Interstate Bridge Replacement Program **Health Analysis**

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These health agencies formed a health analysis working group and began meeting in January 2024. This report will refer to that group as “the working group”, and use “we” and “our” to discuss our analysis and recommendations throughout.

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Glossary

Acronyms

ACS	American Community Survey (U.S. Census Bureau)
BIPOC	Black, Indigenous, and people of color
CDC	United States Centers for Disease Control and Prevention
DOT	United States Department of Transportation
DSEIS	Draft supplemental environmental impact statement
EJ	Environmental justice
EJI	Environmental Justice Index (CDC)
EPA	United States Environmental Protection Agency
FHWA	United States Federal Highway Administration
FTA	United States Federal Transit Administration
GHG	Greenhouse gas
HIA	Health impact assessment
I-5	Interstate 5
IBR	Interstate bridge replacement program
LPA	Locally preferred alternative
LRT	Light-rail transit
MOVES	MOtor Vehicle Emissions Simulator (EPA)
MSAT	Mobile source air toxics
NBA	No-Build Alternative
NEPA	National Environmental Policy Act
ODOT	Oregon Department of Transportation
OHA	Oregon Health Authority
PM	Particulate matter
SVI	Social Vulnerability Index (CDC)
USACE	United States Army Corps of Engineers
VMT	Vehicle miles traveled
WADOH	Washington State Department of Health
WHO	World Health Organization
WSDOT	Washington State Department of Transportation

Definitions

Our working group definitions:

This report discusses “built environment”, “cumulative health impacts”, “environmental health”, “environmental justice”, and “health equity”. The working group of agencies that conducted the health analysis agreed upon the following definitions of those terms to guide our work.

Built Environment

The CDC describes the built environment as "the physical makeup of where we live, learn, work, and play. It involves homes, schools, businesses, streets and sidewalks, open spaces, and transportation options. The built environment can influence overall community health and individual behaviors such as physical activity and healthy eating."[1] An estimated 20% of premature mortality could be prevented through changes to the built environment.[2]

Built environment features can directly affect a community's health through exposures that residents cannot avoid, such as poor air quality or heat exposure. They can also positively or negatively affect the health decisions that are available to residents, such as access to healthy food and healthcare services, which encourage physical activity and reduce stress. The World Health Organization explains how "cities can – and should – promote health through the reduction of air pollution, noise and urban heat islands, the promotion of active and healthy lifestyles, the provision of available – and affordable – healthy food, climate action, and proper housing conditions, waste management and sanitation, among others. In a nutshell, cities will be used in the way we design them."[3]

Cumulative Health Impacts

Cumulative health impacts refer to the combined effect of many factors that influence individual, community, and environmental health. Environmental factors can interact with individual and social factors, and the built environment, to make a person more susceptible to health impacts such as age, genetics, underlying or chronic health conditions, and structural racism.[4,5]

Cumulative health impacts also refer to inequities that are often layered on one another that create disproportionate harm to individuals and communities. Health disparities can be exacerbated by environmental factors, inequities exist in environmental exposures on the individual and community levels, biological and genetic factors determine and can modify impacts of environmental exposures, and social vulnerabilities "may amplify the effects of environmental hazards".[5]

Environmental Health

Environmental health "centers on the relationship between people and their environment".[6] As a public health practice, environmental health aims to prevent and reduce exposures to hazards and risks through protecting "air, water, soil and food".[6–8]

Environmental Justice

The American Public Health Association defines environmental justice as "the idea that all people and communities have the right to live and thrive in safe, healthy environments, and with equal environmental protections and meaningful involvement of these actions."[9] Washington and Oregon have both expanded on that definition to state that environmental justice also includes protection from disproportionate environmental and health impacts.[10,11] Finally, both states include equitable distributions of resources and benefits, in addition to the elimination of harm.[10,12]

To promote environmental justice, you must identify and remedy environmental injustice.

Health Equity

Health equity is the opportunity for everyone "to attain their highest level of health".[13,14] Both the Washington State Department of Health and Oregon Health Authority encourage health equity and that a person's health and well-being are "not disadvantaged by their races, ethnicity, language, disability, age, gender, gender identity, sexual orientation, social class, intersection among these communities, or other socially determined circumstances".[15] Getting to health equity requires undoing inequity and "requires attention to the root causes of health issues and a focus on the communities that are more affected".[16]

IBR Program definitions:

This report also discusses terms defined by the IBR Program, including "equity priority communities", and the "modified locally preferred alternative". The definitions of those terms by the IBR Program are below. We accessed the definition of "equity priority communities" in the IBR Program Equity Framework at https://www.interstatebridge.org/media/1ggih5ae/ibr_equity-framework-final-update-feb-2024_remediated.pdf. We accessed the definition of "modified locally preferred alternative" on the IBR Program website at https://www.interstatebridge.org/nextsteps.

Equity Priority Communities[17]

The Interstate Bridge Replacement Program Equity Framework defines "Equity Priority Communities" or "historically underserved communities" as "Communities, populations, and individuals who have been historically excluded from transportation decision-making, systematically discriminated against, and experience social, economic, and health disparities. These terms are used interchangeably in this document. It is important to note that broad terms such as these change over time, by geography, and perspective. Given That the IBR program spans two states and diverse populations, we acknowledge that there is no right answer and that these terms may evolve over the course of the program in response to local preferences and other factors.

IBR Program Equity Priority Communities include:

- BIPOC: People who identify as Black, Native American and Alaska Native, Native Hawaiian and Pacific Islander, Central and South American Indigenous, Asian, Latin American, Hispanic, and/or one or more non-white races or marginalized ethic groups.
- People living with disabilities: People who have a physical or mental impairment that substantially limits one or more major life activities, people who have a history or record of such an impairment, or a person who is perceived by others as having such an impairment.
- Tribal Governments: (Federally Recognized Tribes) are sovereign nations as recognized by the United States Government, and consultation with federally recognized tribes occurs through a government-to-government consultation process separate and distinct from public and community outreach and comment.
- Communities with Limited English Proficiency: Groups with individuals who indicate that they speak English less than "very well" on the census.
- Persons with lower income: Individuals or households with income below 200 percent of the federal poverty level.
- Individuals and families experiencing houselessness: Individuals and families lacking or in need of a house or home.

- Immigrants and refugees: Immigrants are people born outside of the United States, and refugees are people who have left their country of origin due to persecution or fear of persecution due to race, religion, nationality, political opinion, or membership in a particular social group.
- Young people: Individuals 24 years old or younger.
- Older Adults: Individuals 65 years old or older."[17]

Modified Locally Preferred Alternative[18]

According to the IBR Program website, "The Modified Locally Preferred Alternative (LPA) refers to an agreed upon set of components that will be further evaluated through the environmental review process. It is NOT the replacement bridge's final design but rather a key milestone setting the program's direction as we start to test and evaluate plans for a replacement multimodal river crossing system. Elements of the Modified LPA under analysis include:

- A new pair of Columbia River bridges built west of the existing bridge. Three bridge configuration options are under consideration: single-level fixed-span, double-deck fixed-span, and single-level movable-span.
- Improvements to the I-5 mainline and seven interchanges, north and south of the Columbia River, including options with or without C Street ramps and I-5 alignment options in downtown Vancouver, as well as related enhancements to the local street network.
- Extension of light rail from the Expo Center in Portland to Evergreen Boulevard in Vancouver, along with associated transit improvements, including transit stations at Hayden Island, Vancouver Waterfront, and near Evergreen Boulevard and options for park and ride locations in Vancouver.
- One or two auxiliary lane(s) in each direction and safety shoulders on the bridge.
- A variety of improvements for people who walk, bike and roll throughout the program area.
- Variable rate tolling for motorists using the river crossing as a demand management and financing tool.

What we learn from the review process, and corresponding environmental studies, will determine how we move forward, and necessary work to avoid, minimize or mitigate negative effects to our environment. This process will include opportunities for review and public comment and will inform the design refinements and decisions."[18]

Executive Summary

Prepared by: Washington State Department of Health, Clark County Public Health, Cowlitz Indian Tribe Health and Human Services, Oregon Health Authority, Multnomah County Health Department

Interstate Bridge Replacement Program Overview & Public Comment Information

The Interstate Bridge Replacement (IBR) Program will be one of the largest infrastructure projects in the region for a generation. Because of this scale, it provides tremendous opportunity to positively impact health and advance environmental justice and equity.

The project underwent an evaluation through the National Environmental Policy Act (NEPA) to assess potential impacts. From September 20 to November 18, 2024, the IBR Program held a public comment period on its Draft Supplemental Environmental Impact Statement (DSEIS), a series of draft documents that cover topics studied under the environmental review.

Health Analysis Overview

As part of the planning and implementation of the IBR Program, regional partners requested that a health impact assessment (HIA) be included to understand the project's effects on community health and well-being. State and local health departments in Oregon and Washington, joined by a representative from Cowlitz Indian Tribe Health and Human Services, began meeting in early 2024 to collaborate to complete this request. Time constraints limited the scope of the HIA, and a modified health analysis relying on literature review, existing data, and public health best practices was drafted. The health agencies reviewed readily available information and select DSEIS technical reports to examine the potential health effects of the Modified Locally Preferred Alternative (LPA) – including environmental justice and health equity concerns. The health analysis assesses potential health impacts of the Modified LPA and does not propose an alternative.

The Health Analysis was submitted as a public comment to the IBR Program before the end of the public comment period in November 2024. This summary highlights key takeaways for each topic area and an overview of the project recommendations that were submitted to the IBR Program. The *Recommendations* section of the Health Analysis includes additional detail and implementation suggestions.

For more information about the health analysis, contact EHAssessment@doh.wa.gov.

Topic Areas

The Health Analysis identifies six topic areas of public health interest related to the program. Each topic area is represented by an icon. An icon or multiple icons accompany each of our recommendations to indicate which topic area and associate health outcomes could be improved by implementation of the recommendation:

 Air quality

 Climate change and health

 Transportation & active transportation

 Social determinants of health

 Noise

 Water quality

Key Takeaways

To reduce negative health impacts of the IBR Program, we recommend decision-makers design, construct, and maintain a program that prioritizes human health and safety, ecological health, and environmental justice. There are a number of places throughout the DSEIS where there is insufficient information to determine health impacts. There are also many decisions to be made for the final SEIS, design decisions, and local decisions that could change the assessment of the project having either a positive, negative, or neutral impact to health. We encourage keeping public health partners, community, and Tribal representation at the table in decision-making for the Program.

There is **sufficient evidence** in the DSEIS for the following potential health impacts of the Modified LPA:

- **Potential protective elements and positive health impacts**
    - **Transportation and active transportation:** The extension of light rail services and addition of enhanced pedestrian and bike facilities will likely increase physical activity and improve health. Expanding design and policy decisions that encourage people to walk, roll, bike, or use transit, rather than drive, would increase health benefits.
    - **Access**: Bringing the bridge, and auxiliary connections, up to or exceeding standards under the Americans with Disabilities Act (ADA) would improve access for all. Using inclusive or universal design, which centers around older adults, people with disabilities, and children, would increase benefits.
    - **Heat**: Providing shade and cooling for bridge users, especially active transportation users, could provide protection from heat-related health outcomes.
    - **Employment:** The project would drive a temporary increase in construction-related employment. Increased access to light rail and transit services could increase access to jobs and other essential services. Increasing contracting for Disadvantaged Business Enterprises, Minority Business Enterprises, Women Business Enterprises, and Small Business Enterprises would increase equitable distribution of these benefits.
    - **Access**: The Modified LPA includes plans to expand connections between active transportation networks, trails, and parks. Increased access to greenspace would have a positive impact on health.
    - **Water quality**: Improvements to stormwater infrastructure would have positive health impacts on water quality, and the health of the ecosystem.
    - **Safety:** Replacement of the existing I-5 bridge will result in a structure with greater seismic resilience, minimize the risk of a bridge collapse during an earthquake, and support safety, regional travel, and access to essential services.

