation routes that are located within reasonable distance of residents' homes have wide-ranging impacts on health. Accessible public transportation--particularly transportation that encourages walking or other forms of active transportation--can promote physical activity and lead to reduced risk for diseases such as obesity, diabetes, and depression, among other conditions (Rissel et al. 2012; Litman 2013; Sallis et al. 2004). One systematic review found that public transportation use was associated with between eight and 33 minutes of additional physical activity (Rissel et al. 2012). Access to public transportation can also reduce the risk of air quality-related health conditions (e.g., cardiovascular disease, asthma, chronic obstructive pulmonary disease, and other respiratory illnesses) and motor vehicle-related crashes and injuries by reducing automobile dependency (Friedman et al. 2001; Titos et al. 2015; Xu-Qin et al. 2016).

Table 6.3 Health-Promoting Destinations and their Intermediary Outcomes and Health Impacts

| Destination | Intermediary Outcome(s) | Health Impact(s) |
|---|---|---|
| Full-service grocery stores and other locations that offer healthy food options | Access to and consumption of healthy foods | Healthy weight management; management of chronic diseases such as diabetes and hypertension (Zick et al. 2009) |
| Health care services (clinics, hospitals, pharmacies, etc.) | Ability to attend appointments and receive timely care and medications; access to disease screening services | Ability to diagnose and manage chronic conditions; appropriate treatment of chronic conditions; reduced care inequities for low income, uninsured, and underinsured populations (Syed et al. 2013) |
| Parks and other recreational and social opportunities | Increased physical activity; improved social cohesion; reduction of risky behavior; improved access to health-related information | Healthy weight management; improved cardiovascular health; reduction in obesity and diabetes rates (Braubach et al. 2017); decreased stress; improved well-being (Chuang et al. 2013; Kawachi and Kennedy 1997) |

Lack of transportation options can also reduce access to health-promoting destinations, resulting in adverse health impacts. Table 6.3 describes a subset of the intermediary outcomes and health impacts associated with access to selected health-promoting destinations.

Existing Conditions

Metro Route 7 serves a residential area known as the “Prentice Loop”, connecting the loop to the Rainier Beach commercial area, downtown Seattle, and points in between. The loop is approximately 1.5 miles from the commercial area, and most of Metro Route 7 stops servicing the loop experience low ridership. Metro Route 7 enables connections to several Link light rail stations and other bus routes at various points along its route. Currently, Metro Route 7 does not connect to the Rainier Beach Link light rail station. There are also many missing sidewalks in the area between the Prentice Loop and the Rainier Beach Link light rail station, and in areas immediately surrounding the light rail station. (Rainier RapidRide Existing Conditions)

The study area in general--and Prentice Loop specifically--is more racially diverse than Seattle as a whole. The area has a larger percentage of residents who are low-income and have limited English proficiency. Prentice Loop is mostly characterized by neighborhood residential and low-rise multi-family housing. Greater than 75% of the loop’s population is minority, and greater than 20% has limited English proficiency. Greater than 50% of the loop’s population lives below the poverty level, while less than 16% of households within the loop lack a car, and are considered transit dependent. Given these demographic figures, removing public transportation access from the Prentice Loop would disproportionately affect a largely low-income, minority population (Rainier RapidRide Existing Conditions).

Impact on Health Status

The current bus route connects the Prentice Loop residents with the Rainier Beach commercial area, including a full-service grocery store. Despite low ridership at Prentice Loop stops, Metro Route 7 encourages Prentice Loop residents to engage in active transport and connects residents to nearby green spaces such as the Kubota Garden, therein promoting physical activity. The current Metro Route 7 also serves as a mechanism for connecting residents to other health-promoting destinations, such as community centers, pharmacies, and health care services, thus promoting social cohesion, medication adherence, and other health-seeking behaviors. While the connections of Metro Route 7 to other bus lines and light rail stations facilitate travel over a wider area than is covered by Metro Route 7, the current lack of a connection between Metro Route 7 and the Rainier Beach Link light rail station restricts residents’ abilities to travel longer distances in short periods of time, likely leading some residents to make longer trips via automobile. Reliance on automobile travel can negatively impact air quality and increase some residents’ risk of developing or exacerbating respiratory or cardiovascular conditions. Additionally, public transportation is safer than automobile travel, having less than 10% of the per-mile traffic injury or death rate of automobile travel (American Public Transportation Association 2016).

Assessment

SDOT’s current plan for changing the design of the route entails eliminating the portion of the route that services the Prentice Loop. Changing the route design would likely have adverse impacts on the health of the low-income and minority groups who live within the Prentice Loop. The proposed plan could discourage physical activity among loop residents. While the move to eliminate service to the loop might result in some individuals walking or biking the 1.5 miles to the closest RapidRide stop and increase their activity levels, many individuals might consider this to be too far or unsafe to commute, especially in light of missing sidewalks in the area. The loop has a relatively low proportion of zero automobile households, and loop residents may opt to commute via car—either to public transportation or to final destinations. This could decrease physical activity levels and increase risk for physical activity-related conditions such

as obesity, diabetes, hypertension, and depression. There would be differential physical activity impacts for minority and low-income households without cars, and this effect would be concentrated in the Prentice Loop (e.g., the only area to experience alteration in route design).

SDOT's current plan as it relates to the Rainier RapidRide's interaction includes connecting the Rainier RapidRide line and the Rainier Beach Link light rail station and consolidating and reducing the number of stops on the route. These changes could adversely impact interaction with other transit by decreasing the ease of transferring to other transit. By expanding access to light rail, some residents currently rely on automobile transit might also consider taking the bus to the light rail. It is difficult to anticipate the impact of stop consolidation on interaction with other transit and physical activity, as consolidation might encourage some people to walk further to transfer to other transit lines and dissuade other people from active transport altogether. If they opt to commute via car due to unreasonable distances between transfer points, this would have differential impacts for individuals with mobility issues or other individuals who are unable to trek longer distances to transfer, and those who do not feel safe on the longer walks.

Similarly, decreased reliance on or desire to use automobiles due to easier light rail access could reduce the number of motor vehicle crashes and injuries, while the convenience and acceptableness of transfers under the planned stop consolidation will determine whether automobiles are the more attractive commuting option—and consequently whether crashes and injuries are more or less likely to occur.

6.4 BIKEABILITY

Overview

Active transportation works to increase physical activity, reduce greenhouse gas emissions, improve mental wellbeing, and create a sense of community (Smith et al., Leyden, Friedman, Dannenberg et al.). Residents of Seattle cycle to get to work, to exercise, to go to school, to run errands, among many other reasons. One of the most important factors influencing whether people of across ages and abilities will engage in biking include perceived and actual safety conditions (Dannenberg et al., Smith et al.). Seattle's plan to end all serious and deadly pedestrian and cyclist crashes by 2030 is called Vision Zero (Vision Zero). In conjunction with the Seattle Bicycle Master Plan, Vision Zero seeks to protect cyclists by minimizing conditions which lead to crashes or cause conflict between cyclists, cars, and pedestrians (Vision Zero, City of Seattle Bicycle Master Plan). Implementation of the Rainier RapidRide, with strong emphasis placed on bikeability, can go a long way to attaining Vision Zero's goals and increasing the health of the community.



Figure 6.2 Rainier RapidRide Existing Bicycle Facilities



Figure 6.3 Planned Bicycle Facilities along the Rainier RapidRide

Current Conditions

Throughout the length of the future Rainier RapidRide route, biking conditions and facilities vary. There is a mix of protected bike lanes, shared pavement markings (sharrows) indicating where the road is shared between bikes and traffic, bike lanes with minor separation between parked cars and travel lanes, and neighborhood greenways connecting bike routes through side streets and neighborhoods. Currently there are not any bicycle facilities in Downtown Seattle along the Rainier corridor. However, there is access to protected bike lanes on an adjacent street. There are several locations along the corridor which have biking facilities, including sharrows along S Jackson Street, bike lanes with minor separations running from S Henderson Street between the Rainier Beach Station and Rainier Ave S, and protected bike lanes on Yesler Way between I-5 and Boren Ave S (Rainier RapidRide Existing Conditions Report). Rainier Ave S is completely devoid of biking facilities. This is consistent with an overarching lack of cycling network in southeast Seattle (Rainier RapidRide Existing Conditions Report). There are many neighborhood greenways that currently connect to the Rainier RapidRide corridor.

Impact on Health Status

Improving bus services and other transportation options in the city will reduce the number of SOVs. People will be incentivized to use the frequent, reliable, and safe transit options (Buehler, and Pucher, Dannenberg et al., Leyden). Having safer and more accessible bike facilities along the Rainier RapidRide corridor will have direct positive health benefits and positive co-benefits. People who bike increase their physical activity, helping to reduce risks of cardiovascular disease, diabetes, and feelings of isolation (Dannenberg et al., Leyden, Smith et al.). With a reduction of SOVs, there will be fewer vehicles to emit pollutants which cause asthma and respiratory ailments, especially for persons located immediately along the corridor (Friedman, Smith et al.). Fewer vehicles on the road will result in fewer greenhouse gas emissions that can help to reduce the amount of city heating, heat related illness/death, and other negative health consequences related to climate change (Dannenberg et al., Roberts). Encouraging the use of public transportation and active transportation, such as cycling, should be a priority in Seattle to better overall health.

As noted in other sections, the Rainier RapidRide largely serves an area of Seattle that is made up of minorities and persons of lower socioeconomic status. These populations typically have worse health outcomes because their financial resources, education levels, and access to nutritious foods negatively impact their social determinants of health (WHO Commission). By creating biking facilities that are accessible to all persons, more people along the corridor will be able to bike on a regular basis, allowing more persons to experience the positive health benefits and co-benefits of cycling. Creating an environment that is friendly to physical activity and active transportation in this area will help to narrow the equity gap and show that the city of Seattle is working to achieve social justice.

Assessment

An updated version of the plans and progress of facilities are in the 2017 Bicycle Master Implementation Plan (City of Seattle Bicycle Master Implementation Plan, Rainier RapidRide Existing Conditions Report)

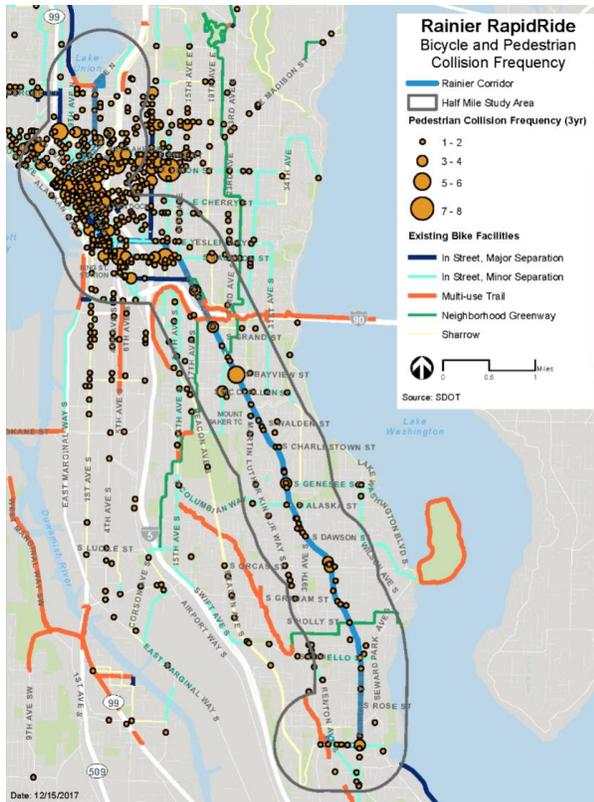


Figure 6.4 Bicycle and Pedestrian Collision Frequency along the Rainier RapidRide

When conducting research and community engagement for the Rainier RapidRide project, SDOT surveyed residents who use the Rainier corridor for various purposes. Respondents spoke to a serious lack of safe cycling conditions along the entirety of the corridor (*Survey of Residents Along the Rainier RapidRide Route*). In addition to lack of safety, many respondents reported that the neighborhood greenways are not realistic alternatives due to significant gradient changes alongside exorbitant stopping and turning; leading to a lack of connectivity and dangerous biking alternatives (*Survey of Residents Along the Rainier RapidRide Route*). This displays a need to continue with (or exceed) the goals of the Seattle Bicycling Master Plan when implementing the Rainier RapidRide program to attain zero pedestrian and cyclist fatalities.

From 2007-2014 there were 3,120 bicycle crashes in Seattle, 237 of which were fatal (City of Seattle Bicycle and Pedestrian Safety Analysis). Because of a number of features contributing to unsafe driving habits, the Rainier Ave corridor has an above average car crash rate compared to other Seattle arterials like Aurora Ave N and Lake City Way NE --

both of which facilitate almost twice the number of vehicles (Rainier RapidRide Existing Conditions Report). These conditions are unsafe for cyclists. If faced with hazardous and unconnected routes, the number of individuals choosing to bike will stagnate or decrease (Dannenberg et al., Gotschi, Buehler, and Pucher). Proper implementation of the Rainier RapidRide should account for measures to reduce erratic driving, reduce driving speeds, and maintain pedestrian visibility to better biker safety and foster an environment that encourages cycling.

Arterial streets can be safer and more bike friendly spaces if properly planned. This is important as 75% of bicycle crashes happen on arterial streets in Seattle (City of Seattle Bicycle and Pedestrian Safety Analysis). SDOT is researching cyclist and car conflict. SDOT can implement their findings through mitigation strategies, along with additional best practices found in other cities onto the Rainier RapidRide corridor.

To further promote active transportation, pedestrian and community safety should be prioritized over the commute times of SOVs. Additionally, the commute times of bicyclists and those using public transportation should be prioritized over SOVs. When these means of transportation are given priority, more people will use them or use a mix of SOV and public transportation by parking at the periphery of a route. One resident says it best, 'Two lanes of personal car travel in each direction is excessive for a road

that sees a relatively small amount of traffic volume but with a higher concentration of vehicle accidents compared to Aurora and Lake City Way. Buses and bikes should be given preference to encourage forms of transportation that are better for the budget, better for the environment, better for health, and to decrease personal vehicle congestion' (Survey of Residents Along the Rainier RapidRide Route).