- **Potential harmful elements and negative health impacts**
    - **Air quality:** Given the existing high traffic volumes along the I-5 interstate bridge, people who live nearby are subjected to greater concentrations of air toxics and are at risk of experiencing additional air quality burdens. The DSEIS estimates a 33% increase in VMT under the Modified LPA by 2045 and increase in freight traffic volumes, which could increase particulate matter and negatively impact air quality.
    - **Transportation and active transportation:** Transit access to jobs for BIPOC residents, immigrants and refugees, and people under the age of 25 did not increase as much as it did for white, non-Hispanic residents. This indicates disparities would continue to remain, likely reinforcing disparities in opportunities for physical activity.
    - **Tolling**: Tolling would have a disproportionate impact on low-income community members and could negatively impact access to essential services like health care and culturally specific health care.

- **Access**: The IBR Program could negatively impact access to traditional cultural activities, culturally specific health care, and access to ancestral lands for American Indian and Alaska Native communities.
- **Access:** Construction delays on roads, delays to bus routes and light rail service, and closures of sidewalks and active transportation paths may negatively impact access to homes, jobs, schools, health care facilities, and other essential destinations. These impacts may be greater for those that do not have car access.
- **Noise**: The Modified LPA would approach or exceed noise abatement criteria at 65 locations in Portland and 135 locations in Vancouver, including Discovery Middle School. Children and their learning comprehension are particularly affected by noise. The DSEIS describes higher levels of noise and vibration will negatively and disproportionately impact communities identified as equity priority communities.
- **Displacement**: The IBR Program will acquire land displacing 43 homes and could also displace houseless residents in the project area. Between 32-35 businesses and 600-742 employees could be impacted due to property acquisitions. Equity priority communities of East Columbia, Rockwood, Esther Short, and Rose Village would be disproportionately impacted.

There is **insufficient evidence** for several topic areas to determine potential health impacts of the Modified LPA.

- **Climate change and health:** The DSEIS anticipates the Modified LPA will reduce greenhouse gas emissions (GHG) compared to the No-Build Alternative. Construction of the Modified LPA will produce GHG emissions. Several climate-related hazards are projected to impact the region throughout the construction and operation of the Interstate Bridge, including heat, wildfire smoke, severe weather and flooding. The health effects of climate change are not equally distributed, and several communities are disproportionately affected by climate change - including IBR Equity Priority communities. More information is needed about how the Program will mitigate climate change impacts to Equity Priority Communities and what protective elements for health and climate justice will be included in final design and construction plans.
- **Air quality:** Due to the large geographic area used to conduct the air quality analysis, and the statement in the DSEIS that localized health impacts due to air quality cannot be reliably quantified, more information is needed to reliably assess air quality impacts. This is the basis of our recommendation for air quality monitoring and further air quality assessment, including dispersion modeling. Air dispersion modeling incorporates data appropriate for analyzing potential health impacts on a local scale.
- **Road safety:** The DSEIS states that crashes will increase by 15% under the Modified LPA, mainly due to estimated increases in traffic volumes. The DSEIS does not provide clear information about how crash frequency would change by travel mode, crash type, severity, location, or for environmental justice communities. There is insufficient evidence in the DSEIS to conclude to what degree severe injury and fatalities would be reduced for active transportation users.
- **Fugitive dust**: There is insufficient information about mitigation plans for fugitive dust during construction and how that could impact air quality and water quality.
- **Water quality**: There is insufficient information in the DSEIS regarding a plan to sample and analyze hazardous sediments and toxic contamination prior to in-water work.

Topic Areas Summary

Air quality + health concerns + potential project impacts

- Transportation is a significant contributor to air pollution-related illness and premature death. Emissions from vehicles, including carbon monoxide, nitrogen oxides, and particulate matter, can lead to respiratory, cardiovascular, neurodegenerative, and metabolic diseases, as well as cancer and reproductive issues.
- The DSEIS projects that the Modified LPA would result in a 33% increase in vehicle miles traveled (VMT) by 2045 compared to the 2015 baseline. Despite the expected increases in VMT, the DSEIS predicts that vehicular emissions will decrease compared to the 2015 baseline. The DSEIS estimates this using modeling from EPA's MOVES model, which assumes that emissions will decrease due to the 2007 EPA Control of Hazardous Air Pollutants from Mobile Sources. This modeling was run on a geographic scale (including Clark, Multnomah, Clackamas, and Washington counties) that is too large to understand local health and environmental impacts in the project area.
- The DSEIS states that concentration of air toxics from mobile sources would likely be more pronounced on road segments where traffic would increase under the Modified LPA compared to the No-Build Alternative due to diversion to avoid tolls. However, many of these road segments were not included in the air quality analysis.
- Modified LPA policy decisions which minimize mobile sources of air toxics during the operation of the project and design elements which mitigate the coinciding health impacts, like green infrastructure and indoor air filtration, would reduce potential public health burdens.

Transportation and active transportation + health concerns + potential project impacts

- Physical activity improves a wide range of health outcomes across the lifespan. Transportation planning and design features influence the opportunities available to community members to be physically active by walking, biking, or using transit.
- Project construction may create travel barriers or delays to essential destinations, regardless of mode.
- The extension of the light rail line and addition of enhanced walking and bike facilities will likely increase physical activity and support improved community health.
- Traffic volumes are projected to increase under the Modified LPA. Design and policy options that encourage more people to walk, bike, or use transit, rather than drive, would yield additional health benefits through increased physical activity.
- The DSEIS projects that the Modified LPA will result in a 15% increase in crashes on the freeway network and negligible change in crash frequency on the local road network. No information is provided on projected changes in crash type or severity.
- Tolls have the potential to further encourage mode shift to transit. This could improve health outcomes related to physical activity and air quality. However, tolls could also have a disproportionate impact on low-income community members.

Noise + health concerns + potential project impacts

- Harmful traffic noise levels can contribute to chronic and cardiovascular disease, disturb sleep, and reduce cognitive functioning. Older adults, shift workers, and people with preexisting sleep disorders are more sensitive to noise-induced sleep disturbance, and children are particularly sensitive to noise-induced health effects and learning disruptions.
- The Modified LPA would approach or exceed noise abatement criteria at 65 locations in Portland and 135 locations in Vancouver, including residences, offices, and one school. Noise walls are the only proposed noise mitigation for the project.
- Noise monitoring during construction, and re-examination of noise mitigation would yield greater protection from harmful noise exposure for community members in the project area.

Climate change and health + health concerns + potential project impacts

- Climate change is associated with many adverse health outcomes, including but not limited to heat-related illness, respiratory illness, cardiovascular failure, adverse perinatal outcomes, mental health impacts, injury, and death. The health impacts of climate change are not equal, and several populations are disproportionately affected.
- The DSEIS *Climate Change Technical Report* projects several climate change scenarios with impacts in the region over the project period, including higher temperatures and more extremely hot days, more fires and severe smoke, changes in precipitation, and increased risks of flooding.
- Workers, pedestrians, bicyclists, transit users, and adjacent communities may be exposed to heat, wildfire smoke or poor air quality, and other severe weather events during bridge construction and operation.
- Modified LPA design and construction operations that prioritize reducing the urban heat island effect, increasing shade and respite from heat, mitigating flooding risks, and planning for heat, wildfire smoke, and other severe weather and climate (flooding, extreme precipitation) events could improve resiliency and yield more protection from climate change-related illness and injury in the project area.
- The DSEIS *Climate Change Technical Report* anticipates the Modified LPA would result in a reduction of greenhouse gas emissions compared to the No-Build Alternative.

Social determinants of health + health concerns + potential project impacts

- The construction and operation of the Interstate bridge replacement will influence other factors that affect health, including housing, income, employment, and access to greenspace and health care.
- The IBR Program could negatively impact access to traditional cultural activities, culturally specific health care, and access to ancestral lands for American Indian and Alaska Native communities.
- The Modified LPA requires the acquisition of land that would displace 43 homes. Construction could also displace houseless community members residing in the project area.
- The Modified LPA will have varied economic impacts. Between 32-35 businesses and 600-742 employees are projected to be impacted due to property acquisitions required for construction. The project will also drive a temporary increase in construction-related employment while the bridge is being built.
- The IBR Program will comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act to provide relocation assistance to displaced residents and businesses. Additional supports to lessen the emotional impact of displacement for all, like investments to support homeless individual relocation, workers affected by business displacement, and the return of displaced individuals or businesses, could support greater health and well-being.

Water quality + health concerns + potential project impacts

- Safe and clean water is essential for the health of humans, animals and the entire ecosystem. Impacts to the health of the Columbia River and surrounding waterways, including the Troutdale Aquifer, could not be more consequential.
- Construction, specifically in-water construction, will have impacts on turbidity of the water, and can disturb hazardous sediments and toxic contamination. There are already waterways in the project area with pollutants that have required monitoring.
- Fugitive dust from construction and demolition can settle into the water and impact water quality. Climate change and drought can increase concentrations of contaminants in water.
- The IBR Program will implement stormwater infrastructure which will help improve water quality. Continuing to adapt to emerging issues such as 6PPD contamination, which is lethal for salmon, could positively impact water quality and ecosystem health.
- The DSEIS *Water Quality Technical Report* and the DSEIS *Hazardous Materials Technical Report* discuss the need to sample and analyze the levels of hazardous sediments and toxic contamination, but no plan to conduct sampling or report on the results prior to in-water work.

Recommendations

Prioritize sustainability, transparency, communication and health for the lifetime of the project

1. Institute accessible systems for real-time two-way communication about project design and construction impacts to keep community members informed of project impacts, and the program informed of community impacts.
2. Prioritize health in program policies and decision-making throughout the lifetime of the program by incorporating regular engagement with community members, health department staff, and Tribal governments.

Provide additional information and modeling to better understand potential health impacts

3. Compile and release to the public more information about demolition plans for the current bridge infrastructure, including potential air quality, noise, and water quality impacts.
4. Expand information about potential air quality, safety, and connectivity impacts of design and construction.
5. Compile and release to the public additional information about potential air quality, safety, and connectivity impacts of tolling-related traffic diversion through neighborhoods.
6. Develop and release to the public a detailed sampling and analysis plan of riverbed sediment including potential contaminants, hazardous sediments, and toxics.

Design with health and equity in mind

7. Design active transportation (bike lanes, sidewalks, and multi-use trails) and public transportation that is accessible to all to improve air quality and physical activity.
8. Design safety features to reduce injury for active transportation users and vehicle users.
9. Improve greenspace and tree canopy cover to improve air and water quality, provide shade, and increase natural spaces.
10. Design with sustainable materials and standards to reduce greenhouse gas emissions.
11. Prioritize resilience to extreme weather events, climate change, and seismic events to improve safety.
12. Maintain and improve good air and water quality in the project area to protect physical and mental health.
13. Minimize noise in the project area to protect nearby neighbors and populations disproportionately affected by noise.
14. Improve connectivity and community cohesion to promote access to community and essential services.
15. Center equity and focus on local businesses in contracting to improve economic opportunities for underrepresented groups.
16. Minimize home and business loss, and proactively support displaced residents, businesses, and employees.

Construct with health and equity in mind

17. Meet and exceed, where possible, state and local requirements for noise, air quality, and water quality to protect the health of workers, community members, and the ecosystem.
18. Design and mark routes during construction to protect pedestrians and active transportation users from injury and environmental exposures.
19. Maintain community connectivity through reliable access to transit, neighborhood services, and regular transportation routes.
20. Protect workers and community members on high-risk days for high heat and poor air quality events.
21. Establish systems for continuous monitoring for noise and air quality during and after program construction, ensuring that pre-construction conditions are measured as a baseline.
22. Implement workforce development and support programs to develop and retain a diverse workforce.

Introduction

The Interstate Bridge Replacement Program is going to be one of the largest infrastructure projects in the region for a generation. The opportunity to create a piece of infrastructure that connects two thriving communities, that has the opportunity to positively influence health, and to center environmental justice and equity cannot be overstated.

Health Impact Assessments

Health impact assessments (HIA) have been used around the world to help decision makers better understand impacts of proposed project, policies, and plans in a multidisciplinary process. They can help draw connections and demonstrate how "non-health sectors' activities play a major role in determining health outcomes."[19] Historically, they have focused on "ensuring threats to human health are considered as part of regulatory [processes]" but have since expanded to include additional information about environmental health, health equity, and social determinants of health.[19] Many have pointed to health impact assessments to fill the gap in federal processes such as the National Environmental Protection Act (NEPA) that do not explicitly require the assessment of human health impacts of proposed projects.[20] "Those concerned with health equity have [identified] HIA as an intervention that can address health inequities in policy development and planning, that is, before inequalities come about."[19]

Health impact assessments comprise a systematic, yet flexible, process that follows a standard six steps of screening, scoping, assessment, recommendations, reporting, and monitoring & evaluation. It also involves robust community engagement at every step of the process. Community engagement and feedback from partners "has consistently been described as a core element of HIA practice and should be considered essential to it."[21(p46)]

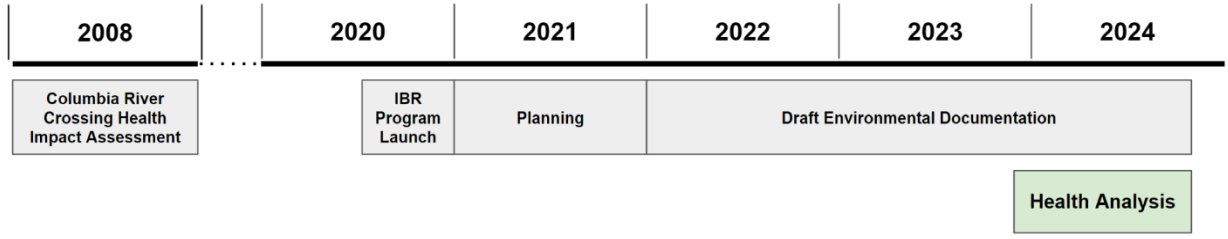
Introduction to Interstate Bridge Replacement Program & Health Analysis

When the state and local government partners sponsoring the Interstate Bridge Replacement (IBR) Program identified a Modified Locally Preferred Alternative (LPA) to replace the Interstate 5 bridge between Oregon and Washington states, several partners requested a Health Impact Assessment (HIA). An HIA had previously been conducted in 2008 during the Columbia River Crossing program.[22] (Accessible at https://www.pewtrusts.org/~/media/Assets/2008/06/HIAReport15ColumbiaRiverCrossing.pdf.)

In late 2023 the IBR Program contacted public health authorities to request that they prepare an HIA. The Washington State Department of Health, which houses an HIA program, agreed to convene the Oregon Health Authority, Clark County Public Health, and Multnomah County Health Department to develop a feasible approach to assessing bridge replacement's health impacts.

These health agencies formed a health analysis working group and began meeting in January 2024 (Figure 1). This report will refer to that group as "the working group", and use "we" and "our" to discuss our analysis and recommendations throughout.

Figure 1. High-level IBR Program and health analysis timeline



Using guidelines from the Society of Practitioners of Health Impact Assessments (SOPHIA), the working group concluded that timeline constraints did not allow for preparation of a comprehensive HIA. Health Impact Assessments require considerable time, resources, and include full community engagement at each step of the process. We estimate that an HIA would take at least two years to complete for a project of this magnitude. However, recognizing the potentially significant environmental and health impacts this project will have, the health agencies decided to prepare a Health Analysis of the IBR Program.

The Health Analysis is based heavily on standards and processes for an HIA, incorporating publicly available information and previous studies already underway for the IBR Program. Table 1 displays our adapted health analysis approach compared to a comprehensive HIA. Washington Department of Health and Oregon Health Authority followed their respective state policies and offered formal consultation to federally recognized Native American Tribes for the Health Analysis independent of IBR Program Tribal consultation. The Cowlitz Indian Tribe Health and Human Services joined as a member of the working group in April 2024. The working group completed the health analysis independently from the IBR program and we are submitting this report as a public comment on the Draft Supplement Environmental Impact Statement.

Table 1. Comparison of traditional health impact assessment and health analysis of IBR Program

Health Impact Assessment Step	Comprehensive Health Impact Assessment	Adapted Health Analysis Approach used to assess IBR Program Modified LPA
Screening	Determining feasibility and value-add of assessment for decision-making process.	The assessment was requested by the IBR Program and local partners.
Scoping	Create a work plan, key impacts to study, and determine methods for engagement and assessment.	• Health impacts identified through literature review • Community engagement not feasible within timeline
Assessment	Establish existing conditions for a baseline profile and evaluate the magnitude and direction of potential impacts.	• Emphasis on effects of Modified LPA versus no build alternative • Impacts evaluated using NEPA technical documents, systematic reviews, and existing data
Recommendations	Develop recommendations to improve health and mitigate harm.	Informed by assessment findings and priorities previously identified by project advisory groups
Reporting	Communicate results.	Posted an executive summary 10/15 on Washington DOH website. Submitting a full health analysis report to IBR Program as public comment.
Monitoring and Evaluation	Track how the assessment influences the decision-making process, if information is used, and if health outcomes improve.	Recommendations include continued integration of public health staff into ongoing IBR Program operations to support implementation and monitoring.

The goals of the Health Analysis are to:

- Identify health impacts of the IBR Program as detailed by the DSEIS.
- Provide and support adoption of evidence-based recommendations to support positive health impacts, reduce health disparities, and mitigate harm
- Leverage existing community engagement and advisory opportunities for Clark County, Multnomah County and the IBR program to incorporate community voice in decision-making
- Incorporate local health data into ongoing efforts to map and address equity and climate priorities for the IBR program.
- Engage public health and tribal partners for future decision-making phases of the IBR program

Health Analysis Methods

The working group completed the health analysis in three phases: scoping, assessment, and recommendations, detailed below. Additional details about our methods, including data sources, are available in Appendix A.

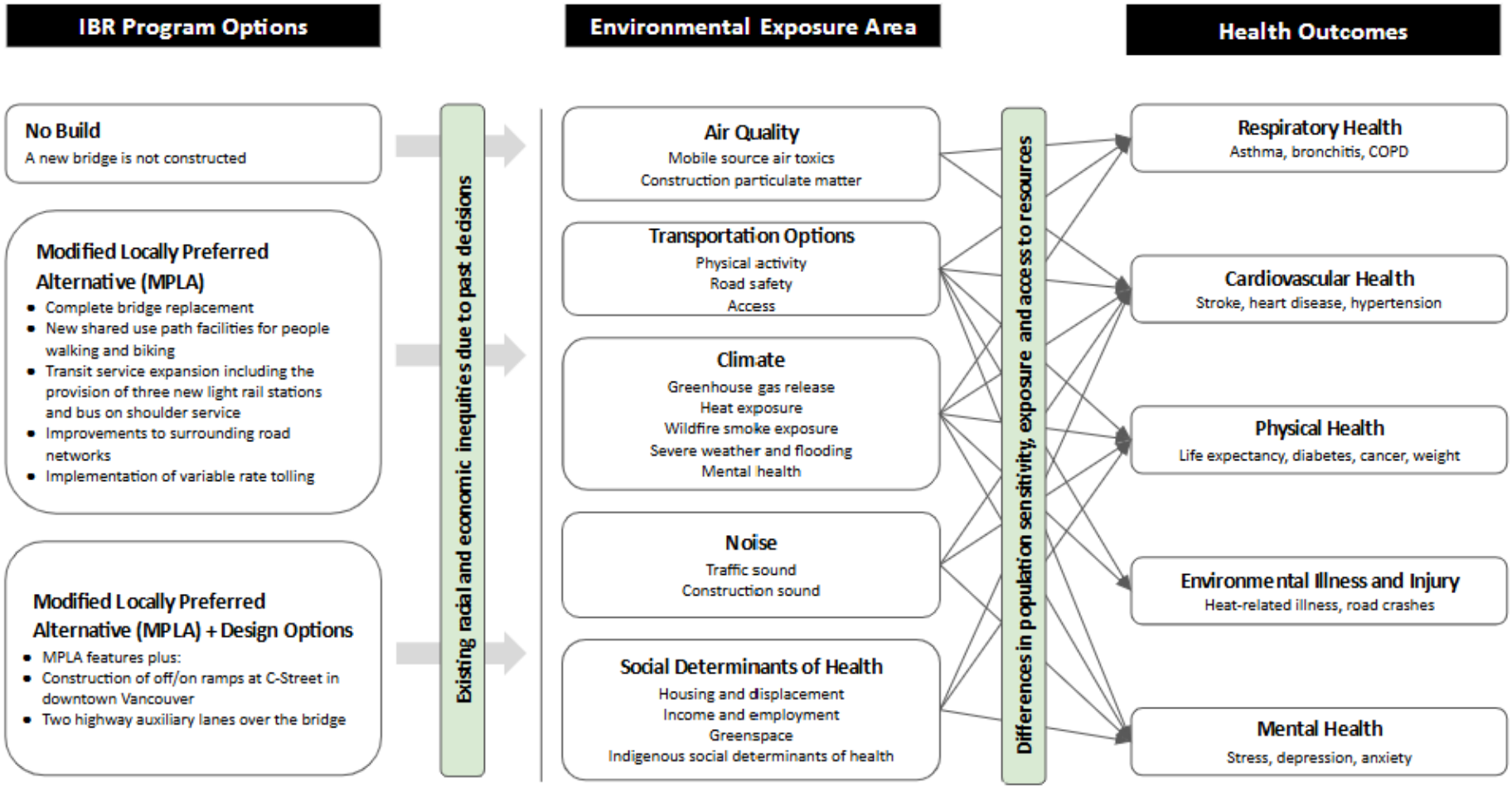
Scoping

The working group selected priority topic areas for assessment per SOPHIA guidelines for scoping. The topics include **air quality, transportation and active transportation, climate change and health, noise, social determinants of health, and water quality**.

As public health professionals, it is our mission to protect and enhance the health of the people in our states and counties. This health analysis assesses potential health impacts of the Modified LPA and does not propose an alternative.

Figure 2 outlines a health pathway diagram that links IBR program elements, focus exposure areas within the health analysis, and related health outcomes. The diagram emphasizes the role of past decisions in creating present health inequities, and how differences in population sensitivity and access to resources similarly influences prevalence of diseases and injury amongst different groups.

Figure 2. IBR Program Health Analysis Health Pathway Diagram



Assessment

The working group reviewed readily available information to examine the potential health effects of the Modified LPA – including environmental justice and health equity concerns. The following sources informed potential outcomes in each topic area:

- **Literature review.** The working group established a baseline of knowledge on each topic area from a scan of peer-reviewed literature, relying on systematic reviews and meta-analysis as a benchmark for strong evidence.
- **Readily available public data.** The working group used primarily the CDC Environmental Justice Index, CDC PLACES, CDC Social Vulnerability Index, and Census data to contextualize local health and environmental justice conditions. The working group chose these data sources based on the following factors: a) widely used and best available evidence-base from authoritative bodies that incorporate validation and rigorous review in publication, b) publicly available and readily accessible, c) comparable across Oregon and Washington, d) include data indicators that are commonly used in health analysis topic areas, and e) when possible, are place-specific and include data by census tract.
- **Draft DSEIS technical reports.** The working group reviewed select draft technical reports from the DSEIS prepared in February 2024 and cross-checked details with the DSEIS published in September 2024.
- **IBR Program Advisory Group Presentations.** Throughout the assessment stage, the working group attended the IBR Equity Advisory Group, Community Benefits Advisory Group, and Community Advisory Group meetings in July and August 2024 to present an overview of the health analysis. This provided an opportunity for the working group to ground the scope of the health analysis topic areas and for IBR advisory group members to highlight health priorities. The working group also presented an overview of the health analysis to the IBR Program Manager Group in May 2024.
- **IBR Program Site Visit.** The working group attended a half-day site tour with IBR program staff in July 2024 to visit key locations in Clark and Multnomah counties that would be affected by the Modified LPA and discuss potential effects.
- **Documentation from IBR Program Advisory Groups.** The health analysis honors the previous work that community members have contributed to the project, and uplifts recommendations documented in notes from previous meetings.

The DSEIS analysis considers IBR effects in three scenarios: 1) No-Build Alternative (no new bridge constructed) 2) Construction Modified LPA, and 3) Construction of the Modified LPA with design options incorporated that include C-Street ramps and two auxiliary lanes across the bridge (Table 2). The health analysis considers health effects from implementation between these three scenarios as data allows.