6.5 DISABILITY AND ACCESSIBILITY

Overview

Disabilities are “an individual’s physical or mental impairment that substantially limit one or more major life activities of that individual,” restricting how the person with the disability may interact with their environment (He, and Larson). Activity limitation in people with disabilities can include difficulties with hearing, seeing, walking, or problem solving, which can impact daily activities, such as commuting, working, self-care, and social activities (“Disability Overview”). The Americans with Disabilities Act (ADA) prohibits the discrimination based on disability, including the Title II provision that any public space not accessible to people with disabilities constitutes discrimination. Meeting ADA compliance standards while improvements along the Rainier corridor are made should be considered as the Rainier RapidRide Project presents a timely opportunity to improve accessibility for people with disabilities who live, work, and visit in the area.

Existing Conditions

The United States Census Bureau estimates that 9.6 percent of Seattle residents are people with disabilities (“2011-2015 American Community Survey 5-Year Estimates | Selected Social Characteristics”). However, residents with disabilities are not distributed evenly, as certain areas along the Rainier corridor have a higher density of people with disabilities compared to other areas of Seattle. For example, people with disabilities are more likely to be low-income, and low-income residents are concentrated in the Rainier corridor at nearly double that of the city at large, where 25.8 and 13.5 percent of residents are low-income, respectively (“2011-2015 American Community Survey 5-Year Estimates | Selected Economic Characteristics”). Americans with disabilities are also more likely to be unemployed and undereducated compared to the population, which negatively affects their earning potential (“Disability & Socioeconomic Status”). There are also slightly more senior residents (aged 65 and over) in this area compared to the city, at 12.9 and 11.6 percent, respectively (“2011-2015 American Community Survey 5-Year Estimates | Selected Social Characteristics”). The rate of disability also increases with age, which may also contribute to the concentration of people with disabilities in this area (He, and Larson).

Additionally, there are major trip generators along the Rainier corridor that bring people with disabilities in and out of the area, such as medical facilities, multiple senior living facilities, and social services like the Lighthouse for the Blind (Seattle Department of Transportation). The Lighthouse for the Blind provides employment and training opportunities for the blind, deafblind, and blind with other disabilities. In addition to employing over 260 people with disabilities, the Lighthouse for the Blind runs a number of programs that draw people into the area such as the Braille Literacy Program. Additionally, their Orientation and Mobility program trains their employees and clients with skills needed to travel independently and safely; bus and street route planning are important aspects of the training (“Our Programs”). Understanding the needs of the people with disabilities as they relate to transit development, walkability, and accessibility is crucial to better serving vulnerable populations in this area.

All RapidRide buses are ADA accessible and most RapidRide busses have a passive wheelchair restraint system that lets people using wheelchairs roll into place without assistance from the bus driver. All Rainier RapidRide busses should include the passive wheelchair restraint system to maintain boarding efficiency

while serving the needs of people using wheelchairs. Additionally, RapidRide busses operate at curb height, which facilitates efficient boarding of people using wheelchairs. Curb height along the Rainier corridor varies and may not meet RapidRide standards. The curb height at all Rainier RapidRide stops should be at this height. Currently, all RapidRide stations have electronic signs that indicate how many minutes until the next bus arrives. The SDOT should consider partnering with King County Metro to install a system to announce bus wait times and approaching busses at the Plum St bus stops to accommodate the high volume of people with vision impairment using this stop to travel to the Lighthouse for the Blind.

Impact on Health Status

The built environment is “disablist” when barriers impede the full participation of people with disabilities within a society (“Disablist”). Design processes typically lack representation of residents with disabilities, and often fail to meet their needs. In addition to disablist infrastructure, streets and sidewalks in disrepair may pose health risks to people with disabilities. For example, sidewalk cracks and potholes can impede the mobility of adults with severe neuromuscular or movement-related disability, reducing accessibility (Clarke, Philippa et al.). Also, seniors are the most likely age group to suffer fatal injuries when struck by a car (Carmeli, Eli et al.). Installing curb ramps and providing safer crosswalks would improve walkability and accessibility. This has positive downstream effects for the community, especially for people with disabilities (“Social Capital”). Public infrastructure improvements reduce the risk of injury but also increase physical activity when people are comfortable spending time outside. Furthermore, when people participate in their community, they are able to build social capital by interacting with their neighbors and engaging with community issues, therein strengthening their communal ties. Social capital is critical for people with disabilities, as they are more likely to be isolated than most residents without disabilities. Improving social connections also have positive effects on mental health. Making streets safe and accessible to residents of all levels of ability is essential for a healthier community.

Assessment

The Rainier corridor is not consistently responsive to the needs of people with disabilities. The pedestrian network along the Rainier corridor has poor connectivity: missing curb ramps, sidewalks, and discontinuous streets prevalent in some areas (Seattle Department of Transportation). Curb ramps are provided at all intersections along the corridor. However, they are only provided on one side of the street in many locations along Rainier Ave S, which does not facilitate safe crossing for people with disabilities. Additionally, missing curbs occur where crossing is already difficult or unsafe due to a lack of marked crosswalks. High traffic volumes and speeds also contribute to unsafe crossing at intersections along Rainier Ave S that lack crosswalks. There are many missing sidewalks and discontinuous streets west of Rainier Ave S between S State St and S Oregon St. South of S Oregon St, a number of streets that intersect Rainier Ave S and S Henderson St lack sidewalks. Sidewalks are narrower along Rainier Ave S and S Henderson St, where sidewalk conditions vary. Some sidewalks are barely wide enough to accommodate a wheelchair or are “damaged to the extent that they would be difficult to navigate in a wheelchair or with vision limitations” (Seattle Department of Transportation). Walkability improvements are needed to comply with ADA standards: widening and repairing sidewalks, providing safe crosswalks, and installing curb ramps, as gaps in the pedestrian network reduce safety and hamper transit accessibility.

The pedestrian bridge crossing Rainier Ave S and Martin Luther King Jr Way S is an example of how the built environment can promote walkability and accessibility. However, people who use wheelchairs may find the bridge ramp too steep to climb and descend without assistance. That this pedestrian bridge may still not be accessible for all highlights the need to engage with stakeholders during the design process, especially those who represent vulnerable populations like people with disabilities. Concerns about steepness could have resulted in a pedestrian bridge that is more accessible for people with disabilities if

this feedback was considered during the design process. SDOT should consider making it a priority to gather feedback from people with disabilities, whether they live, work, or seek care and services along the Rainier corridor to better understand this population's needs and desires. This population is heavily transit-dependent and should have their comments and concerns regarding transit changes heard to ensure an equitable design process that improves accessibility and mobility for all.

6.6 EXPECTED IMPACTS

Based on the team's findings, the following health impacts are expected:

| Health Outcome / Determinant | Direction of Impact | Magnitude | Quality of Evidence | Distribution |
|-------------------------------------|---------------------|-----------|---------------------|--|
| Pedestrian mobility & walkability | + | ▲▲ | * | Pedestrians, especially those south of downtown Seattle |
| Availability of parking | - | ▲▲ | ** | Area near S Henderson St impacted more than others |
| Wider lanes for commercial vehicles | + | ▲▲ | ** | Area near S Henderson St impacted more than others |
| Time spent in traffic | o | ▲ | ** | Area near S Henderson St impacted more than others |
| Interaction with other transit | o | ▲ | ** | Neighborhoods surrounding Rainier Beach Link Light Rail and other transit hubs |
| Bikeability | + | ▲▲ | ** | Area near S Henderson St impacted more than others |
| Boarding time efficiency | - | ▲ | *** | All buses except for instances where persons with disabilities require assistance on- and off-boarding |
| Pedestrian safety | + | ▲▲ | ** | Equal distribution |

Key:

Direction: + = increase, - = decrease, o = inconclusive or no impact

Magnitude: ▲ = minor impact, ▲▲ = moderate impact, ▲▲▲ = severe impact

Quality of Evidence: * = some evidence, ** = moderate evidence, *** = robust evidence

7.0 INFRASTRUCTURE

Introduction

Infrastructure is a critical component of travel and is often the most visible to passengers. For the purposes of this report, the HIA team focused on four key elements of the Rainier RapidRide's infrastructure: logistical and connectivity infrastructure, operating hours and frequency infrastructure, stations and safety Infrastructure, and signage and bus design infrastructure. At each level of infrastructure, the impact on vulnerable populations was explored. Signage that directs individuals to nearby stops in school areas might increase walkability and projects such as walking school bus that could have a great impact on children's physical activity levels, connectivity to nature, and academic progress.

7.1 LOGISTICAL AND CONNECTIVITY INFRASTRUCTURE

Overview

Real-time information has been shown to help riders feel more in control of transit trips, including time spent waiting and perceptions of safety (Watkins et al., 2011). Real-time arrival displays improve feelings of security, reduce uncertainty, increase ease-of-use, adjust travel behavior and improves customer satisfaction (Dziekan, 2007). Keeping riders informed of actual transit arrival times allows riders to plan and reduces uncertainty while waiting (FDOT, 2008). Uncertainty and the added time costs of unreliable service over time decrease rider confidence and may result in ridership declines. Improving consistency and knowledge of transit waiting time may result in more satisfied and increased ridership (FDOT, 2008).

Existing Conditions

As reported in the 2018 SDOT survey of Metro Route 7 riders about the Rainier RapidRide line, the most important aspects of bus transit by riders in this region is bus speed and reliability (SDOT, 2018). Metro Route 7 is a relatively isolated bus line, and the only option to travel north and south along Rainier Avenue for several miles. Without easy-to-access real-time bus arrival schedules at bus stops, people are not incentivized to take the bus. While the One Bus Away mobile device app can provide those with access to mobile data and internet browsing with an accurate timeline for bus arrivals, not all those who depend on the bus have access to mobile web browsing devices. However, more could be done to publicize the app's availability to those with cell phones.

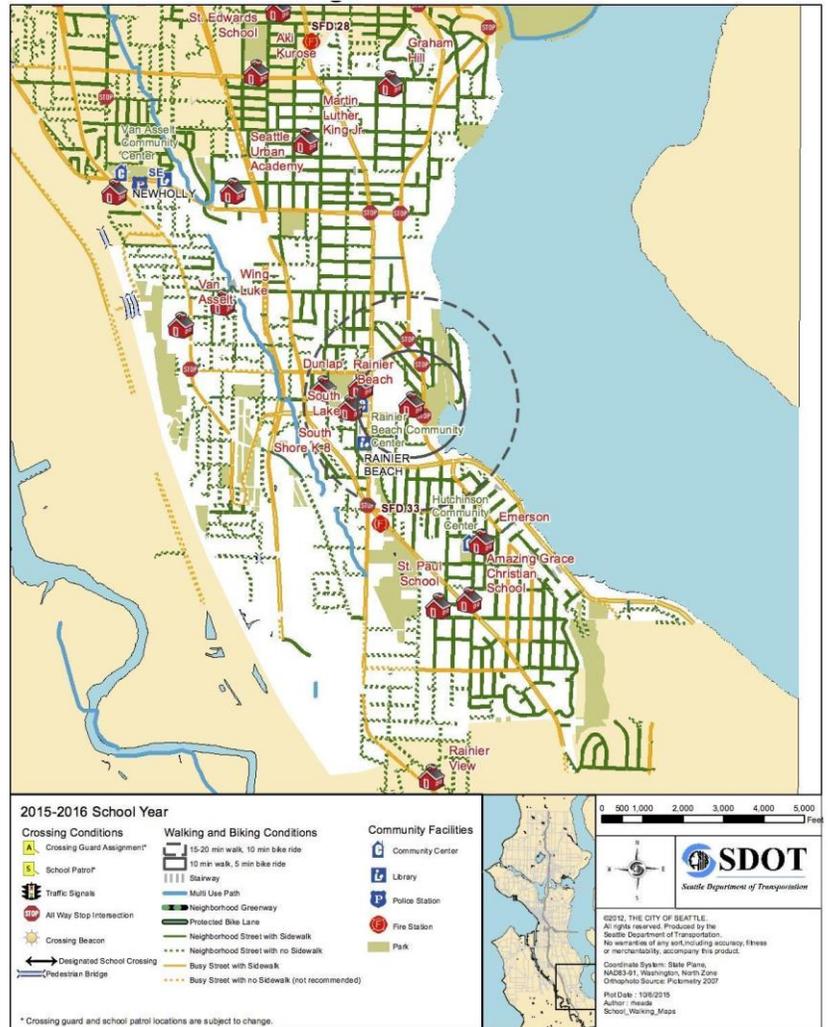


Figure 7.1 Current pedestrian and bicyclist mobility conditions and proximity of community facilities in the Rainier Corridor

Other public survey responses regarding a transition to Rainier RapidRide are concerns about connectivity with other transit options and transfers, especially to any East-West routes (8, 50, 106, 107). Survey respondents express concern that these stops need to remain in place. Schedules for these less frequent buses should be considered in order for passengers to make connections. When asked how SDOT could make Rainier RapidRide transfers better, 9.4% of survey participants requested installing better signage to help riders reach their destination or bus stations (SDOT 2018).

Impact on Health Status

Access to reliable and timely transportation methods both to and from a healthcare facility are often barriers to access to healthcare. Studies have found that transportation barriers impacting health care access range from 3% to 67% of the population (Giambruno, Cowell, Barber-Madden, & Mauro-Bracken, 1997). In a survey of 218 Head Start Programs in New York City, private transportation not available (67%) and cost of transportation (63%) were frequently reported barriers to healthcare in children (Giambruno et al., 1997). Moreover, a systematic review showed that patients with a lower socioeconomic status had higher rates of transportation barriers to ongoing health care access than those with higher socioeconomic status (Kironji et al., 2018). Vulnerable populations, especially individuals who are unable to physically or financially operate vehicles, may include the elderly, disabled persons, low-income families, immigrants, veterans, migrant workers, and the chronically ill. A study of a population largely of immigrants reported that up to 25% of patients missed an appointment due to transportation problems (Syed, Gerber, & Sharp, 2013).

Transportation barriers not only result in adverse health outcomes for individuals but also lead to inefficiencies in healthcare resources. Individuals rely on transportation to receive treatment, but also to obtain diagnostic testing, ancillary services, medications, and referrals for specialty appointments. Without reliable transportation individuals may arrive late, miss, or not schedule an appointment at all. For example, one survey showed that various cancer patients, particularly minorities, forgo needed care in absence of available and affordable means of transportation to treatment facilities (Guidry, Aday, Zhang, & Winn, 1997). These consequences lead to poor management of chronic illnesses and poorer health outcomes.