Table 2. Interstate Bridge Replacement Program implementation options

No-Build Alternative	Modified LPA	Modified LPA Design Options
No new bridge constructed	● Complete bridge replacement ● New shared use path facilities for people walking and biking ● Transit service expansion including the provision of three new light rail stations and bus on shoulder service ● Improvements to surrounding road networks ● Implementation of variable rate tolling	● Modified LPA elements plus: ● Construction of off/on ramps at C-Street in downtown Vancouver ● Two highway auxiliary lanes over the bridge

Recommendations

The assessment informed evidence-based recommendations for the IBR Program and state and local agencies sponsoring the bridge replacement to take into consideration in constructing the new bridge and associated interchange replacements. This health analysis assesses potential health impacts of the Modified LPA and does not propose an alternative.

To reduce negative health impacts and maximize health benefits of the IBR Program, we recommend decision makers design, construct, and maintain a program that prioritizes human health and safety, ecological health, and environmental justice.

Limitations

The most important limitation to note is that this version of the analysis is based on information available to local health agencies as of August 2024, primarily from the DSEIS. In many cases, the DSEIS does not include sufficient information to determine the magnitude, severity, or distribution of potential health impacts. For some pathways, a slight error in foundational assumptions about the project or quantitative models could reverse the *direction* of impacts (i.e., a health harm versus a health benefit).

The working group completed this health analysis on an accelerated timeline, making our best effort to assess potential health and health equity impacts of the IBR program in the time available (February – September 2024, with the first requested deadline of May 2024). We reviewed select technical reports to identify potential environmental health and health equity concerns and develop evidence-based recommendations for the Program.

The working group consulted subject matter experts from across our agencies to develop this report, but given the timeline, the working group had limited opportunity for extensive review. We welcome feedback and external review.

Further, we were unable to engage community fully in this process. While we received thoughtful feedback from community members and local representatives from the IBR Advisory Groups, we did not involve community at each step of the health analysis process, as is best practice for HIA. Our recommendations reflect a need for continued and enhanced community engagement by the IBR Program.

Our assessment of health topics and potential project impacts is based on literature review, readily available existing data, and review of draft DSEIS technical reports. We were unable to model potential health impacts. Our recommendations reflect a need for detailed modeling to better understand how air quality, transportation, and noise impacts by the IBR Program may affect communities.

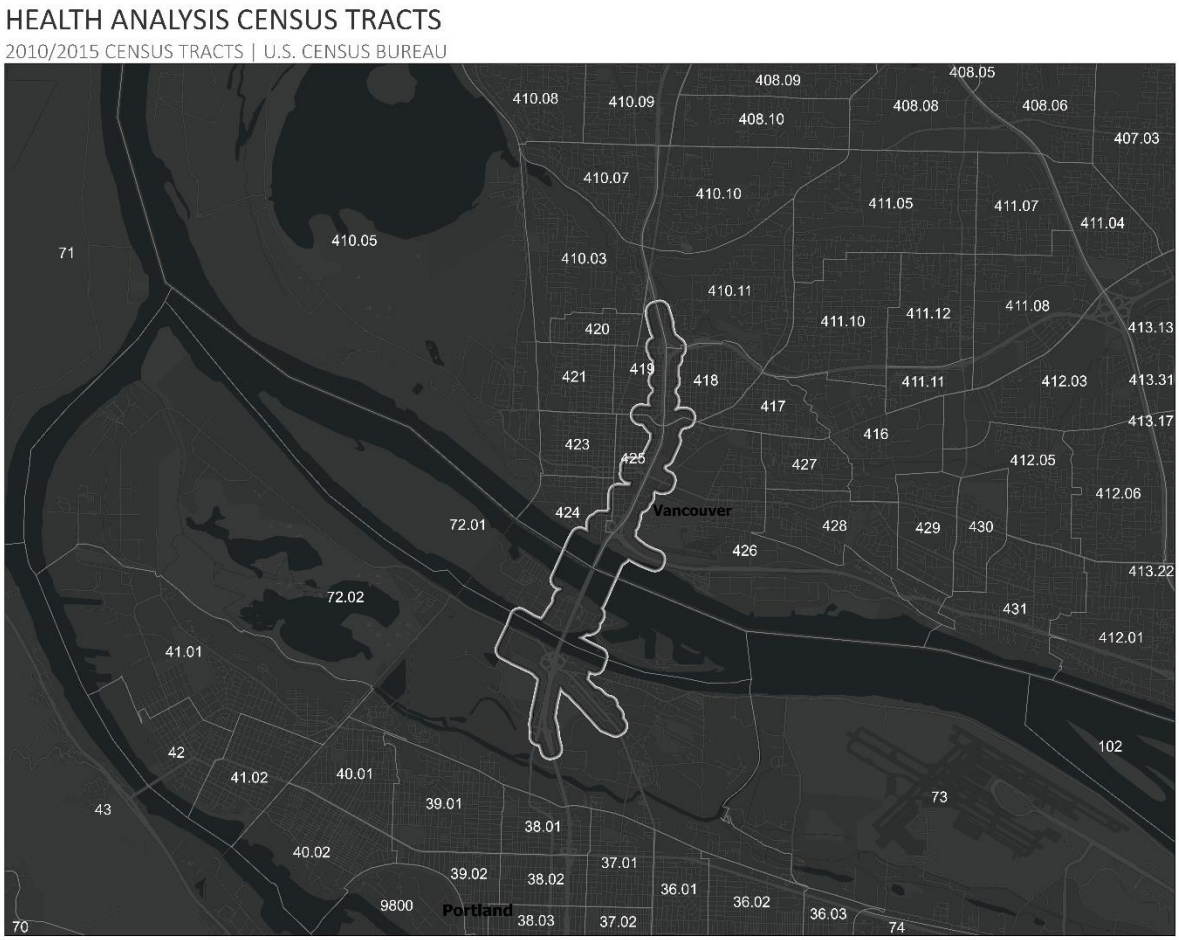
Some readily available existing data sources used in this assessment were only available by region, county, or census tract. Therefore, we were unable to draw more specific conclusions for some topics about communities most impacted and potential health impacts on a more granular scale (e.g., block or block group level).

Project Area Context

Geography

In this analysis, the IBR Project Area was defined as census tracts that overlap with the IBR Project boundaries, which include census tracts 410.11, 418, 419, 424, 425, and 426 in Washington, and 72.01 and 72.02 in Oregon (Figure 3, 2010/2015 Census). When census tract-level data was available, we summarized/averaged estimates for these 8 census tracts in the IBR Project Area to compare to Clark and Multnomah counties overall. Some data utilized the 2020 Census and is denoted in this report. Data available at the county-level only is also included.

Figure 3. Census tracts included in the project area and health analysis



Demographics and Social Factors

Tables 3 and 4 include demographic and socioeconomic data for the IBR Study Area, compared with Clark and Multnomah counties.

Table 3. Demographics in IBR Study Area, Clark County, and Multnomah County. Source: CDC EJI[23]

Indicator	IBR Study Area	Clark County	Multnomah County
Population	26,611	504,091	808,098
Percent CoC	26%	22%	29%
Percent <17	14%	24%	18%
Percent 65+	18%	15%	13%
Percent w disability	20%	13%	12%
Percent with limited English proficiency (LEP)	1.4%	2.6%	4.1%

Table 4. Socioeconomic factors in IBR Study Area, Clark County, and Multnomah County. Source: CDC EJI[23]

Indicator	IBR Study Area	Clark County	Multnomah County
Percent below 200% poverty	33%	25%	28%
Percent households that make less than 75K	34%	28%	33%
Percent who are uninsured	7.4%	5.9%	6.5%
Percent unemployment	5.3%	4.8%	4.8%

Health Outcomes

Table 5 includes select health topics and outcomes related to health analysis topic areas, and compares these estimates in the IBR Study Area to Clark and Multnomah counties overall.

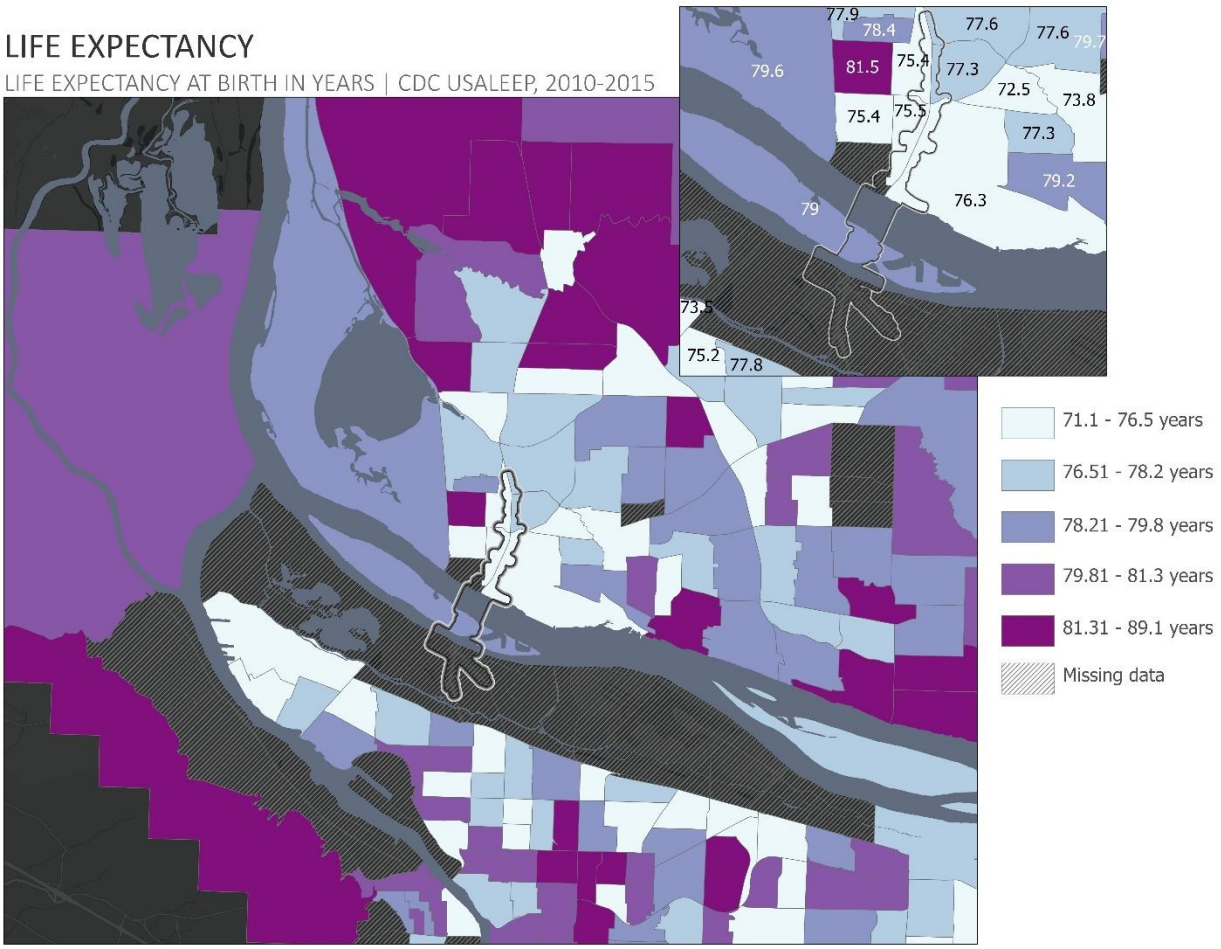
Table 5. Health Indicators[*] Related to Health Analysis Topic Areas in IBR Study Area, Clark County, and Multnomah County. Sources: CDC EJI[+23], CDC PLACES[^24]

Indicator	IBR Study Area Average Crude Prevalence (%)	Clark County Average Crude Prevalence (%)	Multnomah County Average Crude Prevalence (%)
Physical Inactivity[^]	18.7%	17.2%	17.1%
Asthma[+]	10%	10%	11%
High Blood Pressure[+]	30%	29%	26%
Cancer[+]	6.9%	6.7%	6.1%
Reported Poor Mental Health[+]	14%	13%	14%
Diabetes[+]	9.8%	8.8%	8.4%

*Estimates are crude – meaning they do not account for age

Life expectancy at birth is an indicator of mortality widely used in public health. Figure 4 displays life expectancy at birth estimates from 2010-2015 by census tract surrounding the IBR project area.[25] Life expectancy data for census tracts 424 and 72.02 are missing from this dataset. Figure 4 shows life expectancy in census tracts that overlap with the IBR project area are in the middle-to-lower ranges among life expectancy in Clark and Multnomah counties. Census tract 72.01 has the highest life expectancy in the IBR project area, at 79 years, while census tracts 419 and 425 are within the lower range around 75 years.