Assessment

Transitioning to the Rainier RapidRide would improve connectivity of this line to other types of transit. The proposed route would connect Metro route 7 with the Rainier Beach and Mount Baker Light Rail stations, also connecting the route to additional buses that depart from those stations. Connectivity to other types of transit would make access easier, likely leading to increased ridership. Transitioning to Rainier RapidRide would also increase the inclusion of real-time arrival information at all RapidRide stations with up-to-date bus arrival times available to all riders. Knowledge about the frequency of arrivals and easier to track schedules will also improve bus arrival reliability and address the concerns of most survey takers.

7.2 OPERATING HOURS AND FREQUENCY INFRASTRUCTURE

Overview

Previous literature has suggested that shorter wait times in public transit use is associated with a reduced risk of crime, as well as a reduced perceived risk of crime (Alameda-Contra Costa Transit District., 2004). Furthermore, increases in ridership that may result from improvements to bus service, facilities and convenience can lead to greater numbers of commuters present at bus or train stops which may also reduce crime (Human Impact Partners, 2012).

Reductions in real or perceived risk of crime may in turn lead to greater levels of physical activity and social interaction, as well as their attendant health benefits (Fullilove, 1998, and Guite, 2006). Furthermore, crime reduction may also mitigate health risks in vulnerable populations, as illustrated by the findings of Ozer et. al (2006) who observed that exposure to violence was associated with poorer mental health among Chinese American adolescents living in urban areas. Reduction in crime risk may also promote greater neighborhood-level cardiovascular health (Sundquist et al., 2006).

Existing Conditions

The existing Metro Route 7 currently functions as the primary route of transit in the Rainier Corridor, and runs between the Rainier Beach neighborhood and downtown Seattle. Metro Route 7 has a peak headway of 7.5 minutes, a midday headway of 10 to 15 minutes, and a night headway of 60 minutes. Route 7 is in operation 24 hours per day, and runs on weekdays and weekends. Metro Route 7 is occasionally extended an additional 1.6 miles via South Prentice St with a 30-minute headway.

Impact on Health Status

Optimizing operating hours and increasing frequency of public transportation would decrease travel time and reduce one barrier to access to care, especially for vulnerable populations. Travel time has been identified as a barrier for patients to receive healthcare, especially for vulnerable populations that rely on public transportation. For example, a study of low-income women with breast cancer who rely on public transportation showed that they had difficulty in completing recommended radiation therapy due to inadequate access to radiation facilities and were more likely to choose a mastectomy rather than breast conserving surgery (Nattinger, Kneusel, Hoffmann, & Gilligan, 2001). Mastectomy and breast conserving surgery followed by radiation have been shown to have equal health outcomes. However, radiation therapy requires daily sessions over the course of five to six weeks, and some women may opt to undergo mastectomy to avoid radiation therapy. A study using SEER registry data found that women living 15 miles or more from a radiation therapy facility were less likely to undergo breast-conserving surgery. In a study using geographic information system and network analysis in Atlanta metropolitan area showed that the median public transportation travel time to the nearest radiotherapy facility was 56 minutes versus 8 minutes by private vehicle (Peipins, Graham, Young, Lewis, & Flanagan, 2013).

Moreover, increased wait times at bus stops may further expose passengers to other adverse health outcomes, such as respiratory illnesses (asthma from exposure to air pollution including particulate matter).

Assessment

The transition to transit service by the RapidRide model will mark a commitment to stated performance goals that include headways of 10 minutes or fewer during daytime hours, headways of 15-30 minutes or fewer during night and weekend hours, and an 85% on-time arrival rate.

7.3 STATIONS & SAFETY

Overview

The safety features and physical station structures of the Rainier RapidRide stops may not fall completely under SDOT jurisdiction but should be included when considering the overall infrastructure components. SDOT may consider sharing these recommendations with Metro if they meet unmet needs of the riders in the proposed RapidRide. The current state of many of the existing stops is that of a typical bus route: a bench, weather protection, and an occasional trash can. As the Rainier RapidRide route is implemented,

there will be opportunities to enhance safety features already in place at many RapidRide stops in Seattle. To maintain feasibility, station design and safety will be based on existing Metro design at other bus stops in Seattle. Therefore, the labor, costs, and impacts will already be known to the parties involved.

Assessment

The current bus stops have many of the standard features: shelter, bench, and trash can depending on use of the stop and number of riders. The proposed RapidRide is expected to increase ridership, presumably leading to a greater demand of stop accommodations.

Existing Conditions

For new riders beginning to use the RapidRide, bike lockers (or bike racks in more congested areas) may be useful to: (1) reduce the number of bikes the RapidRide bus needs to carry or (2) allow commuters to bike to the RapidRide stop, bus into the city, and not worry about carrying their bike. Providing commuting options for bikers would allow individuals to bike during a portion of their commute, both offering exercise and reducing vehicle emissions.

With increased ridership at popular stops, the existing bus stop weather protection shelters will need to be expanded. The existing structures do not provide enough space for more than 6 people to stand under or more than 3 people to sit. A wider, more open shelter with more seating options would provide space for people to both sit and stand in severe weather conditions.

Existing RapidRide stations are designed with multiple lights so passengers are seen by others, including bus drivers. The proposed route would require modifications to the existing structures to improve the general lighting at stops, as well as a trigger light to notify bus drivers at night. As the number of passengers waiting at each stop increases, lighting will need to expand to ensure all passengers can be seen in the dark, even if they are unable to wait directly under the bus stop shelter.

Perhaps the most popular feature of the RapidRide, the off-board payment system may be a new process that will require an adjustment period for riders. Signage stating the three fare payment options (ORCA card, Valid transfer ticket, or Cash) and a fare inspection warning will be a necessity. This feature allows individuals to board from the back doors of the bus which may also require temporary signage notifying passengers how to do so. Clear indications for how to pay off-board will allow passengers needing extra assistance boarding to have the space and time they need to be accommodated at the front loading door.

Although Metro has not specifically stated these as RapidRide characteristics, two additional features could be considered. First, blue light, or emergency light and phones could be considered as an improvement to bus stop safety. If certain stops are identified as posing potential risks for passengers, emergency blue lights and phones would allow passengers to get into immediate contact with Seattle police. Second, station cameras, similar to those on the inside and outside of the RapidRide buses, may offer an extra level of comfort to waiting passengers. Bus stop cameras may not be a typical feature at all stations, but could be used to address safety concerns at specific stops.

The proposed Rainier RapidRide route will pass by major schools including Dunlap Elementary School, South Shore K-8, South Lake High School, and Rainier Beach High School. In addition, Rainier Beach Playfield, Rainier Beach Branch Library, and the Somali Community Services of Seattle are near the Rainier Ave S and S Henderson St Intersection. Thus, the safety at bus stations served by Rainier Rapid ride is a particular concern for vulnerable populations such as school children, the elderly, and the disabled.

Assessment

The existing stops would ideally transform from a typical Metro stop to a standard RapidRide stop, complete with the shelter, benches, and trash cans.

7.4 SIGNAGE & BUS DESIGN

Overview

Wayfinding and its relationship to public health and walking, although intuitive, has not been well researched. Having to find one's way in unfamiliar surroundings can inhibit walking (Vandenberg et al., 2016). Visible landmarks and signage can be helpful for wayfinding, which leads to the question of how wayfinding can be enhanced for visually impaired persons who are particularly vulnerable to traffic injuries. One study showed that audible beacons improved wayfinding for visually impaired adults in Portland, OR (Barlow, Scott, & Bentzen, 2009).

Others have shown promise in phones and use of technology for wayfinding for those with visual impairments. London has an initiative called "Legible London," for increasing ease of wayfinding and has shown to increase interest in walking (Vandenberg et al., 2016). As wayfinding is a cognitively demanding activity, it can sometimes take attention from walking itself, but more research needs to be done on its effects on public health (Vandenberg et al., 2016). One might argue that improving signage would not only improve and encourage walkability, social capital, and possibly mental health as it helps people stayed oriented, but it also might be that people are more confident in finding their way home because there is helpful signage. Less isolation would improve connectivity and may even decrease homesickness as this area is inhabited by people who are recent immigrants although this has not been studied (SDOT, 2018).

Existing Conditions

There is only one pedestrian crossing bridge in the area, and sidewalks have numerous bumps which might constitute a barrier to wheelchair use. No audio for the blind was seen on sidewalks and intersections during a survey. Street signs showing trails or names of streets were numerous but often too small to read. This area is reportedly one of the neighborhoods with the highest number of car accidents in the Seattle area (SDOT, 2018). If transit conditions are not improved together along with socioeconomic status, the enhancement of technology will not only be a poor economic investment choice, but it has the potential to further oppress disabled people and lead to emotional distress shaped by their contexts. This disconnection between one's reality and the socioeconomic context they live in, along with cutbacks in social services (such as transportation) further oppresses them (Jenkins EK, et al 2015) Such a disconnection between one's reality and their environments can increase stress, which can affect health (Jenkins, E.K et al, 2015). For example, a wheelchair user may be further slowed down or risk injury if there is uneven sidewalk, with or without improved technology on the bus. This would not enhance their experience that the Rainier RapidRide aims to achieve.

Impact on Health Status

Individuals who are print disabled, visually impaired, or blind are at a disadvantage for independent travel via public transportation options. One study done by the Department of Veterans Affairs showed that infrared signage helped blind travelers to negotiate complex environments in transit stations and crossing intersections with better safety, precision, and independence (Bentzen, Crandall, & Myers, 1999; "Making healthy places: designing and building for health, well-being, and sustainability," 2012).

Bus design is also important for people with disabilities to facilitate the use of public transit. New technology such as wireless communication systems and LED flashing lights for visually impaired to signal stops to bus drivers has shown to be helpful in boarding buses for the visually impaired (Wang, Chen, Rau, & Yu, 2014). Schedule and number of accessible buses and access to employees trained to help wheelchair users is also important to wheelchair users (Almada & Renner, 2015). However, it is arguable that if the technology is enhanced but the community cannot afford it because they are poor, then these technologies may not be the most realistic in the community. Knowing an average number of people in the community with disability might help planners in design.

Assessment

Existing stops should have new technologies implemented for wayfinding to maximize health benefits and increase ridership ease of use.

7.5 EXPECTED IMPACTS

Based on the team’s findings, the following health impacts are expected:

| Health Outcome / Determinant | Direction of Impact | Magnitude | Quality of Evidence | Distribution |
|------------------------------------|---------------------|-----------|---------------------|---|
| Personal Safety | + | ▲ | ** | Equal distribution |
| Risk of crime (real or perceived) | - | ▲ | * | Wide distribution but more impact on vulnerable populations |
| Protection from weather / elements | + | ▲▲ | ** | Equal distribution |
| Community connectivity | + | ▲ | * | Equal distribution |

Key:

Direction: + = increase, - = decrease, o = inconclusive or no impact

Magnitude: ▲ = minor impact, ▲▲ = moderate impact, ▲▲▲ = severe impact

Quality of Evidence: * = some evidence, ** = moderate evidence, *** = robust evidence

8.0 COMMUNITY & DEVELOPMENT

Introduction

The places where people work, play, learn, and live hold an important role in individuals' health status and outcomes. When implemented effectively, mass transit has the ability to influence the development of neighborhoods. By providing greater economic opportunity for local residents and community members, amplifying social capital and community cohesion can provide easier access to resources that are critical for everyday living. Conversely, when implemented poorly, mass transit can adversely impact public health through gentrification and decreased housing affordability and accessibility.

It is advisable that SDOT considers the impact Rainier RapidRide will have on surrounding communities and assess how the proposed route can be used as a tool that bolsters both mental and physical health. This chapter provides an impact assessment of the community mechanisms and characteristics the proposed Rainier RapidRide may influence, including economic development, gentrification, housing, food access, social capital, and public art.

8.1 ECONOMIC DEVELOPMENT

Overview

Socioeconomic status (SES) – which includes indicators like employment, education, and income – has been identified as a strong predictor of health and premature mortality (Doubeni et al., 2012). Multiple studies have shown that lower SES is correlated with a disproportionately higher prevalence of both physical and mental health conditions, such as cardiovascular disease, anxiety, and depression (Doubeni et al., 2012). Furthermore, living in a low-SES neighborhood is associated with an increased risk of mortality; this is especially true for communities of color, who are more likely to live in low-income neighborhoods (Winkleby & Cubbin, 2003).

One way to possibly mitigate the effects of low socioeconomic status of individuals within the Rainier corridor could be to increase the community's access to small, locally-owned businesses. Access to small businesses can positively impact health and civic engagement. Communities with a thriving small business sector have reportedly lower rates of mortality and lower prevalence of obesity and diabetes (Blanchard, Tolbert, & Mencken, 2011). One explanation for this is that small business owners contribute to both economic and non-economic factors in the local communities, such as social capital and the ability to address local issues.

Expanding economic development through tourism has also been shown to improve community health. Increased tourist activity has been linked to conservation of local cultural practices, investment in infrastructure and urban areas, and additional opportunities for entertainment and social interaction (Zaei & Zaei, 2013). Tourism can also benefit the economy as small businesses attract more consumers, thus increasing activity in the area; more visitors might generate additional job opportunities in the service and transportation industries.