Figure 4. Life Expectancy at Birth (years) around IBR Project Area



Environmental Justice Context

Redlining, the discriminatory practice of lending based on a neighborhood desirability score largely dependent on race and income, was used in Portland in the 1930s.[26,27] There is evidence that banks continued with this practice through the 1990s, and redlining reinforced disparities in intergenerational wealth in Multnomah County.[28] Parts of the Kenton neighborhood, in the southern part of the IBR Program study area, were classified as “definitely declining” on maps created by the Home Owners Loan Corporation in the 1930s.[28] A similar map was not created for Vancouver, though the Racial Restrictive Covenants Project identified several properties that had racial restrictions in neighborhoods in the project area: West Minnehaha, Lincoln, Rose Village, and Central Park.[29] There is a significant association with the neighborhood desirability score (A [best] - D [hazardous]) and pedestrian fatalities, the result of decades of underinvestment in infrastructure.[30]

Those racist housing practices contributed to Portland's Black community primarily residing in the Albina neighborhood.[31] Vanport, developed as a temporary neighborhood to house shipyard workers and families, was also one of Portland's most diverse neighborhoods. Both Albina and Vanport serve as examples of built environment decision making disproportionately harming communities of color and low-income communities. The Columbia River flooded Vanport in 1948, displacing more than 18,000 residents, a third of whom were Black. Many relocated to Albina in the absence of other options in a heavily segregated Portland. The construction of I-5 and the Memorial Coliseum in the 1950s through '70s displaced hundreds of Abina families and bisected the neighborhood, cutting off connections from East to West.[31,32]

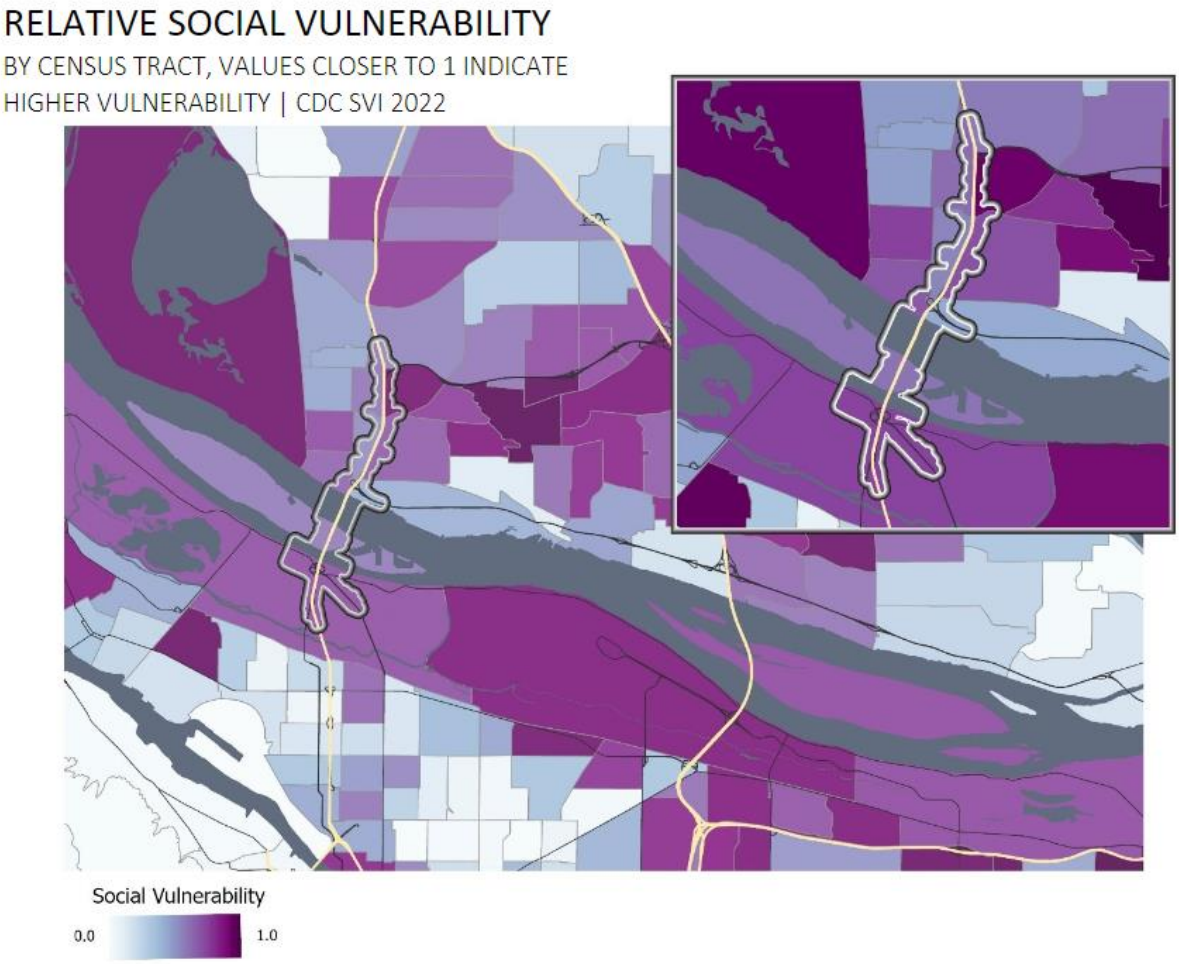
While Albina is outside of the IBR Program area, lessons from these harmful built environment decisions of the past remain relevant and valuable to decisions that will shape this once-in-a-generation project. The IBR Program has the potential to either further harm or mitigate additional harm by equitably distributing benefits to residents across the program area.

CDC's Social Vulnerability Index (SVI)(Figure 5) "indicates the relative vulnerability of every U.S. census tract".[33] This metric accounts for 16 different demographic factors, including poverty status, educational attainment, and racial and ethnic minority status. This index includes factors similar to those considered in the IBR Program's definition of "equity priority communities," though it does contain more information on housing-related indicators. The full list of variables includes socioeconomic status (below 150% poverty, unemployed, housing cost burden, no high school diploma, no health insurance), household characteristics (aged 65 and older, aged 17 and younger, civilian with a disability, single-parent households, English Language Proficiency), racial and ethnic minority status, and housing type and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

A note on language

In census and other federal or state data, racial and ethnic demographic data often are reported in lumped groups, using terms like "minority populations." Even the acronym "BIPOC" reflects a grouping of multiple different racial and ethnic identities that are unique. Use of the phrase "minority populations" throughout this report is reflective of language in our source material, including DSEIS documents and census data.

Figure 5: Relative social vulnerability in program area based on CDC Social Vulnerability Index. Source: CDC SVI 2022[33]



Notably, all but one of the census tracts that fall within IBR's defined project area are contained in the most vulnerable half of census tracts in their respective states. Census tract 418, containing the Rose Village neighborhood of Vancouver, is the census tract with the highest overall relative vulnerability anywhere in the project area.

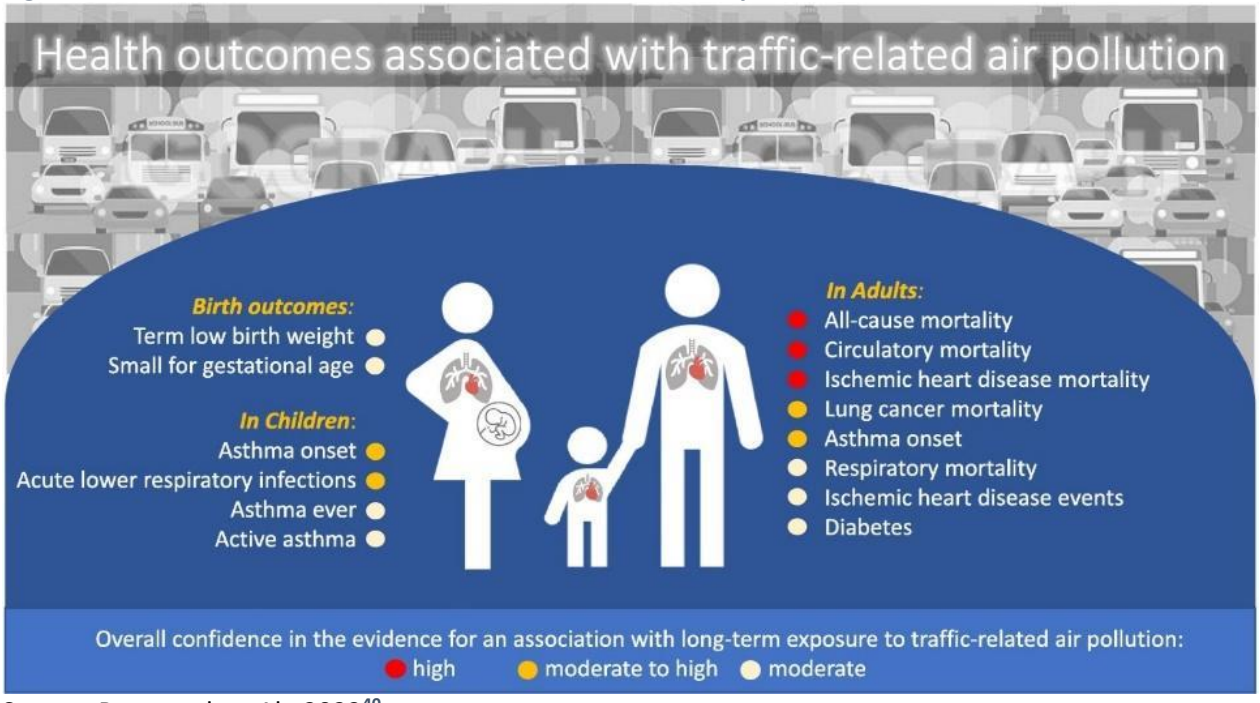
Assessment

Air Quality

Literature Review

Transportation is a significant contributor to air pollution-related illness and premature death. Emissions from vehicles include carbon monoxide, nitrogen oxides, and particulate matter. Exposure to traffic-related air pollution can lead to respiratory, cardiovascular, neurodegenerative, and metabolic diseases, as well as cancer and reproductive issues.[34–36] On-road diesel vehicles are a major source of these pollutants and have been shown to have the largest contribution to the health burdens of traffic-related $PM_{2.5}$ and ozone pollution.[37] The health impacts of carbonaceous traffic-related air pollutants, such as particulate matter (e.g., PM 2.5) and volatile organic compounds, are a particular concern in urban areas.[38] Road traffic pollutants like nitrogen dioxide, carbon monoxide, and elemental carbons can also have detrimental effects on human health and the environment.[39,40]

Figure 6. Health outcomes associated with traffic-related air pollution



Source: Boogaard et. Al., 2022[40]

Exposure to traffic-related air pollution has negative health impacts on children, adults, and pregnant people.[40] Higher rates of asthma exacerbation and onset in both children and adults are associated with exposure to traffic-related air pollution. [40] The CDC estimates that asthma costs the United States roughly $80 billion a year due to medical costs, days missed from school and work, and deaths.[41] These pollutants also increase risk of all-cause mortality, circulatory mortality, lung cancer mortality, and ischemic heart disease mortality.[40] Additionally, poor air quality is associated with respiratory issues, heart attacks, absences from work and school, lung cancer, and declines in cognitive development for children.[42,43]

The use of electric and hybrid fuel vehicles and transportation demand policies can help mitigate health concerns associated with traffic-related air pollution in areas where they are used.[44,45] However, TRAP reductions associated with electric and hybrid fuel vehicles may not be distributed evenly, as research suggests that relative reductions in TRAPs are lower for disadvantaged communities than in non-disadvantaged communities due substantially higher baseline concentrations.[46] Despite advancements in emission reduction technologies, the total number of vehicle miles traveled (VMT) and number of vehicles on roads continue to increase around the world, potentially counteracting any potential benefits resulting from emission reduction advancements.[36,47] Instead, researchers have estimated that prioritizing improvements to public transit, freight policies and passenger car efficiency, along with shifting away from single occupancy vehicles, could result in the removal of an estimated 2.8 GT of greenhouse gases from cities around the world by 2050.[36,48]

Local Context

While traffic-related air pollution in the project area is a concern, it is one of many sources that impacts the air quality for residents. The IBR Program includes areas proximate to the Port of Vancouver, Pearson Field, Portland International Airport, BNSF railway terminal, and active railways. As climate change contributes to increasing average maximum and minimum temperatures throughout Oregon and Washington[49], the physical and mental health impacts of poor air quality will continue to increase. Wildfires occurring more frequently and for longer durations will exacerbate poor air quality in the region. *(For more information about climate change and health, see the Climate and Health section.)*

Combining the impact of existing sources of air pollution in the Program area, as well as the increasing days of poor air quality from wildfires, contributes to the cumulative health impacts on an individual and community.

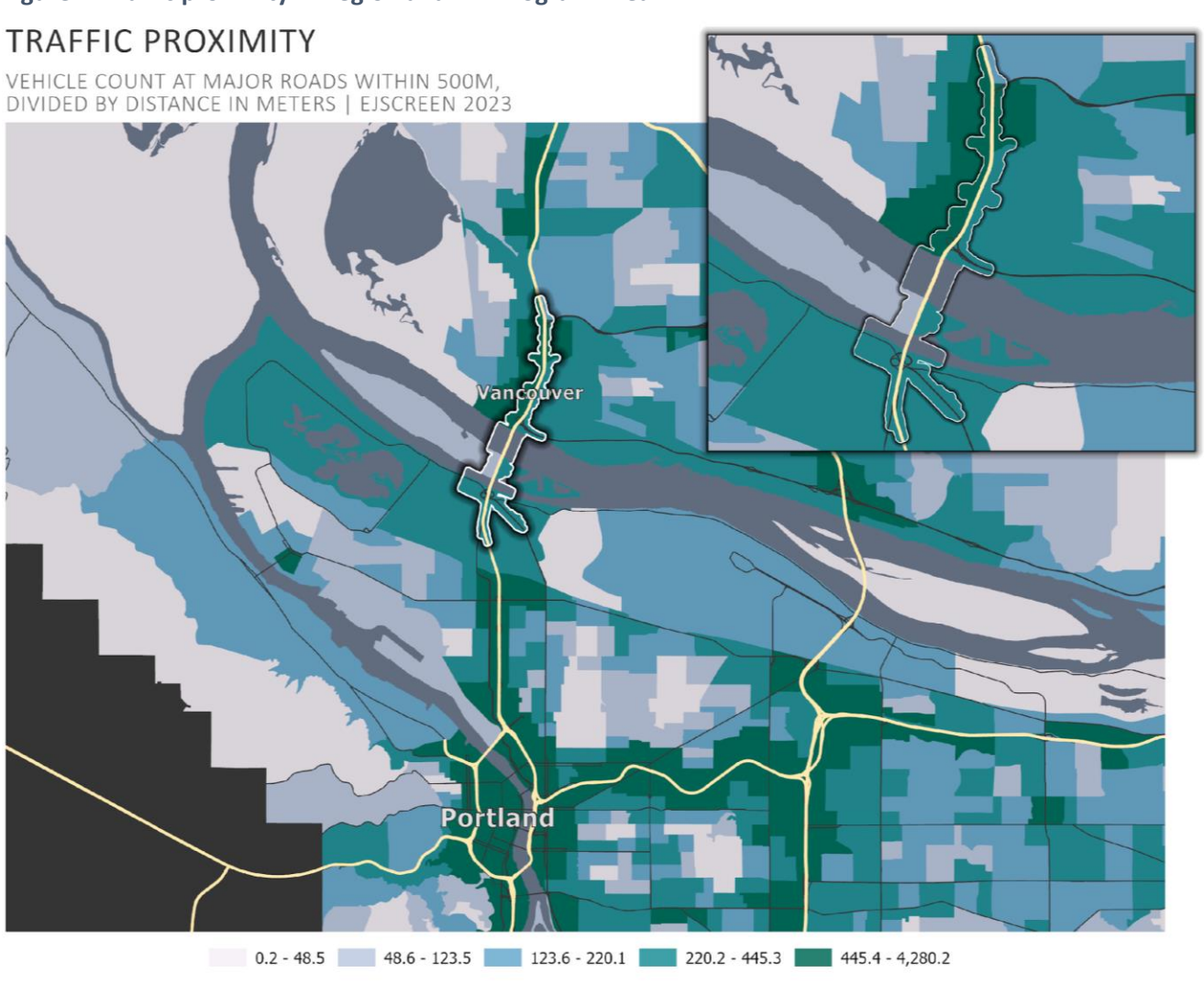
Within the IBR project area, 10% of adults have asthma, 30% have high blood pressure, 14% are children, and 18% are over 65 years old (Tables 3 & 5).[23] According to the Washington State Department of Ecology, Vancouver is identified as "overburdened and experiences high levels of PM2.5".[50] These baseline health conditions of residents in the project area could be further impacted negatively by poor air quality. The average estimated cancer risk from mobile sources of air toxics in the IBR study area is 2.6 cases per million (Table 6).

Table 6. Cancer Risk from Mobile Sources of Air Toxics (Modeled Estimates in Cases per Million). Source: EPA 2020 AirToxScreen[51]

IBR Study Area	Clark County	Multnomah County
2.6 (1.9 - 4.2)	2.0 (0.4 - 3.1)	3.4 (0.4 - 5.7)

The I-5 interstate bridge is an existing contributor to poor air quality, making it a public health hazard for those who live nearby. The air quality analysis presented in the *DSEIS Air Quality Technical Report* suggests that there would not be significant differences in air quality impacts between the Modified Locally Preferred Alternative (LPA) and the No-Build Alternative (NBA) scenarios.[52] However, the air quality analysis in the DSEIS uses a large study area composed of Clackamas, Clark, Multnomah, and Washington counties. Due to this large study area and lack of modeling at a smaller geographic level, it is unclear whether the Modified LPA and NBA scenarios will contribute to improved or worsened local air quality conditions within the project area. Given the existing high traffic volumes along the I-5 interstate bridge, people who live nearby are subjected to greater concentrations of air toxics and are at risk of experiencing additional air quality burdens given the expected 33% increase in VMT under the Modified LPA by 2045.

Figure 7. Traffic proximity in Region and IBR Program Area



Potential Project Impacts

Project Design

The DSEIS states that concentration of air toxics from mobile sources would likely be more pronounced on road segments where traffic volumes would increase under the Modified LPA compared to the No Build Alternative due to diversion to avoid tolls. However, many of these road segments were not included in the air quality analysis conducted by the IBR team. These streets where traffic volumes are projected to increase due to diversion are not easily identified in the DSEIS. The DSEIS states that their analysis of localized health impacts due to air quality changes cannot reliably quantify the duration and magnitude of project-specific increases in air toxics and related health impacts due to uncertainties in the available data. This gap in the data is the basis for a recommendation for more detailed air quality modeling and monitoring in the project area.

Project Construction and Demolition

Construction of the Modified LPA would generate heightened amounts of particulate matter including dust from demolition and preparation and emissions from trucks and construction equipment. The DSEIS *Air Quality Technical Report* describes increase in particulate matter "in the form of fugitive dust, (from demolition, ground clearing and preparation, grading, stockpiling of materials, on-site movement of equipment, and transportation of construction materials), as well as exhaust emissions from material delivery trucks, construction equipment, and workers' private vehicles".[52(p5-1)] It also states that "elevated emissions would likely occur immediately adjacent to the construction activities, staging areas, and material hauling routes". [52(p5-1)] Furthermore, air quality impacts from construction would result in long-term exposure as construction activities would occur during a 9- to 15-year period. At this phase of the planning process, the IBR Program has not developed detailed construction sequencing plans.

There is insufficient information in the DSEIS to show how much of an increase in particulate matter and fugitive dust will contribute to negative impacts on air quality. A comparison is made between this project and the Dan Ryan Expressway in Chicago, where air quality monitoring was done prior to and during construction. It was found with that project, that "the number of times the project action levels were exceeded was low".[52(p5-2)] While a comparison can be helpful, there are still concerns and more clear information needed regarding this project about the specific air quality impacts. Additionally, the DSEIS references the construction of the Dan Ryan Expressway from January 2005 through October 2007, which is a significantly smaller time frame of construction than the IBR Program.[52(p5-2)]

Due to the increased risk from air pollution to children and older adults, construction plans should be made to mitigate impacts to the schools, elder care facilities, and health care facilities. Construction staging and idling vehicles should not occur near those sites. Changes in traffic volume and proximity to residents could change an area from a low pollution area to a high pollution area and increase health risks. A detailed construction plan should also include traffic diversion information and assess the risk of current low traffic areas of becoming high traffic areas during construction. Residents should be made aware of all construction activity, duration, and mitigation measures being taken. Our recommendations reflect the need for more detailed information about air quality impacts and mitigation during construction.

As noted above, demolition will contribute to fugitive dust and negatively impact air quality. An additional concern in addition to the amount of particulate matter released from demolition is the content of the fugitive dust. The DSEIS *Air Quality Technical Report* describes that other than compliance with the EPA's National Ambient Air Quality Standards, there are no specific air quality regulations "governing emission of lead from demolition activities during construction" and that "control of potential lead emission is addressed in the construction contracts".[52(p2-8)] The DSEIS *Hazardous Materials Technical Report* states that the existing Interstate Bridge, and any other structures, that contain lead or asbestos will go through proper abatement prior to demolition.[53(p5-11)] Due to the potential public health, worker health, and ecological impacts of lead dust getting into the air, and settling on soil or water surfaces, more information about mitigation and lead abatement would help assess the likelihood of exposure.

Long-Term Impacts

The DSEIS projects that the Modified LPA would result in a 33% increase in vehicle miles traveled (VMT) by 2045 compared to the 2015 baseline.[52] Despite projected increases in VMT for both the NBA and Modified LPA, the EPA's Motor Vehicle Emissions Simulator (MOVES) model used in the DSEIS resulted in expected reductions in mobile source air toxics (MSAT) emissions by 2045 largely due to incorporation of emission reduction standards from the 2007 EPA Control of Hazardous Air Pollutants from Mobile Sources. This 2007 ruling from the EPA set annual standards for reducing MSATs. Beginning in 2011, the EPA requires fuel refiners and importers to meet benzene reduction stands and vehicle manufacturers to meet non-methane hydrocarbon exhaust emissions standards.[54] The MOVES model used in the DSEIS assumes that fuel and vehicle standards set by this 2007 EPA ruling will be met in 2045, resulting in substantial MSAT reductions compared to existing conditions primarily due to use of cleaner fuels and engines rather than design differences between the NBA and Modified LPA. These assumptions included in the MOVES model, combined with the large geographic scale of this analysis and its output in tons per year, does not provide adequate information for determining possible health impacts associated with the Modified LPA.

According to the DSEIS *Transportation Chapter*, "approximately 14,000 heavy and medium trucks crossed the Interstate Bridge on an average weekday in 2019, accounting for approximately 10% of all bridge traffic".[55(p3.1-8)] Additionally, the Washington State Freight System Plan anticipates that "forecasted truck vehicle miles traveled on the various interstates are expected to increase by 67 percent from 2022 to 2050".[56(p48)] An increase in freight traffic volumes could increase air quality related health concerns, especially for people walking, biking, and rolling on active transportation paths in the vicinity of traffic and freight emissions, housed and unhoused people living nearby, and future housing developments.

From the analysis performed in the DSEIS, the IBR Program concludes that emissions under the No-Build Alternative and the Modified LPA are expected to be substantially lower than emissions under existing conditions. The model predicting emissions in 2045, however, shows negligible difference in predicted emissions the NBA and Modified LPA. These expected decreases in emissions for the Modified LPA also rely on meeting the mode share targets included in the analysis (e.g., people choosing to commute via ride light rail instead of single-occupancy vehicles. The air quality analysis presented in the DSEIS is limited to a select number of road segments within the project area and evaluates air quality impacts for the area as a whole, rather than by each segment.