Existing Conditions

The proposed RapidRide would replace the existing Metro Route 7 along Rainier Avenue South, which currently extends from downtown Seattle to Rainier Beach. This region has a higher proportion of low-income residents (26%) compared to the city of Seattle as a whole (14%); over 50% of residents near the Rainier Beach service area are low-income (Seattle Department of Transportation, 2018). In terms of

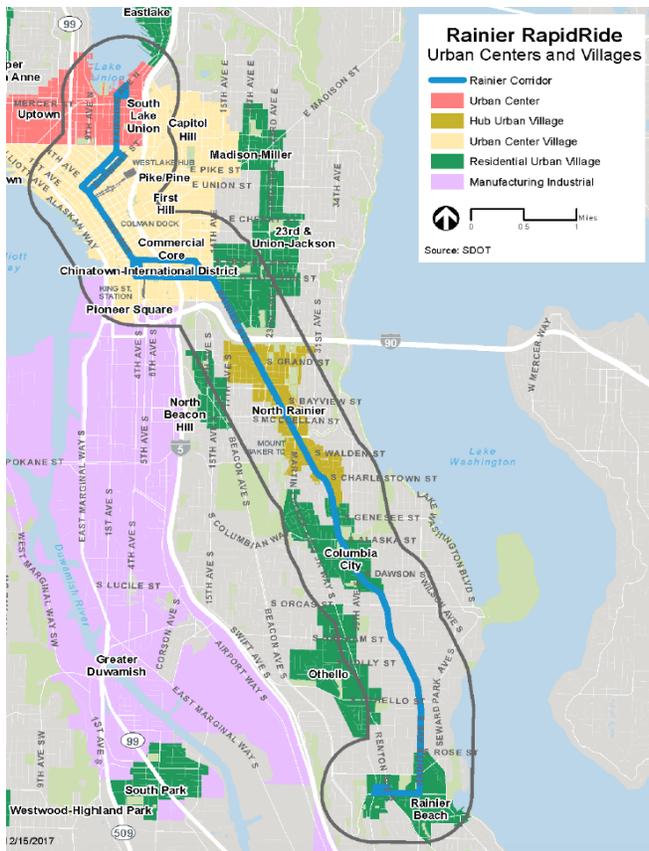


Figure 8.1 Urban center and villages along the proposed Rainier RapidRide

which offer goods and services for residents but may not have high concentrations of employment; see Figure 8.1 (SDOT, 2018).

Seattle’s small business sector is growing as well. Ninety-four percent of Seattle establishments have fewer than 50 employees, and women and people of color are more likely to own smaller businesses (City of Seattle Office of Economic Development, 2018). Several parts of the RapidRide route are also designated Business Improvement Areas by the City of Seattle: Downtown, Pioneer Square, Chinatown/International District, and Columbia City (City of Seattle, 2018). These Business Improvement Areas work with local advisory boards to promote business district revitalization and management.

Impact on Health Status

Increasing transit frequency and improving amenities could attract more residents from other parts of Seattle, as well as tourists, to the areas surrounding the Rainier RapidRide route. With increased ridership, local businesses may see an influx in customers, especially those near bus stops. This effect could be mutually beneficial for both consumers, who have increased access to shops and restaurants, and small business owners who rely on customers for income. A more efficient bus route could also incentivize tourists to travel outside the commonly trafficked downtown and Chinatown/ID areas, toward the southern region of the Rainier Corridor. This project could provide more equitable access to businesses and employment opportunities for lower-income neighborhoods of Seattle, like Rainier Beach. If the new RapidRide project yields calmer streets and less car traffic, the small business districts along

employment, the U.S. Census Bureau reports about 138,600 primary jobs within the RapidRide service area, with the greatest density closer to downtown Seattle (SDOT, 2018). Jobs within the Rainier RapidRide service area range from retail, health care and social assistance, food services, and technical services. Importantly, there are more jobs within the RapidRide service area (138,600) than people who reside in the area (27,586). This means many employees rely on public transit or other means of transportation to arrive to work, since they may not live within the corridor. Currently, 23% of employees use a form of public transit.

The regions served by the Metro Route 7 bus also include several commercial areas that could be impacted by the proposed RapidRide. For example, Rainier Ave S passes through the downtown parts of Columbia City, Chinatown/International District, and Downtown Seattle. The northern section of the corridor is primarily comprised of urban centers, or denser regions that include sites of employment and housing. The southern section of the corridor, near Columbia City and Rainier Beach, is primarily made up of residential urban villages,

the Rainier Corridor could also present as more inviting for locals and visitors rather than feeling like a “highway” (SDOT Survey Results, 2018). This would not only increase the safety of customers but could also promote more activity in these areas.

Assessment

Since increased access to local restaurants and shops can provide health benefits (e.g. food access, social capital, improved walkability), the Rainier RapidRide project is likely to create a positive impact in the surrounding communities. Furthermore, this project creates an opportunity for SDOT to partner with tourism organizations to promote cultural sights and events within the service area. For people residing within the corridor, the Rainier RapidRide could also ensure that employees can arrive to work on time and keep their jobs. These impacts may encourage long-term economic development and investment in community.

8.2 GENTRIFICATION & HOUSING AFFORDABILITY

Overview

Gentrification can be defined as “a profit-driven race and class remake of urban, working class communities of color that have suffered from a history of disinvestment and abandonment. The process is characterized by declines in the number of low-income people of color in neighborhoods that begin to cater to higher-income workers willing to pay higher rents” (Aboeleta, 2017). It is frequently associated with displacement, in which residents cannot afford to stay in their homes and neighborhoods (ChangeLab, 2015). In recent years, concentrating wealth in central cities has pushed lower and middle-income households to neighborhoods and suburbs farther out from city centers (Allard, 2017).

Gentrification is closely linked with negative health outcomes. If residents face higher housing costs and opt to stay in their current residence, they may cut back on essential health-related spending, such as health care and food. Other households may consolidate their housing and live in overcrowded conditions, or move to poor quality housing, both of which are associated with respiratory disease, elevated stress and high blood pressure, and increased rates of infectious disease (ChangeLab, 2015). Moving to less safe or farther away neighborhoods puts households at greater risk of exposure to allergens and toxins (ChangeLab, 2015). Finally, complete loss of housing has substantial negative health impacts including chronic and infectious disease, hunger, injury, violence, and disruption in health care (ChangeLab, 2015).

Gentrification is most commonly measured in terms of rising property values (Zuk et al., 2015). Researchers estimate that proximity to transit raises nearby housing values by 10%, but the overall impact varies widely depending on the context (Duncan, 2008; Wardrip, 2011). Reliability of the transit

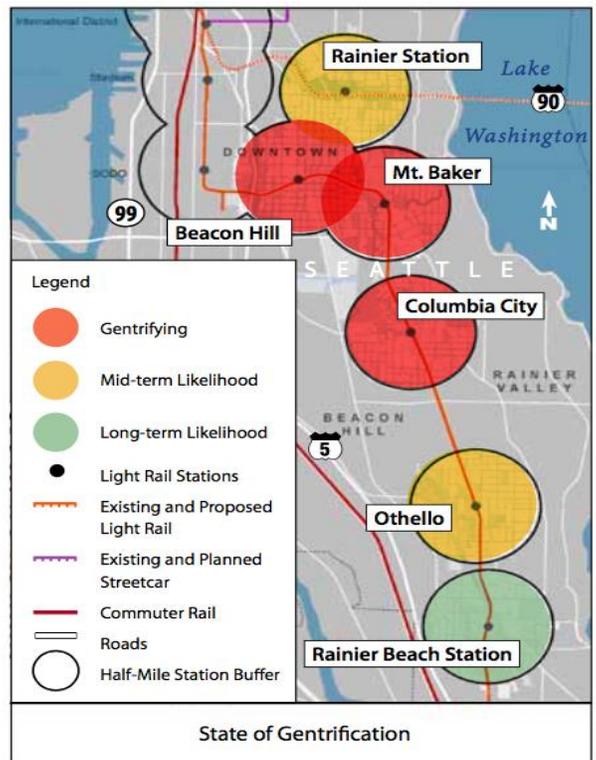


Figure 8.2 City of Seattle Community Cornerstones Gentrification Map, 2013

system and the strength of the housing market are factors that increase the effect of transit on house premiums (Wardrip, 2011). However, these effects are better documented for rail transit than rapid bus transit (Zuk et al., 2015). Overall, improvements to neighborhood accessibility including transit can lead to rising property values that may price out current residents (Pollack et al., 2010; Zuk et al., 2015).

The neighborhoods along the current Metro Route 7, as already noted, are known as some of the most diverse in the Seattle Metro area, with many families having resided in their homes for many years, if not generations. The imminent gentrification process that goes hand-in-hand with increased transit in an ever-growing city will directly impact the population of people within the area, a direct correlation to the new types of housing developers and the city offer along the route.

Existing Conditions

Housing along the Rainier RapidRide route is primarily determined by pre-existing zoning within the area. Closer to downtown, residential density is higher due to greater building height allowances, with more single family and 3-5 story multifamily buildings further south along the route. Because of Urban Village overlays along the route, higher density buildings tend to be along Rainier Ave S, with single family homes on adjacent streets along either side (SDOT, 2018, p. 24).

The Prevention Institute outlines the risk factors for displacement of communities and individuals, which include: geographic adjacency to high-value or gentrifying neighborhoods, public infrastructure developments such as new transit in previously under-invested communities, low-density development that could be denser, a concentration of low-income households and non-white populations, low home or property ownership rates, and rent-burdened households (Aboeleta, 2017).

Most of these risk factors for displacement are present in the Rainier RapidRide project. The Columbia City and Rainier Beach Residential Urban Villages and North Rainier Hub Urban Village are along the route, but currently have lower average housing units per gross acre than similarly zoned areas like the 23rd and Union-Jackson or Wallingford Urban Villages. Average housing units per acre in census tracts along the project area is 5.17, while it is not uncommon for other urban villages in Seattle to average over 10 units per acre. Median household income (using the most recently available census data, 2009-2013) along the project area averages \$56,283, which is lower than Seattle's average of \$65,227 over the same period, and median household income is significantly lower within certain neighborhoods such as Rainier Beach (\$27,292). In addition, the project runs through some of the most racially diverse areas of Seattle - people of color represent over 68% of the population (US Census Bureau, 2014).

The area also has high housing costs with 46% of residents on average paying more than 35% of household income toward rent. Among homeowners, 33% pay more than 35% of income toward mortgage payments. These figures are from 2009-2013 census data and are likely higher as Seattle's housing prices have risen substantially in recent years. However, owner-occupied housing units in the area averages 55%, which is slightly above average in Seattle (US Census Bureau, 2014).

Gentrification in the area is not a new phenomenon; residents of Southeast Seattle have experienced economic and demographic changes for many years. In 2013, the City of Seattle Office of Housing's Community Cornerstone project recommended an Equitable Transit-Oriented Development Loan Program in response to ongoing gentrification (see Figure 8.2) following new Light Rail transit, which was later implemented (Seattle Office of Housing, 2013). Hess (2018) found that neighborhoods around Seattle Light Rail stations saw a rising share of non-Hispanic whites in the population following

construction, while neighborhoods along the Light Rail's more suburban periphery experienced growth in racial and ethnic diversity.

Median sale prices across Southeast Seattle have grown faster than Seattle as a whole in recent years. According to data from Redfin, a national real estate brokerage, median sale prices grew by over 163% percent in Southeast Seattle neighborhoods from January 2012 to March 2018, compared to a 134% increase in Seattle. As of March 2018, the median sale price by neighborhood averaged \$598,162 in the area. This is still lower than the Seattle median of approximately \$701,000. However, the median varies widely by neighborhood: in Mount Baker, a neighborhood that has been gentrifying for a longer period of time, the median has climbed to \$949,000 (versus \$340,000 in 2012), which is far above the median of \$375,000 in Dunlap (\$188,000 in 2012).

The City of Seattle and Mandatory Housing Affordability (MHA) has made an effort to provide both new buildings and renovations of current buildings in the area, including ESC Rainier House and Columbia Place (SDOT, 2018, p. 25) (see Figure 8.3). Seattle has made strides in mitigated inequity in the housing market by trying to implement Transit-Oriented Housing options along transit heavy corridors. Because transit stations and hubs increase housing costs due to greater transportation opportunities, affordable housing options must be provided to offset the spike in housing cost. Seattle is use the Regional Equitable Development Initiative (REDI) Fund to carry out such a measure, which has already seen success in Denver and the San Francisco Bay Area (Capps, 2016).

In short, gentrification is ongoing in the areas of Southeast Seattle served by the existing Metro Route 7. The region's demographic and economic conditions suggest it will continue, but the City of Seattle is exploring policy options to improve housing affordability.

Impact on Health Status

It is not possible to fully disaggregate the anticipated gentrification effect of the Rainier RapidRide project from ongoing demographic and economics shifts in Seattle contributing to displacement, in particular rising housing costs across the city. However, because the Rainier RapidRide project is anticipated to be a significant improvement in transit amenities and reliability compared to Metro Route 7, it will likely increase neighborhood access in a similar manner as a new transit route. Because transit access is associated with increased property values as stated above, as well as demographic shifts, the project is expected to increase gentrification in the area, as measured by property values, rent-burdened households, and share of the population that is white. However, the severity and likelihood of these outcomes is uncertain.



Figure 8.3 Existing zoning along the proposed Rainier RapidRide

If the City of Seattle is unable to provide additional affordable housing alternatives in these gentrifying regions, many residents must travel farther to reach transit. This not only affects persons who cannot travel as far, but also becomes a safety risk for children, seniors, and other vulnerable populations. Providing equitable housing along the route creates a safer and more secure opportunity so that many people will not need to travel so far. Further, providing a standard of housing quality for all housing units would allow people to live in a healthier, safer environment.

Assessment

Despite the threat of negative health impacts from displacement, investments should be made in public infrastructure and safety improvements in underserved communities, given the other anticipated health benefits of the project. Moreover, gentrification throughout Southeast Seattle will likely continue with or without the Rainier RapidRide project, and SDOT and King County Metro do not have control over housing trends. However, SDOT has an opportunity to implement and advocate for strategies that will reduce the negative health impacts from gentrification along the corridor. Expanding ORCA LIFT outreach, continuing investment and engagement in underserved areas, and collaborating with stakeholders in Seattle housing and affordability will help ensure that existing residents can remain in the area to experience the anticipated improvements with RapidRide service.

8.3 SOCIAL CAPITAL

Overview

Social capital has been defined as “the features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions” (Putnam, 1993). Social capital can be further defined in two distinct groups: bonding social capital and bridging social capital. Bonding social capital refers to the cohesion among members of a group who are similar to one another with respect to various forms of social identity, while bridging social capital consists of links among community members who differ on aspects of social identity (Eicher & Kawachi, 2011). Because public transit is used for the purposes of making connections within and outside one’s community, it is worthwhile to assess how the Rainier RapidRide project may impact both types of social capital.