Environmental Justice & Health Equity

According to the DSEIS, the IBR Program focus area includes five healthcare facilities, six schools, and six assisted living facilities, all of which contain people who are especially susceptible to the health impacts of poor air quality.

While research suggests that the ambient concentrations of air toxics exceed cancer risk benchmarks throughout the country, BIPOC communities and people with lower income experience a disproportionate risk of exposure to these air toxics. This is a result of historic and ongoing sociopolitical factors like residential segregation, uneven industrial development, and neighborhood disinvestment.[57,58]

Research suggests that poor air quality often has a disproportionate health impact for low-income populations and BIPOC communities.[59] Disparities in traffic-related air pollution exposure are larger by race/ethnicity than income and disproportionate to contributions to overall pollution concentrations between different racial/ethnic populations.[36] Uneven tree canopy and vegetative cover further exacerbate the inequitable burden of air pollution and its impact on cardiorespiratory health. Tree canopy and vegetation have been shown to reduce respiratory difficulties[60] by controlling the flow and distribution of air pollutants.[61]

Transportation and Active Transportation

Physical Activity and Health

Literature Review

The development patterns of neighborhoods and cities shapes the travel options that are available to residents, and how feasible it is to walk, bike, roll, take transit, or drive to essential, everyday destinations. Urban planning decisions and design features influence travel options, like the availability and connectedness of sidewalks and bike lanes, mix of land uses, neighborhood density, proximity of recreational and open spaces, design variety and aesthetics, and proximity and access to transit and employment. Improvements in these areas can lead to increases in physical activity.[62,63]

In contrast, urban planning decisions can also discourage active travel. Induced demand is a well-studied concept in transportation infrastructure that describes how when highways expand to include more lanes (supply), traffic increases to use those lanes (demand).[64,65] Induced demand is associated with increased vehicle miles traveled, which in turn has negative effects on physical activity and air quality.[66]

Physical activity improves a wide range of health outcomes across the lifespan. When community design makes active travel safe, feasible, and attractive, physical activity can become an easy option for everyone in their everyday life. Health benefits include improvements in mental health and cognition, stronger bones and muscles, and reduced risk of all-cause mortality, cardiovascular disease, type II diabetes, and several types of cancer.[67,68] Inversely, sedentarism is associated with increases in all-cause mortality, metabolic syndrome, obesity, and unhealthy cardiometabolic biomarkers.[69]

A review of health impact assessments evaluating health benefits and risk from shifting from car travel to active travel found a majority of studies (27/30) determined the benefits outweighed risks.[70] Benefits were primarily driven by increases in physical activity, and include a wide range of outcomes, including improvements in all-cause mortality, cardiovascular disease, stroke, type 2 diabetes, cancer, dementia, depression, life expectancy, and health care costs. The studies found the risks from traffic crash injuries and exposure to air pollution to be minor compared to benefits, though uncertainty exists for demographic subgroups.[70] Changes in physical activity and active transportation in response to changes in large scale infrastructure are highly context specific, difficult to evaluate, and therefore understudied. Existing findings are mixed. A review of physical activity effects from the implementation of new built environment infrastructure changes including traffic-free bridges, an informal boardwalk, and a cycling trail, found inconsistent changes for walking but positive effects for cycling.[71] Despite inconsistent effects in walking, the review found that closer residential proximity to the intervention area was associated with higher levels of physical activity and walking.[71]

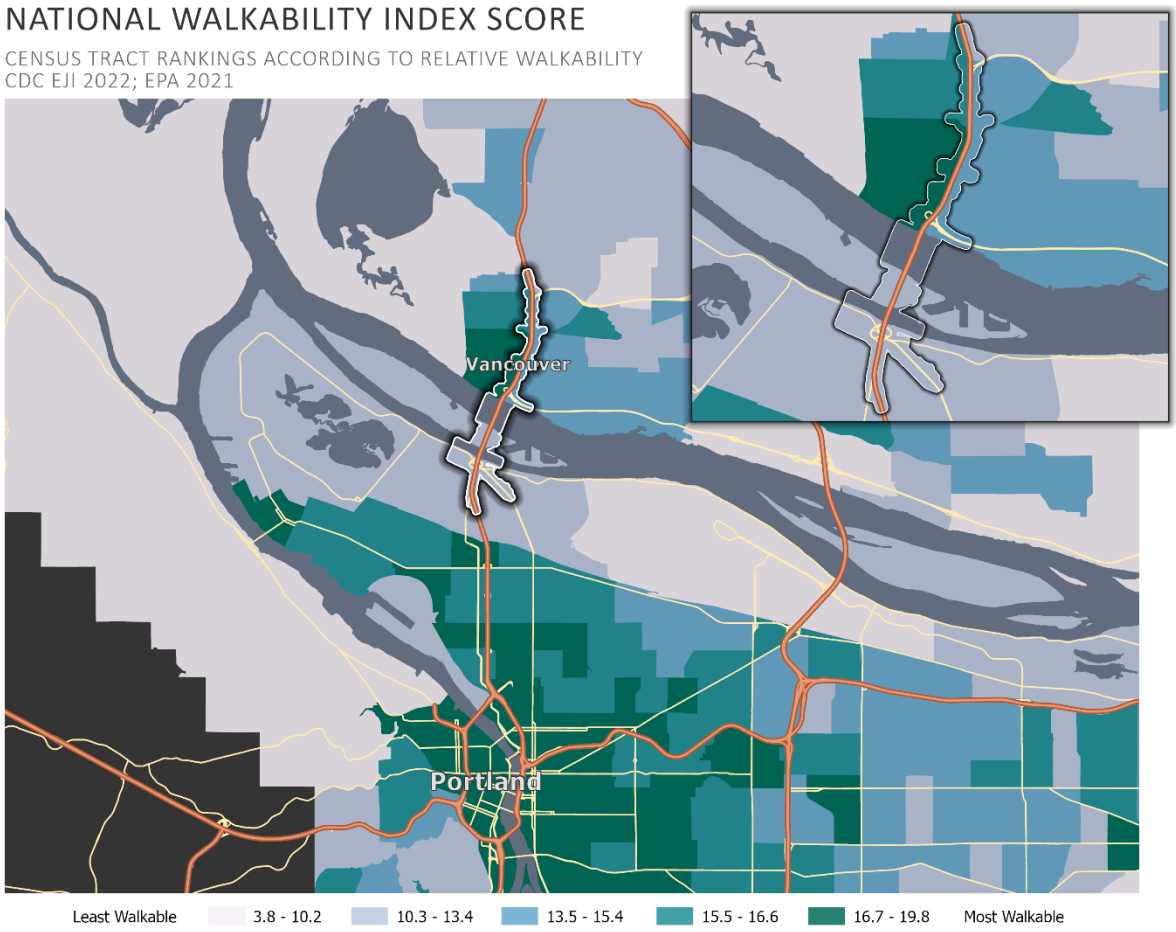
Public transit is associated with increases in physical activity, as people tend to walk or bike to transit stops and stations. A review of natural experiments evaluating the effects of new or extended bus rapid transit or light rail services found that building a new public transit line is associated with an increase of nearly 30 minutes of light to moderate physical activity a week for new users. This is one fifth of the WHO weekly physical activity recommendation.[72] A review of light rail transit effects on physical activity found that new light rail increased user weekly walking rates between 7-40%. There were limited effects on cycling rates.[73] Projects that incorporate built environment changes that affect both transportation systems, like light rail improvements, and the surrounding land use and environmental design, create places that are more welcoming and easier to navigate, which in turn increases physical activity.[74]

Local Context

Active Transportation. Approximately 2.4% of workers over the age of 16 that live in the study area walk to work, and 1.0% bike to work.[75] This proportion is greater than Clark County overall and less than Multnomah County overall. The project study area connects the downtown core of the City of Vancouver, an area with greater walkability (as identified by the EPA EJI), directly to parts of Multnomah County outside of the urban core and lower walkability (Figure 8). The IBR Program conducted a 24-hour bicycle and pedestrian count on the interstate bridge October 19th, 2022 to establish a baseline for travel modelling. The count occurred during a significant smoke event, so program staff adjusted the counts based on the upper threshold reduction percentages identified in Doubleday et al., 2021.[76] It is unclear if these assumptions in this methodology match the IBR program area context. Future analysis would benefit from active transportation counts when environmental conditions are not biasing travel choices.

The *DSEIS Transportation Technical Report* notes that existing active transportation structure is lacking in the project area. Walking and biking path networks are incomplete and often do not meet current design standards, including state, local, and ADA standards, depending on location. Multnomah County land uses in the project area, such as in the Columbia Slough watershed and industrial zones have limited the development of extensive active transportation infrastructure. The existing shared use path spanning the Interstate bridge is narrow and does not allow two-way travel or passing for people biking. I-5 presents a large barrier for people walking or biking Eastbound and Westbound in Vancouver (Section 3.8, *DSEIS Transportation Technical Report*).[77] Community members have also expressed that discrimination and racism can limit outdoor exercise and recreation for communities of color in the region.[78]

Figure 8. National Walkability Score in Region and IBR Study Area



Transit. Trimet and C-Tran provide current transit service in the study area through local, regional, and express bus service and light rail. Full descriptions of available transit service in the project area are in the *DSEIS Transportation Technical Report* section 3.7.[77] The *DSEIS Transportation Technical Report* notes that currently I-5 congestion adversely impacts transit travel times and reliability during peak morning and afternoon travel periods (Section 3.7.6).[77]

Approximately 3.5% of workers over the age of 16 that live in the study area use transit to get to work (Table 7).[75] This is a little more than double the proportion of Clark County overall and a little less than half the proportion of Multnomah County overall. The IBR Program estimates that approximately 3,200 people cross the interstate bridge via bus on a typical weekday (Table 3-28, *DSEIS Transportation Technical Report*).[77(p3-89)]

Car Travel. There are currently three lanes for cars, vans and trucks in either direction along the existing bridge spans (6 lanes total). Approximately 74.5% of commuters drive or carpool in the project study area.[75] The *DSEIS Transportation Technical Report* states that the average weekday daily traffic volume for the I-5 bridge is 143,400 vehicles (Table 3-5, *DSEIS Transportation Technical Report*).[77(p3-18)]

Table 7. Mode Split in IBR Study Area, Clark County, and Multnomah County, ACS 5-Year Estimates* 2018-2022[75]

Mode	IBR Study Area	Clark County	Multnomah County
Car – Drive Alone	67.7%	72.2%	55.1%
Car – Carpooled	5.9%	8.1%	7.8%
Public Transportation	3.6%	1.5%	7.8%
Bike	1.0%	0.3%	3.5%
Walk	2.4%	1.5%	4.5%

**2020 census tract geographies:*
Washington: 410.11, 418, 419, 424, 425, 426.01, 426.02 | Oregon: 72.01, 72.02

Travel-Related Health Outcomes. The IBR project area has slightly higher levels of physical inactivity than Clark and Multnomah County overall. The prevalence of physical activity-related health conditions in the study area, including high blood pressure, cancer, and diabetes, is slightly higher than the surrounding counties overall (Table 5). Disparities within these outcomes vary widely by age, race, ethnicity, sex, and geography.

Potential Project Impacts

Overall, the replacement of the existing I-5 bridge will result in a structure with greater seismic resilience, and minimize the risk of a bridge collapse during an earthquake. This will support continued regional travel and access during the recovery period of a seismic event. Additional effects on health vary by project stage and travel mode, as described below.

Project Long Term Impacts

Active Transportation and Health. IBR Program modeling predicts that active transportation trips will increase with the Modified LPA primarily due to the increased attractiveness of active mode facilities (80-160% increases in active trips) and mode shift from other travel means (15-25% increases in active trips). Modeled estimates predict that daily total active transportation trips could increase to 740 to 1,600 daily active transportation trips (Tables 4-49 and 4-50, *DSEIS Transportation Technical Report*).[77(p4-134)]

An increase in active transportation trips would support the improvement of health outcomes related to physical activity in the study area in the future.