There is consistent evidence showing an association between perceptions of trustworthiness of other people in the community and health status (Kawachi, Subramanian, & Kim, 2008). With this, social support is garnered through residents’ investment in their surroundings and the people in them. Social support has been largely demonstrated in the literature as being a critical component to physical and mental health (Holt-Lunstad & Uchino, 2015). On the other hand, the more people may be disinvested in their community (i.e., stay at home), the less likely they are to feel a sense of social bonding with their community, and thus their perceived social support is likely to diminish.

Therefore, social capital has clear implications for health, and given that public transit is a significant factor in connecting people and place, public transit can be considered a contributing factor between social capital and health. Social capital may influence the health of transit users and neighborhoods affected by the RapidRide changes by impacting connections between people and the places they frequent, creating community buy-in/ownership of transit changes, and impacting existing or future relationships between SDOT and Metro and the surrounding community

Existing Conditions

According to survey data from Rainier RapidRide community engagement efforts, the most common use of the current Metro Route 7 is for riders to get to recreation or social activity places, such as parks, community centers, restaurants, and movie theaters; shopping centers; home; and work (67%, 60%, 59%, and 54% of respondents, respectively; see Figure 8.4). Also important, approximately 44% of respondents use this bus service to travel to neighborhood service locations (e.g., a bank, library, or post office). Less common uses, but crucial for social capital, showed that about 20% of respondents use the Metro Route 7 to get to a medical facility or social services agency, about 15% to travel to a place for education, learning or training, and approximately 8% to a religious or cultural facility. Each of these locations determines perceived social cohesion among neighbors and the people they purposefully visit or “bump into” while outside their homes.

5. What types of places do you travel to on Metro Route 7? Select all that apply.

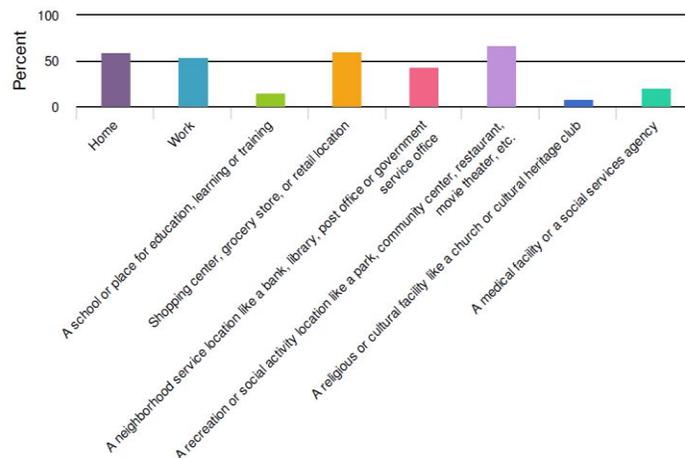


Figure 8.4 Responses to SDOT conducted survey focused on current Metro Route 7 usage

Distance to bus stops may be a determining factor in one's decision to take transit. In the survey, 54% said distance to a station or stop from home matters when getting to the Metro Route 7 bus. Thus, distance to a stop is an important factor to consider when analyzing the impact of the Rainier RapidRide project on maintaining feasible connections between people and their destinations. Also important are connections between different types of transit, which allow people to travel longer and more diverse distances. Among survey respondents, 57% said that the proposed connection from Rainier RapidRide to the Rainier Beach Light Rail station was most important to them in that part of the project corridor. This suggests that community members desire greater connections to other transit options, which has implications for social capital; more transit options increase the potential for connections to more distant places, such as neighborhoods and social/recreation spaces outside the Rainier Beach area, which then improves bridging social capital. The existing Metro Route 7 conditions show that people rely on transit to connect them to the places they are likely to see people they know (or interact with neighbors they have not yet met) and places that hold social and cultural value.

Impact on Health Status

Perceptions of an individual's connection to others impacts health, where the perceived connection is more indicative of health than actual connections. Transit is one mechanism through which people feel connected to people and places important to them. One advantage of RapidRide routes is that they increase the reliability of service. With this, people may use transit more often as they feel more confident in their ability to get around to the places they meet people in their immediate and extended social circles. In addition, because the number of opportunities for impromptu encounters is dependent on the built environment, placing RapidRide stops near communal places increases the chances that neighbors will “bump into” one another, such as in the shopping center on Rainier/Andover (Figure 8.5) or the community center on Henderson (Figure 8.6) (Eicher & Kawachi, 2011). This then increases a feeling of

social cohesion among neighbors and is likely to have a moderate impact on increasing perceived social support. On the other hand, the proposed elimination of the Prentice Loop from the RapidRide route can leave people in this neighborhood feeling less connected. Not only could this mean physical disconnection, but also social disconnection as people may perceive the commute to people or places as less doable. This could lead to a decrease in perceived neighborhood cohesion as their area is less serviced by the transit they utilized to feel connected.



Figure 8.5 Frequently visited shopping center on Rainier Ave S & Andover St

In addition, we predict a small to moderate impact on social isolation and stress. The change from the original bus service to RapidRide has the potential for making people feel left “in the dark” about how to navigate the changes. If changes are not communicated in a way that all users can access and understand, some users might feel intimidated to use the new RapidRide service. This may then lead to increased isolation, which will then decrease perceived social support, negatively affecting health.



Figure 8.6 Rainier Beach Community Center, near South Shore K-8 School

With new development usually comes attractive additions to community infrastructure, which can have a positive, small to moderate, impact on the way people view and value their community. Thus, new development that comes with the project (i.e., new business that come in near the bus stops) may increase community buy-in and ownership, which can be a surrogate measure of social capital. As neighbors share value for their community, they take initiative in making sure their community is a safe place to live, work, learn, and play. Also with new construction comes the potential for tense relationships between developers/planners and the community. If the project makes changes that the immediate community was not expecting or informed on, this may increase the community’s distrust of SDOT. Such wariness may decrease social capital as people may feel their network is being disrupted, disrespected, or disregarded by the developers. Cultural cohesion/strength is an important aspect of building social capital, and thus social health. If not reconciled, community members may feel left out of important decision making on transit development that has the potential to affect their everyday lives; this can have a small to moderate impact on health.

Assessment

Overall, the Rainier RapidRide project may impact social support and connection to communal places, social isolation and stress, community buy-in/ownership, and existing and future relationships between neighborhoods and transit users affected by the project and SDOT/Metro. It is vital to maintain high levels of community engagement so that community members feel informed and heard. It is also crucial to ensure that the proposed changes do not disrupt the current perceptions of neighborhood cohesion. By

mitigating the risk of social disconnectedness, SDOT has the chance to promote an even greater sense of community ownership and social capital.

8.4 FOOD ACCESS

Overview

The Centers for Disease Control and Prevention (CDC) classifies a food desert as an area that “lacks access to affordable fruits, vegetables, whole grains, low-fat milk, and other foods that make up a full and healthy diet” (Centers for Disease Control and Prevention, 2017). There are several groups that can be subjected to a food desert, including low-income, minority, and rural populations. These populations are often forced to rely on convenience stores and/or corner stores to purchase groceries because they lack the access to large retail supermarkets. Low-income households with more difficult access to large grocery stores providing healthy options tend to spend a similar portion of their food budget at large grocery stores when compared to households who do not experience any difficulty in access. However, those low-income households do spend a *much greater* portion of their food budget at convenience, dollar, and drugstores (Larimore & Ver Ploeg, 2018). Studies have also found that neighborhoods of color tend to have much fewer supermarkets and that the availability of chain supermarkets in black neighborhoods, specifically, was only 52% that of their white counterparts (Walker, Keane, & Burke, 2010).

Existing Conditions

According to the USDA Food Access Atlas, there is a large portion of the Rainier Beach corridor experiencing food desert conditions. They are considered to be low-income (at least 20% of the population in the area is experiencing poverty) and live at least ½ mile, in an urban setting, from a grocery store. There are two Safeway grocery stores located near the proposed Rainier RapidRide route with one located on Rainier Avenue S and S Andover (which is one of the only areas that does not fit the food desert criterion according to the Food Access Atlas),

as can be seen in Figure 8.7. It should be mentioned that there is also a PCC market on Rainier Avenue S, however this grocery store is an organic market that is much more expensive than most and is likely unaffordable to low-income residents living nearby. There are several convenience stores and gas stations along the Rainier RapidRide route, as well as mini-marts and traditional ethnic food stores. The Rainier Valley Food Bank is also located along Route 7 and serves as an important food source for many households. It is the busiest food bank in Seattle and currently fulfills over 6,000 food requests each month.

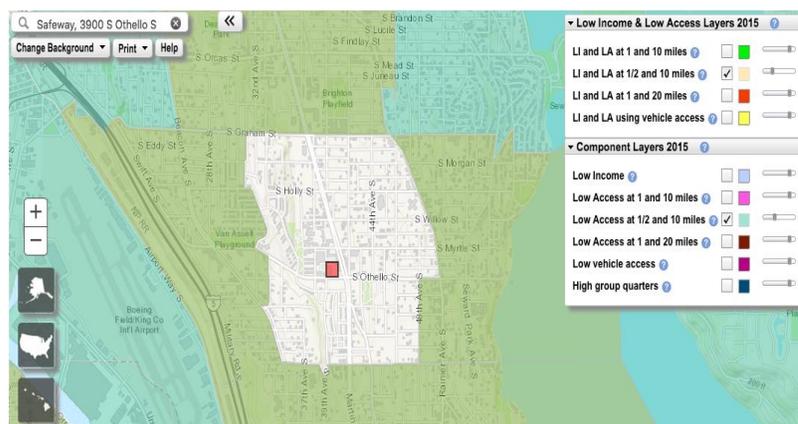


Figure 8.7 USDA’s Food Access Atlas identifies low-income and low access areas with the red marker indicates the Safeway grocery store located along the RapidRide Route

Impact on Health Status

Approximately 6% of U.S. households are classified as being “access-burdened,” meaning that they do not use their own vehicle to travel to the grocery store and they live more than 0.5 miles from the nearest SNAP-authorized grocery store, which serves as a proxy for the nearest source of healthy and affordable food (Ver Ploeg, Larimore, & Wilde, 2017). As can be expected, individuals make food choices depending on what is most easily available in their immediate neighborhoods, which can pose a health concern for many low-income areas that have a much higher density of fast food restaurants and corner stores (Hendrickson, Smith, & Eikenberry, 2006; Walker et al., 2010).

Many studies throughout the years have indicated that socioeconomic status is strongly related to the “nutritional quality of dietary intake” (White, 2007). Residents who live in or near a food desert will likely have increased exposure to “empty-calorie” foods, or nutrient-poor options, that are readily available at convenience stores and fast food restaurants. This has obvious health implications that can lead to poorer health outcomes due to high amounts of fat, sodium, and sugar in these foods. Poor diet often leads to obesity and chronic illnesses such as cardiovascular disease and diabetes. Children often report buying snacks at local convenience stores before and after school which leads to poor eating habits later in life, making it difficult to alter behaviors. Increased access to healthier food options, such as fruits and vegetables, as well as easy access to local ethnic/traditional food markets can improve health outcomes. It is important to consider what the residents of this area are consuming and where essential ingredients can be found.

Assessment

The Metro Route 7 is currently connecting residents of the corridor to large-scale grocery stores, such as Safeway, and local produce/farmers markets. When asked, 60% of SDOT survey respondents reported that they use Route 7 to get to a “shopping center, grocery store, or retail location” (SDOT, 2018). Residents of the International District have also reported their reliance on Route 7 to get to markets and produce vendors located in the Rainier Beach area. While almost half of respondents (46%) indicated that they would be “okay with moving or removing some bus stops on Rainier Ave S to keep buses arriving on-time,” (SDOT, 2018) it is crucial that SDOT considers the changes in distance to grocery stores, traditional markets, and other healthy food retailers by altering stops on Rainier Ave S. SDOT should certainly take these factors into consideration when determining which bus stops will be maintained and which stops will be removed. One respondent reported that “walking farther to get the bus is a big challenge when I have a baby, a toddler, and groceries...Consolidating bus stops favors able-bodied men, in my opinion, who are less likely to be doing family errands and childcare” (SDOT, 2018). Another respondent commented on safe pedestrian crossing, indicating that “it is so dangerous right now by the Rainier Valley Food Bank...I want to reiterate how important it is” (SDOT, 2018).

8.5 PUBLIC ART

Overview

Public art has long been recognized as a community asset yet is often treated as a low priority, especially when funding is already limited. Previous research has shown that low-income residents who live in neighborhoods with more art and cultural amenities are healthier, better educated, and safer than those in similar communities with fewer art and cultural opportunities (“Strengthening Communities Through Public Art,” 2018). Art and neighborhood aesthetics can provide a space for social interactions and foster an environment of inclusion across diverse groups of people. This, in turn, is an important element for community cohesion, which further elicits a sense of belonging among residents and boosts individual

morale and self-esteem. Simply put, shaping public spaces to be aesthetically appealing can reverse feelings of alienation or isolation and build social capital and cohesion.

Existing Conditions

Public art throughout the Rainier RapidRide route is most present at the Rainier Beach Light Rail station where there are several art displays created by both local and non-local artists. The station is surrounded by large glass mosaics, bronze columns that feature measuring systems (which allow the public to interact and see how they “measure up” to the natural world around them), and a ceramic tile mosaic created by South Lake High School students as depicted in Figure 8.8.



Figure 8.8 Examples of art installations at the Rainier Beach Light Rail Station and along Henderson Street (“Public Art,” 2018)



Figure 8.9 Examples of art installations along Rainier Avenue S

On Henderson Street, public art is limited with the exception of a few dated bus stop shelters that display art. The Rainier Beach Community Center, which is also located on Henderson Street, offers a full slate of different programs, including a before- and after-school program that has an art-specific curriculum. A little further down Henderson Street and onto Rainier Avenue lies the Ethiopian Community in Seattle center, a prominent community asset which offers an afterschool art program for Kindergarten to 5th graders, and a cultural immersion program where individuals can learn about Ethiopian leaders in art and literature.

Similar to the sporadic art found on bus shelters on Henderson Street, some of the bus shelters along Rainier Ave S display artwork as shown in Figure 8.9.

There are also some art installations on this avenue – along the proposed RapidRide route – behind Metro bus stops. They include a steel sculpture, murals of animals painted by local high school students, and a whimsical sculpture of different shapes that move with the wind. These are only a few examples of the different art installations seen in this corridor.

Impact on Health Status

The community that surrounds the proposed Rainier RapidRide route is largely (60%) composed of people of color and high percentages of low-income residents. Across the U.S., black, native/indigenous,

and Latinx communities fare worse than whites on the majority of examined measures of health status and outcomes (Artiga, Foutz, Cornachione, & Garfield, 2016). At large, people of color face greater barriers to optimal health, including repeated exposure to racism and racial discrimination. This then adversely affects mental health, producing depression, anxiety, and heightened psychological distress. Previous studies point to the positive influence public art can have on reducing the impact of stressors (Clow & Fredhoi, 2006). The increase of public art within the communities that surround the Rainier RapidRide route can therefore have a positive influence on the overall well-being of residents and its impact on health is at a moderate level.

In addition to reducing stress, community-driven art can invigorate neighborhood stewardship and stimulate a sense of well-being among residents. In Portland, OR for example, community members gathered to paint a large sunflower in the middle of an intersection and installed several interactive art features (Semenza, 2003). The project created a strong perceived sense of community and greater appreciation for their neighborhood among residents living within a 2-block radius from the intersection. Such installation is an example of how art created by and for the community is vital when advocating for neighborhood cohesion. The current conditions of the Rainier RapidRide route have some level of art integration, yet many of these installations were not created by the community at large. While some do feature students from local schools, many are done by one artist. Residents may therefore feel less emotionally attached to the artwork as they cannot relate to its presence.

Assessment

Assuming that the Rainier RapidRide will increase ridership and foot traffic to the nearby Light Rail stations and bus shelters, the installation of more public artwork has the ability to positively influence the overall health of community members. Conversely, if public art is not considered and the current conditions of the area remain, it is likely that such influence will be nonexistent. Similarly, if RapidRide bus shelters are designed to include calming artistic features, this may also positively influence the mental health of riders and nearby pedestrians.

While the incorporation of public art has many positive attributes associated with the health status and outcomes of nearby residents, it is simply not enough to incorporate art if other components of the community's aesthetics are not considered. If there are other aesthetical features of the community that are deemed unfavorable, the influence public art can have will be limited. To maximize the effectiveness of public art, the community's aesthetics at large need to be evaluated. It is therefore recommended that SDOT work with the Seattle Department of Neighborhoods and other agencies at the community and bureaucratic level to assess what can be done to improve the neighborhood conditions that surround the Rainier RapidRide route.

8.6 EXPECTED IMPACTS

Based on the team's findings, the following health impacts are expected:

| Health Outcome / Determinant | Direction of Impact | Magnitude | Quality of Evidence | Distribution |
|---|---------------------|-----------|---------------------|--|
| Employment | + | ▲ | * | Working-age population will benefit the most |
| Tourism | + | ▲ | * | Business community will benefit the most |
| Housing prices | + | ▲ | ** | Vulnerable populations will be most impacted |
| Quantity of residents who are rent burdened | + | ▲ | ** | Vulnerable populations will be most impacted |
| Proportion of non-Hispanic white population | + | ▲ | * | Vulnerable populations will be most impacted |
| Threat of displacement | + | ▲ | * | Vulnerable populations will be most impacted |
| Social support & connection to communal places | + | ▲ | ** | Equal distribution |
| Social isolation and stress | + | ▲ | * | Equal distribution |
| Community buy-in/ownership | + | ▲ | * | Equal distribution |
| Neighborhoods' and bus users' relationships with SDOT/Metro | + | ▲ | * | Commuters will benefit most |
| Walking distance from stops to grocery stores or markets | o | ▲ | ** | Impacts affect non-car households most |
| Community cohesion | o | ▲ | * | Equal distribution |
| Mental health | + | ▲ | * | Equal distribution |

Key:

Direction: + = increase, - = decrease, o = inconclusive or no impact

Magnitude: ▲ = minor impact, ▲▲ = moderate impact, ▲▲▲ = severe impact

Quality of Evidence: * = some evidence, ** = moderate evidence, *** = robust evidence

9.0 ENVIRONMENTAL CONDITIONS

Introduction

A population’s health is inextricably connected to that of the environment. When initiating public projects such as the Rainier RapidRide, the immediate and long-lasting effects the construction and operation such a project will have on the environment should be considered. Securing the health of the environment, both present and future, means the project itself should have negligible adverse effects on the environment which can be achieved through referencing evidence-based public health science.

Environmental conditions have been proven to play a critical role in the health status of individuals and neighborhoods, especially members of the community who heavily use outdoor common spaces. This demographic includes but is not limited to vulnerable populations such as children and the socioeconomically disadvantaged. As a result, this HIA sought to address how the Rainier RapidRide might environmentally impact the southeast Seattle community along the proposed route. Five key elements of the Rainier RapidRide are explored below: air quality, water quality, noise pollution, green space, and waste management and recycling.

9.1 AIR QUALITY

Overview

Air pollution refers to the harmful compounds found in the air we breathe. Over the past several decades, researchers have linked a wide variety of health outcomes to air pollutant exposure including cardiovascular disease, respiratory diseases such as asthma, adverse pregnancy outcomes, cancers, and death (National Institute of Environmental Health Sciences, 2018). As such, the U.S. Environmental Protection Agency sets national ambient air quality standards for particulate matter, ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and other air toxics. Fine particulate matter and air toxics pose the greatest air quality challenge to King County (Puget Sound Clean Air Agency, 2017). Most fine particle pollution in King County comes from a variety of sources including wood burning, vehicles, and industry. While concentrations of particulate matter less than 2.5 micrometers (PM_{2.5}) in King County meet the EPA’s health-based standard of 35 micrograms per cubic meter in 2016, they did not meet the local Puget Sound Clean Air Agency’s more stringent health-based goal of 25 micrograms per cubic meter, particularly during the winter season. Air toxics have also been measured in King County at levels shown to adversely affect population health by increasing rates of as cancer, respiratory disease, and other

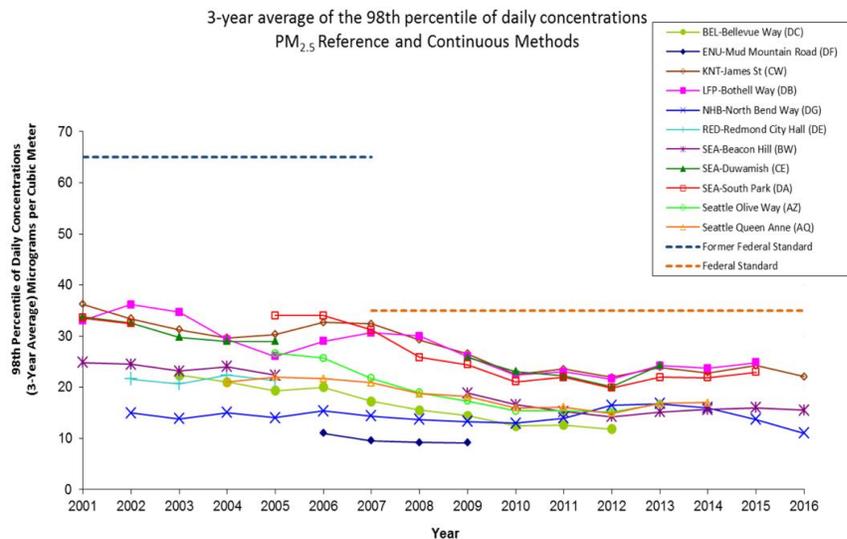


Figure 9.1 PM_{2.5} levels in King County

diseases. Given the importance of air quality on human health, it is important to consider the air quality impacts of replacing the Route 7 bus with a RapidRide bus.

Existing Conditions

The closest air monitoring station to the Rainier corridor is located in Beacon Hill's Jefferson Park. Given that the Rainier corridor is a heavily traveled one, the concentrations of air toxics along Rainier Avenue would be expected to be higher than those measured at the monitoring station in the park (Cohen, Bronzaft, Heikkinen, Goodman, & Nadas, 2007). Therefore, it is important to keep in mind that the current conditions reported here are likely underestimating the true air pollutant concentrations that exist along the Rainier corridor.

The Beacon Hill area has about the 5th highest level of average daily PM2.5 in King County (Figure 9.1). The overall trend for daily concentrations of PM2.5 is improving yearly in King County. There is seasonal variability of PM2.5 concentrations with peak levels occurring during the winter months due to wood burning.

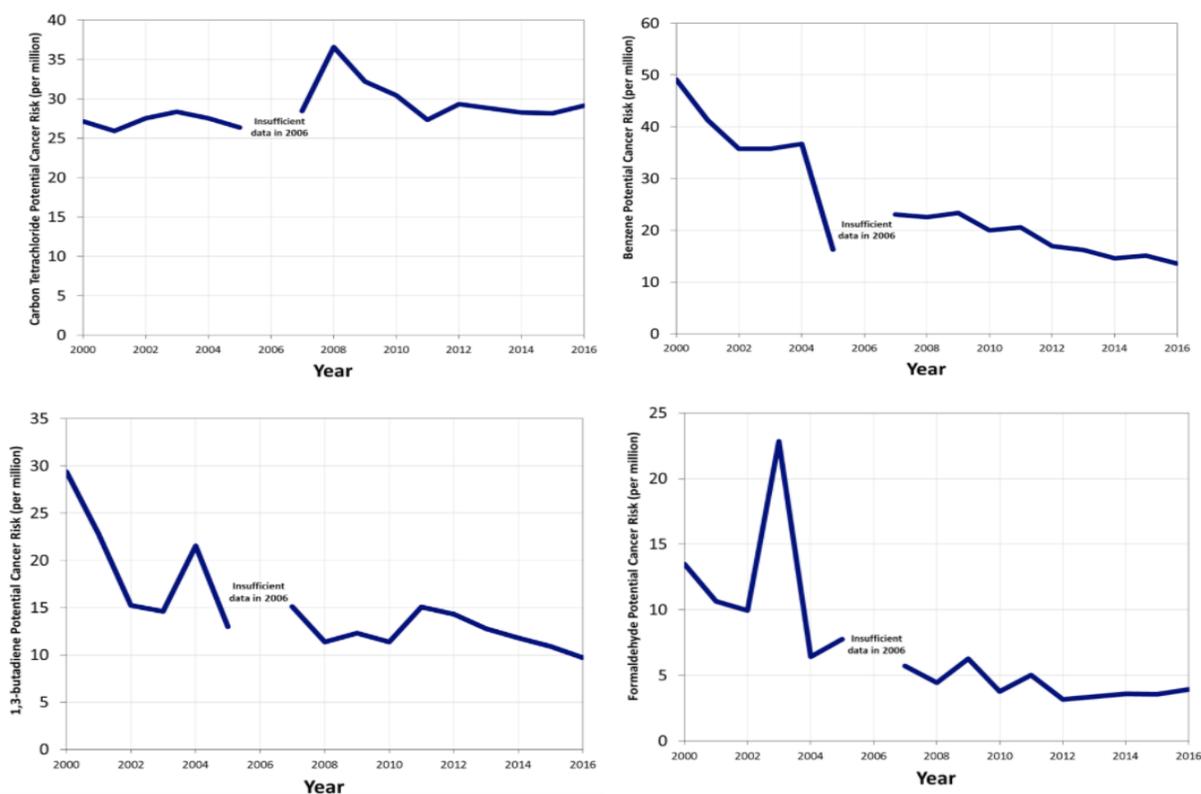


Figure 9.2 Annual Average Potential Cancer Risks at Beacon Hill, 2000-2016 for Carbon Tetrachloride, Benzene, 1,3-Butadiene, and Formaldehyde

The PSCAA has identified over 400 different air pollutants as air toxics (Washington State Legislature, 2018). The top four air toxics based on average potential cancer risk are carbon tetrachloride, benzene, 1,3-butadiene and formaldehyde. Carbon tetrachloride is a probable human carcinogen that is associated with liver and kidney damage (Environmental Protection Agency, 2000a). It has a long half-life and remains ubiquitous in the environment with no differences in concentration between urban and rural areas. Levels of carbon tetrachloride have been steady at the Beacon Hill site over the past several years with not statistically significant trends detected by the PSCAA (Figure 9.2.A). At Beacon Hill, carbon tetrachloride's 2016 average cancer risk is 29 in 1 million persons.

Benzene is a known human carcinogen that has been linked to immune, blood, and nervous system disorder (Environmental Protection Agency, 2012). Benzene comes from a variety of sources including car/truck exhaust, wood burning, and industry. Benzene levels have been gradually decreasing in Beacon Hill over the past decade due to decreases car pollution and fewer fuel and gas station emissions (Figure 9.2.B). The 2016 average potential cancer risk at Beacon Hill for benzene was 14 in 1 million persons.

1,3-butadiene is another known human carcinogen that has been linked to neurological disorders (Environmental Protection Agency, 2009). 1,3-butadiene primarily comes from motor vehicles and wood burning. In the Beacon Hill area, the 2016 average potential cancer risk was 10 in 1 million persons. The overall trend for 1,3-butadiene has been decreasing each year much like benzene due to efforts to reduce vehicle and wood stove emissions (Figure 9.2.C).

Formaldehyde is a probable human carcinogen that has been associated with irritation of the eyes, nose, throat, and lungs (Environmental Protection Agency, 2000b). It is mainly produced by automobiles, trucks, wood burning, and other combustion processes. The overall trend of formaldehyde in Beacon Hill is on the decline due to efforts to reduce automobile and wood stove emissions (Figure 9.2.D). The average annual potential cancer risk in 2016 attributable to formaldehyde was 4 in 1 million persons.

Impact on Health Status

Air quality has been linked to a wide variety of health outcomes including cardiovascular and respiratory diseases, neuropsychiatric complications, eye irritation, skin disorders, cancers, adverse pregnancy outcomes, and premature death (Anderson, Thundiyil, & Stolbach, 2012). Chronic particulate matter exposure affects cardiovascular outcomes through systemic inflammation. Increased levels of inflammatory cytokines have been linked by previous research with increased levels of PM_{2.5} and PM₁₀ exposure. Acute exposure to particulate matter exposure has also been linked to changes in coagulation and platelet activation which could place an individual at higher risk of developing coronary artery disease.

Exposure to particulate matter has also been linked with pulmonary oxidative stress and inflammation. When human airway epithelial cells are exposed to particulate matter, inflammatory cells are activated and can result in oxidative damage. Long term exposure to particulate matter results in chronic inflammation that may contribute to asthma development, a decrease in carbon monoxide diffusion, and a decrease in lung capacity. Air pollution has also been positively linked to death from lung cancer and cardiopulmonary disease. Particulate matter may also be associated with cerebrovascular health outcomes such as stroke through the elevation of risk factors of stroke such as high C-reactive protein. However, the relationship between particulate matter and stroke still requires further research to fully understand the effects of particulate matter exposure on cognitive function and cerebrovascular outcomes.

Assessment

The replacement of the current Metro Route 7 hybrid-electric bus with a RapidRide bus has the potential to positively increase the health of those along the current route if Metro uses fully electric buses in their RapidRide program. As the Rainier corridor is a heavily trafficked one, reducing emissions of air toxics and particulate matter by using electric, non-diesel buses would help reduce the concentrations of air pollutants along the corridor.

Furthermore, implementing a reliable and efficient mode of transportation that is safe and consistently maintained would increase use of mass transit within the area. An increase in use of the RapidRide would

decrease the need for community members to use personal vehicles and would serve to improve overall air quality along the corridor. The reduction of bus stops with the use of the RapidRide should also serve to reduce car idling and stop-and-go traffic, thereby reducing pollutant emissions from other motor vehicles as well.

Because the Rainier corridor will still serve as a main thoroughfare for freight trucks and cars, it is important for cyclists along the corridor to be aware of their increased exposure to pollution during peak hours. Strategies to inform and reduce cyclist exposure to vehicle created air pollution should be communicated.

9.2 WATER QUALITY

Overview

For a city that saw over 47 inches of rainfall in 2017 (“2017 Rainfall,” 2018). Seattle has made stormwater and wastewater management a priority within their public utility and infrastructure maintenance programs. While the Seattle Public Utility portion of the Seattle.gov website provides a multitude of information on how individual households can lower their own impact on wastewater and stormwater systems, it does not directly address the concerns of public transit’s impact. While an increase in human foot-traffic along the current Metro Route 7 could contribute to more litter making its way in to street storm drains, the decrease in diesel fuel pollution would have a positive effect on local water sources as waste and stormwater diverted to them in times of combined sewage overflow would have less diesel particulate contamination.

Existing Conditions

2017 marked the 4th consecutive year that Seattle has seen above-normal rainfall for the area. This, accompanied with the fact that Seattle is one of the fastest growing cities in the U.S., means that the existing sewer systems in the Seattle area are currently accommodating more wastewater and stormwater than in prior years. Seattle Public Utilities handles both types of water and Figure 9.3 depicts how they are handled in normal conditions as well as times of heavy rainfall (“Stormwater Management,” n.d.). As sewage systems become overwhelmed due to heavy rains, a higher percentage of overflow intended for treatment plants is diverted to local waterways. This is additionally complicated by the range in sewage holding systems currently used throughout the city. Combined, partially-separated and completely separated sewer systems are

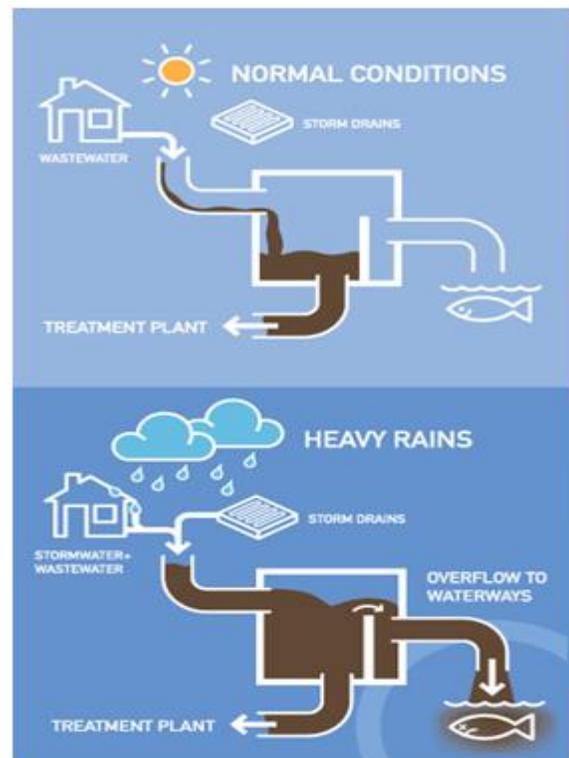


Figure 9.3 How SPU handles CSOs



Figure 9.4 A typical storm drain along the Metro Route 7

all employed throughout the city, with combined sewer systems leading to the most overflow to waterways.

To help mediate the sewage overflow issue, Seattle has been investing in retrofitting several existing structures throughout the city to allow for additional storage capacity. One of these retrofits is currently underway in South Henderson, at the intersection of Rainier Ave S & S Cooper St which is currently serviced by the Metro Route 7 (“South Henderson Basin,” n.d.).

Additionally, areas surrounding the Rainier RapidRide have been identified as target basins for what Seattle Public Utilities is calling “Green Stormwater Infrastructure Improvement” measures (“Green Stormwater Infrastructure,” n.d.). At this moment, little additional information is available on what exactly these improvements entail other than they “serve to reduce the costs of treating large amounts of polluted runoff, help cities reduce energy expenses and improve public health”. Hopefully, some of these measures will include improvements to storm drains. Figure 9.4 displays a storm drain currently in use at one intersection along the Metro Route 7 that, which, even on a sunny day with no precipitation, is partially clogged with debris.

The need for improvements in this area’s sewage system indicates that the current status of the area’s storm water and wastewater holding capacity and management is subpar in comparison to other areas of the city that do not require such infrastructure improvements. This subpar sewage system combined with the diesel particulates that are released into the environment by current, non-electric buses and cars in the areas contributes to negative impacts in the area (Lloyd & Cackette, 2001).

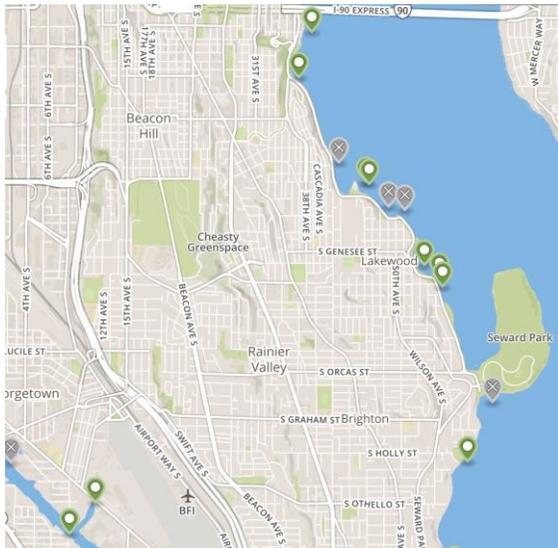


Figure 9.5 Seattle beaches affected by combined sewer overflow within the Rainier corridor

While the impact of wastewater and storm water overflow does not impact Seattle drinking water, it can still injure and infect individuals, especially those that frequent Seattle beaches. According to King County’s website, residents are warned to “Stay out of water for 48 hours after a combined sewer overflow (CSO); contact with polluted water can make you sick.” Below this warning is a map of sites around Seattle which are affected by these CSOs as shown in Figure 9.5 (“Combined sewer overflow status,” n.d.). This may seem an easy task but considering that public beaches and parks are commonly used by families with small children and local homeless populations, contact with these contaminated water sources could prove to be life threatening in extreme cases due to human contact to a variety of pollutants and pathogens. Around the Rainier Valley, there approximately 11 sites which have been identified by King County and Seattle Public Utilities as sites which overflow wastewater and storm water are pushed into Lake Washington.

Impact on Health Status

The implementation of the Rainier RapidRide could both increase and decrease the current water quality of public beaches within the area. Increased ridership and foot-traffic in the area may contribute to more litter making its way in to street-accessible sewers that are known to divert water to local beaches. But the increased usage of the RapidRide and its proposed use of electric-only buses may decrease the level of

diesel particulates that make their way into the sewer system and may then in turn lower their relative prevalence in water diverted in times of combined sewer overflow.

Assessment

With increased pedestrian, bicycle and transit traffic along the proposed Rainier RapidRide line comes an increased chance of litter not making its way to appropriate waste containers. If improvements on storm water and wastewater management and infrastructure are not made in a timely manner alongside the RapidRide's implementation, it is possible Seattle will see an increase in pollutants making their way in to local waterways which can negatively impact human and wildlife inhabitants. Conversely, the implementation of fully-electric buses as outlined by SDOT's current plan will decrease the amount of diesel particulates in sewer systems and, importantly, local parks and beaches.

9.3 NOISE POLLUTION

Overview

Noise pollution poses a significant public health risk because of its widespread potential exposure. Noise pollution can lead to hearing loss, annoyance, sleep disturbance, and stress, and may contribute to cardiovascular disease. The EPA has identified 24-hour exposure to noise levels of 70 decibels as the level which may cause measurable hearing loss over a lifetime. The EPA has specified that 55 decibels when outdoors and 45 decibels when indoors may cause activity interference and annoyance by preventing spoken conversation, sleeping, and other activities essential to daily life (Office of the Scientific Assistant, Office of Noise Abatement and Control, & U.S. Environmental Protection Agency, n.d.). Excessive noise pollution often occurs in areas associated with high levels of human activity. Areas with high amounts of road traffic are areas of elevated concern, as residents are exposed to the noise produced by vehicles with elevated intensity as vehicles gain speed. The Rainier RapidRide must consider the impact on the ambient noise levels in the Rainier Corridor and take the necessary steps to reduce their noise footprint to ensure the health of the community.

Existing Conditions

Studies have shown a positive correlation between traffic volume and road traffic noise. Speed of vehicles and road surface materials can also contribute to ambient noise pollution. Based on the 2017 SDOT traffic report, the Rainier Corridor experienced an average annual weekday traffic volume (5-days, 24-hour) of 44,500, making the list of Seattle's top 10 busiest arterials (Seattle Department of Transportation, 2017). Additionally, elevated traffic speeds have been recorded throughout the Rainier Corridor. One recent study found that 85 percent of drivers along the Rainier Corridor traveled at or below 39.1 MPH northbound and 37.1 MPH southbound, significantly higher than the mandated 30 MPH (Seattle Department of Transportation, 2017). High volumes of traffic at increased speeds results in more noise, a particularly concern many sections of the proposed Rainier RapidRide traverse residential communities.

Impact on Health Status

Excessive exposure to noise pollution can have marginal to moderate negative impacts on health. Although much of the noise generated from road traffic poses little serious risk of causing permanent damage, prolonged ubiquitous escalated noise levels like those of the Rainier Corridor can lead to annoyance, disturbance of sleep and other daily activities, decreased school performance and can even lead to hypertension and ischemic heart disease as well as hearing loss (Passchier-Vermeer & Passchier, 2000).

Sound exposure is determined by lifestyle, physical activity and social environment and is processed differently by individuals whose appraisal of noise may vary as a result of genetic and acquired characteristics (Passchier-Vermeer & Passchier, 2000). The primary effect of excessive noise exposure is annoyance which may lead to disturbed activities and somatic/psycho-somatic health effects (Passchier-Vermeer & Passchier, 2000). Noise exposure and its corresponding negative health effects take place within dynamic demographic, social, cultural, and technological environments, in which historically marginalized populations such as people of color and children should be given special attention in the interest in securing equity.

Assessment

The major effect on noise pollution that the Rainier RapidRide could have is by providing a viable alternative to commuters who would otherwise drive on the Rainier Corridor. The more people who decide to use the RapidRide system means there will be fewer people who opt to drive, thus reducing road traffic noise. These effects would be most noticeable in places with high volumes of traffic, especially during rush hour. The current RapidRide routes in place use high fuel efficiency buses thus reducing the noise produced by the buses themselves. This can have a significant impact in reducing noise pollution and should be continued as it affects all those who live along the corridor, use the road, and use the transit system. Specific design features could be implemented in the RapidRide program to reduce noise pollution. Green enveloping, in which structures are lined with plant foliage can act as for natural sound reduction and improve the overall aesthetic as well can contribute some environmental benefit (Renterghem, Hornikx, Forssen, & Botteldooren, n.d.). Additionally, planting foliage around roads could reduce the noise from traffic.

9.4 GREEN SPACE

Overview

Green spaces can provide a range of benefits for residents of urban areas. Nature and green spaces not only have environmental benefits, but direct health benefits through their promotion of physical activity and social interaction (Lee, Jordan, & Horsley, 2015). Unfortunately, green spaces can also lead to environmental justice, gentrification, and displacement issues (Wolch, Byrne, & Newell, 2014). To encourage the development of thoughtful and beneficial green space along the Rainier Avenue Rapid Ride bus line, SDOT can preserve existing trees, plant new trees and shrubbery, and partner with community members and groups on projects affecting green spaces along Rainier Avenue.

Existing Conditions

According to the 2009 Seattle Canopy Assessment, the southeast neighborhood where Rainier Avenue lies has a robust amount (30%) of tree canopy cover—a number in line with Seattle’s Urban Forest Stewardship Plan which set to

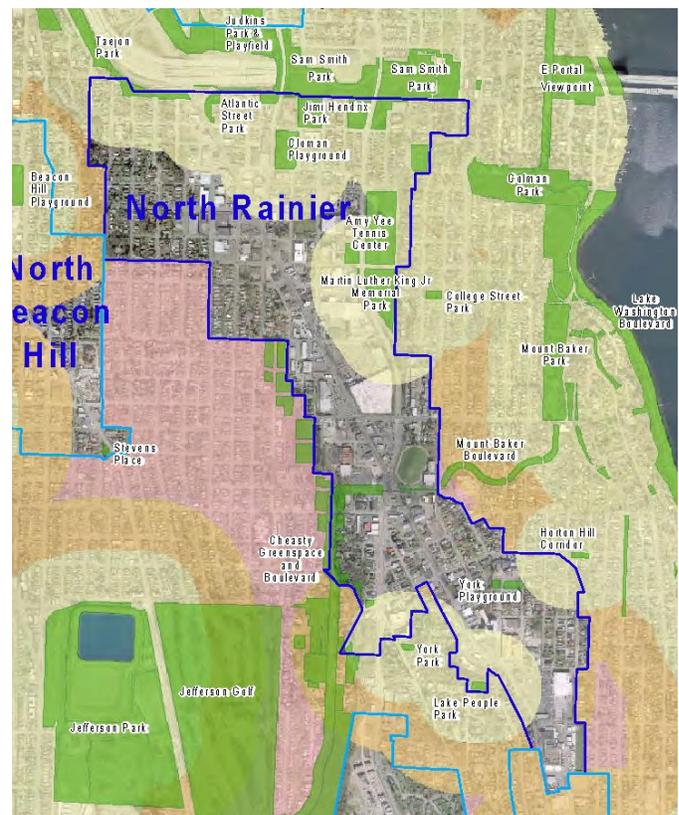


Figure 9.6 Green spaces within the North Rainier community

achieve 30% tree canopy cover by 2037 (Seattle City Council, 2009). Rainier Avenue is also a major thoroughfare for residents accessing major southeast Seattle parks including Sam Smith Park, Mount Baker Park, Lake Washington Boulevard, and Seward Park.

Directly along the northern section of Rainier Avenue, there are significant gaps in usable green space as seen in Figure 9.6. One major park lies directly along this northern section of Rainier Avenue: Rainier Playfield. The public park includes tennis courts, a ballfield, and children’s play area. The park also sits next to a community center. As part of the 2008 Parks and Green Spaces Levy, the city acquired two parcels to provide more open space for the northern Rainier Avenue community as shown in Figure 9.7. To be completed in Spring 2020, the park will provide increased access to open green space. Community input regarding this park project focused on pedestrian safety, age-friendliness, and walking paths.

One public park lies directly along the southern section of Rainier Avenue: Rainier Beach playfield. The playfield is located adjacent to Rainier Beach Community Center and includes tennis courts and ballfields. Several parks are located near the southern section of Rainier Avenue along Lake Washington including Beer Sheva Park, Pritchard Island Beach, and the Rainier Beach Urban Farm and Wetlands. The southern section of the Chief Sealth Trail also lies near Rainier Avenue and Henderson Street. This 4.5-mile paved path is used by many bicyclists and pedestrians.

Impact on Health Status

Green spaces promote many forms of physical activity including walking, biking, and running (Hartig, Mitchell, de Vries, & Frumkin, 2014). Physical activity has positive impacts on physical health outcomes including cardiovascular and respiratory health (Lee et al., 2015). Green spaces can also have positive impacts on mental health outcomes through their role in fostering social interaction and cohesion as well as in their ability to reduce stress (Kim & Kaplan, 2004).



Figure 9.7 Spaces acquired through the 2008 Parks and Green Spaces Levy

Assessment

Although portions of Rainier Avenue have abundant green space and canopy cover, certain areas lack sufficient greenery or access to green space. As a result, there are many opportunities to create and improve green spaces along the Rainier Avenue corridor, especially around the northern section of Rainier Avenue between Interstate-90 and Columbia City. Promoting tree cover and greenery along pedestrian walkways can not only improve the pedestrian experience but can promote beneficial health outcomes as well. Since green spaces can lead to gentrification and the displacement of existing residents, initiatives to improve and create additional green space should pay special attention to involving community residents in the planning and decision-making phases of projects (Wolch et al., 2014).

9.5 WASTE MANAGEMENT AND RECYCLING

Overview

Rapid urbanization and increasing population in cities have resulted in a marked growth in quantities of waste generated (Mukhtar et al., 2016). Inadequate waste management has caused environmental degradation (Emery et al., 2003) and has impacted adversely on public health (Saffron, et al., 2003). Waste management includes all activities and actions required to manage waste from its inception to disposal. Waste can be anything that is discarded by an individual, household or organization and sometimes contains substances that are hazardous to human and environmental health. Thus, waste management is critical to the health of urban environments. To better manage the waste disposal along the Rainier Avenue Rapid Ride bus route, SDOT, Metro and local schools and community organizations can work together to provide better bus stop amenities that include site appropriate trash receptacles, creative signages, and programs to promote environmental awareness and good littering behaviors towards on-site waste management and recycling.

Existing Condition

To better understand the existing and potential health risk associated with waste management along the proposed Rainier Avenue RapidRide, a site visit was conducted. Some of the major findings of the site visit include lack of trash and recycling receptacles along the current Metro Route 7, careless dumping of trash on sidewalks, various types of waste generated from different types of land uses that negatively impacts the pedestrian experience and the overall aesthetic quality of the corridor. Figure 9.8 illustrates the types of litter found during the site visit included but not limited to fast food packaging (both paper and Styrofoam), cigarette butts, beverage bottles (aluminum, plastic, and glass), chewing gum wrappers, broken glasses, small electrical parts, food scraps, newspapers, and dirty napkins. In addition to the apparent risk of physical harm associated with some of these types of litter, specifically broken glass and other sharp objects, uncovered trash, and careless littering can accelerate the spread of disease.



Figure 9.8 Pictures from May 3rd, 2018 Site Visit depicting variety of litter currently present along Rainier Ave S

The cigarette butts found on the sidewalks of the proposed corridor contain toxic substances like arsenic that can contaminate soil and water (Causes, Problems and Solutions of Littering - Conserve Energy Future, n.d.). Unattended litter reduces air quality and can generate toxic odors (Causes, Problems and Solutions of Littering - Conserve Energy Future, n.d.). Littered places along the proposed corridor affect the aesthetics and visual appearance of the neighborhood. Bus stops with scattered litter discourages people from using buses. Litter and unkept environments pose a risk of making pedestrians feeling unsafe. The result of this is unpleasant pedestrian experiences that can discourage people from using bus shelters and possibly mass transit itself. Figures 9.9 further depicts current conditions near currently in-use bus shelters and stops.

Additionally, the existing bus stops and the sidewalks along the proposed route lacks signage that prohibits illegal dumping or that promotes environmental awareness of waste management and recycling. This lack of environmental education and careless attitude towards illegal trash dumping can contribute to behaviors such as habitual littering.

The on-site waste along the Rainier Avenue Rapid Ride is managed by Seattle Public Utilities (Services — Seattle Public Utilities, n.d.) while the bus shelter and amenities are designed and implemented by Metro (Recycling & garbage - King County, n.d.). A partnership between these agencies can provide opportunities to develop a comprehensive waste management strategy that can address both local and border physical and environmental health impacts caused by improper waste management.



Figure 9.9 Metro bus shelter next to abandoned lot and corner store

Impact on Health Status

Improper dumping of trash on the sidewalks, bus stops and other public areas pollutes the environment and degrades the quality of life (Causes, Problems and Solutions of Littering - Conserve Energy Future, n.d.). Such public and environmental health impacts are often determined by the overall waste management strategy adopted locally, regionally and nationally. The waste management options chosen by decision makers will have direct health impacts as well as broader environmental impacts on the global ecology, loss of biodiversity and the depletion of non-renewable resources. (Saffron, et al., 2003)

Assessment

The Rainier RapidRide project has the potential to improve the current quality and quantity of waste and recycle receptacles along the proposed route through designing creative and site appropriate bus amenities. SDOT and Metro can partner to design, implement and monitor such process. In addition to the amenity design, integrating creative signages in the bus shelter or receptacles containing environmental awareness and information about waste management and recycling can help mitigate littering behaviors. Various events and programs can be launched and managed by local community organizations and schools to educate, encourage and promote the environmental benefits and potential health impacts of efficient on-site waste management and recycling.

9.6 EXPECTED IMPACTS

Based on the team's findings, the following health impacts are expected:

| Health Outcome / Determinant | Direction of Impact | Magnitude | Quality of Evidence | Distribution |
|---|---------------------|-----------|---------------------|--|
| Cardiovascular Health | + | ▲ | ** | Vulnerable populations will benefit the most |
| Respiratory health | + | ▲ | ** | Vulnerable populations will benefit the most |
| Cerebrovascular health | + | ▲ | * | Vulnerable populations will benefit the most |
| Diesel contamination of air and water sources | - | ▲ | ** | Equal distribution |
| Mental Health (Stress) | + | ▲ | ** | Adolescent populations will benefit most |
| Sleep Disturbance | - | ▲▲ | ** | Adolescent populations will benefit most |
| Social Cohesion | + | ▲ | ** | Equal distribution |
| Built Environment | + | ▲▲ | ** | Equal distribution |
| Sanitation of bus stops | + | ▲ | ** | Commuters will benefit the most |

Key:

Direction: + = increase, - = decrease, o = inconclusive or no impact

Magnitude: ▲ = minor impact, ▲▲ = moderate impact, ▲▲▲ = severe impact

Quality of Evidence: * = some evidence, ** = moderate evidence, *** = robust evidence

10.0 PRIORITY RECOMMENDATIONS

Below are the major recommendations the HIA team compiled from reviewing its findings:

- SDOT should consider reducing the speed limit along Rainier Ave S from 30 MPH to 25 MPH to reduce the number of motor vehicle crashes and pedestrian/bicyclist injuries on the route.
- SDOT should consider ensuring the maximum distance between Rainier RapidRide stops is no greater than 0.5 miles for all stops.
- SDOT should consider designing the Rainier RapidRide bus route to align with local businesses and large employment hubs, and should consider avoiding bus stop placements adjacent to liquor and recreational marijuana stores so as not to encourage consumption.
- SDOT should consider using materials in the bus stop and areas of added pavement designed to minimize road traffic noise.
- SDOT should consider prioritizing the cohesiveness of Rainier Beach and other neighborhoods by working to connect the Rainier RapidRide with current and future Light Rail stations.
- SDOT and King County Metro should consider collecting additional community feedback on existing RapidRide lines and on the Rainier line when complete to help guide future decisions.
- SDOT, King County Metro and local community organizations should consider working together to provide site appropriate trash receptacles, creative signage, and programs to promote environmental awareness and discourage behaviors that increase litter.
- SDOT and King County Metro should consider prioritizing community outreach with information on RapidRide service changes, especially in regions of the Rainier Corridor with higher concentrations of families without vehicle access and the Prentice Loop neighborhood.
- SDOT and King County Metro should consider partnering with the healthcare, mental health and substance services centers located in Rainier Valley to communicate transportation changes.
- SDOT should consider proceeding with the following options which prioritize pedestrian and bicyclists safety along the proposed Rainier RapidRide:
 - Option 1 for the proposed route changes on Chinatown/International District on Jackson St to keep existing stops along the route and increase accessibility for the elderly.
 - Option 2 for the proposed changes to Chinatown/International District to Columbia City to improve pedestrian crossings and increase safety benefits for bicyclists with in-street protected lanes.
 - Option 2 to add protected bike lanes on Henderson St and add improvements to pedestrian crosswalks at intersections with both Rainier Ave S and MLK Jr Way S.
- SDOT should consider improving sidewalk and pedestrian crosswalk infrastructure such that at least one side of the sidewalk would be even and walkable 100% of the time along the 8-mile route with a focus on areas south of Downtown Seattle, specifically neighborhoods Dunlap, Rainier Valley, and Hillman City.
- SDOT and King County Metro should consider installing bike racks or bike lockers at popular stops to incentivize bicyclists connection with the Rainier RapidRide.
- SDOT and King County Metro should consider replacing existing weather shelters with the expanded RapidRide shelters to increase waiting space protected from the elements.
- SDOT should consider seeking feedback from Seattle Office of Housing, Seattle Housing Authority, Seattle Office of Economic Development, Rainier Chamber of Commerce, and nonprofit developers like Southeast Effective Development (SEED) on project design.
- SDOT and King County Metro should consider collaborating with Seattle Office of Housing as an advocate for Seattle's Multi-Family Tax Exemption program (MFTE) and incentive zoning.
- SDOT should consider supporting reduced parking requirements in the Seattle Building Code to decrease the land area needed for new development.

- SDOT should consider working with Metro Transit and the local art centers such as the Rainier Beach Community Center and Ethiopian Community in Seattle to rehabilitate the Henderson St. sidewalks for community art installations.
- SDOT should consider increasing its coordination with Seattle Public Utilities in relation to Rainier Corridor improvements.
- King County Metro should consider ensuring that 100% of Rainier RapidRide buses are equipped with cameras with both audio and visual feed to improve real and perceived security on buses.
- King County Metro and Seattle Police Department should consider addressing equity issues to fare enforcement by developing an enforcement model that does not include criminal charges or fines that are processed by the courts, and that are sensitive to the homeless and housing unstable context in Seattle.
- King County Metro should consider prioritizing efforts to expand Orca Lift enrollment offices in Southeast Seattle, particularly in Rainier Beach and work to include Orca Lift enrollment services at community events and public meetings near Rainier RapidRide locations in the six months prior to and following RapidRide start of service.

11.0 MONITORING

The UW HIA team encourages SDOT and King County Metro to consider the recommendations provided in this report and to periodically review these recommendations as the project proceeds. The team does not have capacity for ongoing monitoring.

12.0 LIMITATIONS

Limitations identified during the development of this HIA include:

- The time available to conduct the HIA was only 10 weeks, constrained by the UW Spring Quarter academic calendar.
- No data were available from SDOT and King County Metro about previously implemented RapidRide programs related to their efficacy and customer satisfaction.
- The HIA team did not have the opportunity to directly interact with community stakeholders. However, SDOT staff were very helpful during all phases of the HIA and provided much useful information from their extensive community engagement efforts.
- The HIA focused primarily on the communities in the Rainier corridor and less on the areas in the northern section of the Rainier RapidRide route near downtown Seattle.

13.0 CONCLUSION

The HIA team recommends that SDOT proceed with the proposed Rainier RapidRide project, as the overall positive health impacts outweigh the identified potential negative impacts.

The HIA team suggests that SDOT consider the recommendations listed in this report to help mitigate negative health outcomes and promote health equity along the Rainier RapidRide route and larger Rainier Corridor. The HIA team encourages SDOT and King County Metro work together to monitor the health impacts of the Rainier RapidRide project to ensure that positive health outcomes are observed where predicted and to promote health in the design of future RapidRide routes.

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