Transit and Health. Using the Metro Regional Travel Model, the *DSEIS Transportation Technical Report* predicts that in 2045 there would be 29,100 transit riders using a part of the planned transit improvements scoped within the IBR Modified LPA (Table 4-40, *DSEIS Transportation Technical Report*).[77(p4-119)] The DSEIS estimates that approximately 36% (12,000) of these riders would be new transit riders that shifted from driving. A majority of transit boardings and departures would occur in Clark County at the Waterfront light-rail transit (LRT) station (24% of total predicted boardings) and Evergreen/I-5 LRT station (61% of total predicted boardings) (Table 4-39, *DSEIS Transportation Technical Report*).[77(p4-117)]

The expected increase in new riders and the addition of three new LRT stations is likely to support increases in physical activity via walking and biking to and from transit stops. This is also likely to support the improvement of health outcomes related to physical activity in the study area in the future.

Car Travel and Health. Using the Metro Regional Travel Model, the *DSEIS Transportation Technical Report* projects that traffic volumes crossing the interstate bridge in 2045 will increase regardless of current design options, ranging from 0.93%-1.07% per year.[77(p4-12)] Average weekday daily traffic volumes over I-5 are predicted to increase by 26% in the no-build scenario and 23% in MLPA option Table 8). MPLA traffic volumes are smaller due to the increased availability of transit options that would be provided and diversion resulting from tolls. The *DSEIS Transportation Technical Report* estimates that the MLPA with the addition of two auxiliary lanes would result in similar peak travel volumes. The auxiliary lanes would reduce congestion-related delays by 33% in either direction compared to the hours of congestion forecast in the MLPA without auxiliary lanes. Depending on how many lanes are in the final design, the IBR program area could experience induced demand, which would likely increase vehicle miles traveled. Our recommendations reflect the need for more appropriate modeling to identify potential health impacts, including consideration of the number of lanes in design options.

Despite the forecasted reductions in travel times for car travel, traffic volumes and vehicle miles traveled are projected to continue to increase. This will likely result in little to no change in health outcomes related to car travel, physical activity, and sedentary behavior at the population level.

Table 8. Predicted Travel Changes along I-5 in IBR Study Area by Mode, ODOT DSEIS Transportation Technical Report[77]

Mode/Metric	Existing	No-Build	Modified LPA
Car			
Average Weekday Daily Traffic Volumes *(Page 4-13, Table 4-5)*	143,400	180,000 (26% increase)	175,000 (23% increase)
Vehicle Miles Traveled	Not cited in DSEIS	436,400	424,900
Transit			
Regional Transit Mode Share *(Page 4-113, Table 4-38)*	Not cited in DSEIS	5.26%	5.37%
Weekday Corridor Daily Transit Ridership *(Page 4-119, Table 4-40)*	Not cited in DSEIS	14,900	29,100
Bike			
Daily Trips *(Page 4-134, Tables 4-49 and 4-50)*	279 (205 unadjusted)	No change	740-1,600 (combined biking and walking)
Walk			
Daily Trips *(Page 4-134, Tables 4-49 and 4-50)*	132 (91 unadjusted)	No change	740-1,600 (combined biking and walking)

Project Construction

IBR construction will affect all regional travel patterns and modes for 9 to 15 years depending on project implementation. Construction would require nighttime closures of I-5 and surrounding arterials that would result in rerouting and potential congestion and delays. The project may affect existing transit operations including alterations to existing light rail operations along the Yellow line, delays for bus routes that need to be rerouted or encounter construction-related congestion, and the relocation of bus stops in affected project areas. To the extent practical, the active transportation crossing over the bridge will remain open, but surrounding sidewalks, shared use paths, and bicycle lanes may be closed and rerouted. This may negatively affect access to employment, health care, and other needed services, especially for those that are transit dependent or do not have car access.

Environmental Justice and Health Equity

Some groups face greater or additional barriers to engaging in regular physical activity through active transportation. Fear of crime and perceived safety from other road users can influence travel choices for children/parents, older adults, and people that don't identify as male.[79,80] In Multnomah County, census tracts with higher densities of intersections, an indicator of walkability, tend to have lower shares of BIPOC residents. The same pattern exists for population percentage within ¼ mile of a bus or light rail stop.[81]

The *DSEIS Equity Technical Report* evaluated potential changes in mode shift benefits by analyzing increases in transit and driving access improvements for equity priority communities identified by the IBR Program. While the analysis found improvements across the board for program area residents, benefits were not equally (nor equitably) distributed. Transit access to jobs for BIPOC residents, communities with limited English proficiency, immigrants and refugees, and people under the age of 25 did not increase as much as it did for white, non-Hispanic residents (Table 4-2, *DSEIS Equity Technical Report*).[82(p4-3)] This indicates disparities would continue to remain, likely reinforcing disparities in opportunities for physical activity. Additionally, the *DSEIS Equity Technical Report* does not include spatial analysis of active transportation benefits within the program area for equity priority communities. Further evaluation of distribution of the benefits would inform decision-makers and community advocates in further policy or programmatic interventions are needed to reduce existing disparities.

Road Safety

Literature Review

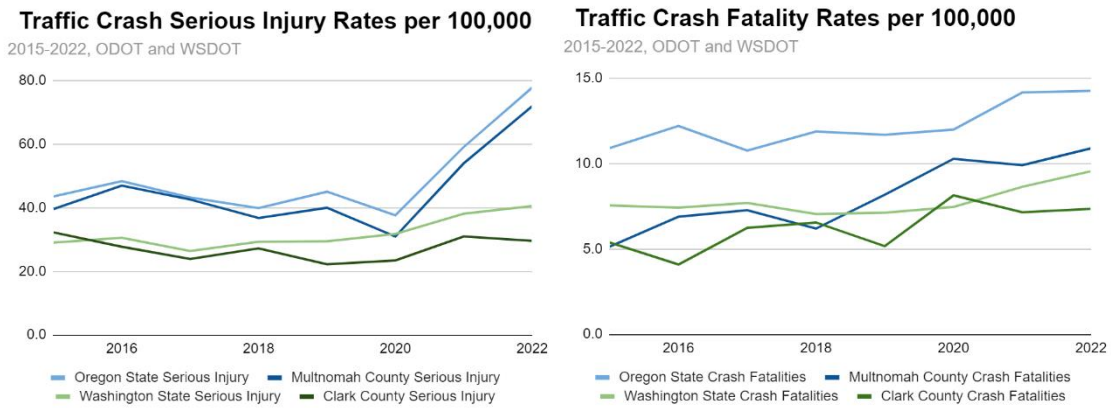
Transportation safety is a primary public health and transportation concern. Traffic crashes are a leading cause of death in the United States, and fatality rates have been increasing in recent years. Motor vehicle crashes specifically are the leading cause of death for teenagers.[83]

The Safe System approach to road safety is a multi-tier approach to improving road safety based on the fact that people make mistakes in the roadway and that humans cannot withstand the crash forces they experience from vehicles. Interventions and design principles focus on encouraging safer speeds, designing roads that encourage safer behavior, cultural shifts to promoting safety for all amongst all modes, making vehicles safer, and improving post-crash care.[84] These strategies align with core public health intervention approaches to change the context in which people operate to promote healthier actions and improve population health.[85] System-level interventions focused on safe speeds include focusing on highway design and implementing tools to encourage compliance with speed limits and manage traffic flow and density.[86]

Local Context

Locally, serious injury and fatality rates per 100,000 have been steadily increasing since 2015 (Figure 9). In 2022, there were 88 crash-related fatalities in Multnomah County and 37 in Clark County. That same year, there were 581 serious injuries related to crashes in Multnomah County, and 149 in Clark County. Since 2020, the serious injury crash rate per 100,000 has almost doubled in Multnomah County.

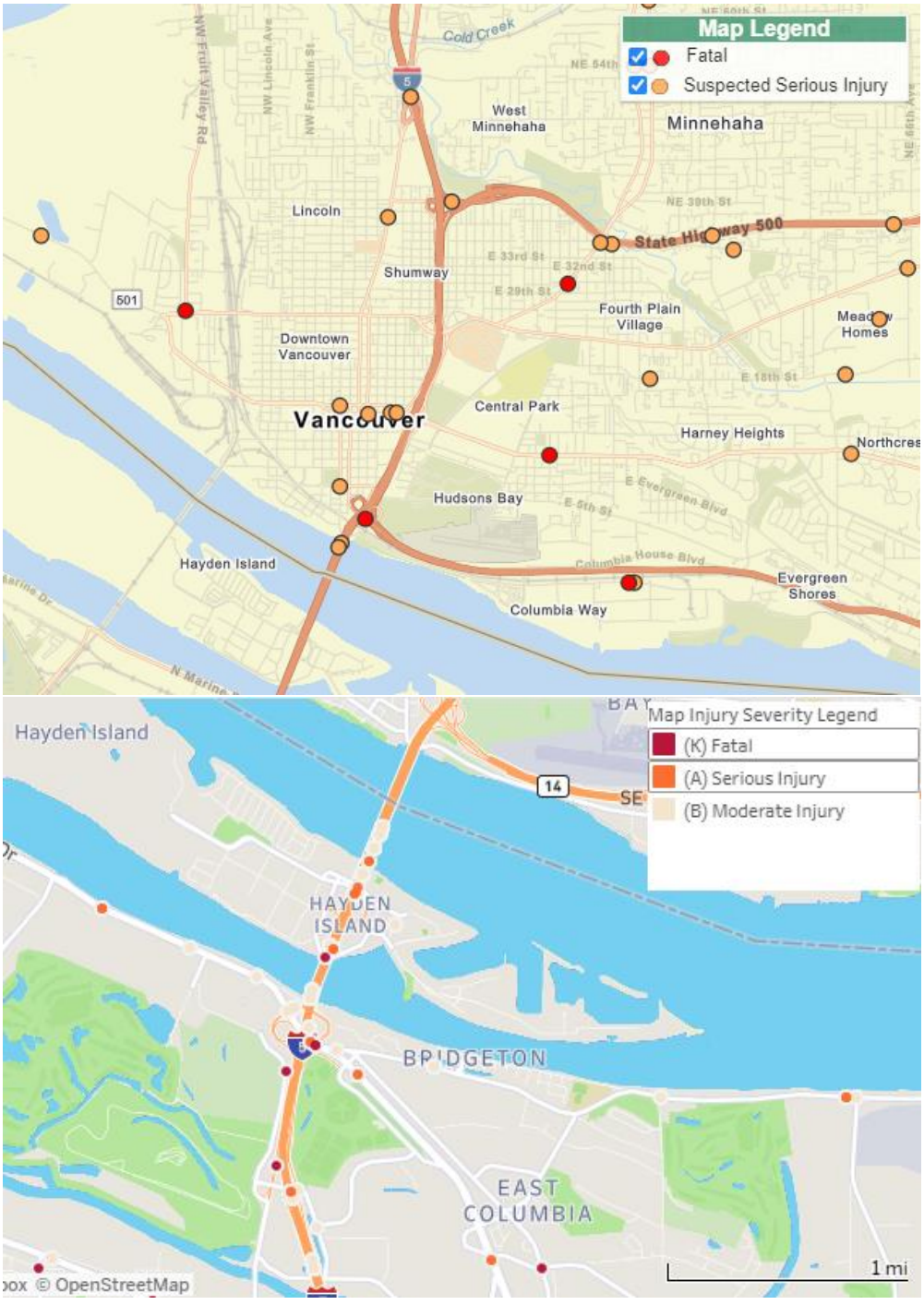
Figure 9. Rates per 100,000 for traffic crash serious injuries and fatalities. 2015-2022. Source: ODOT Crash Data Viewer, WSDOT Crash Data Portal, ACS 5-year population counts.[75,87,87]



The *DSEIS Transportation Technical Report* includes crash data from 2015 through 2019. Between 2015 and 2019 there were 2,270 crashes that occurred within the study area between 2015 and 2019. A little over half of these occurred on the I-5 mainline (Table 3-34, *DSEIS Transportation Technical Report*).[77(p3-117)] Overall, 38% (n=856) resulted in an injury, 1.5% (33) resulted in a serious injury, and 0.3% (7) resulted in a fatal injury. Seventeen involved a bicycle and 30 involved someone walking (Table 3-37, *DSEIS Transportation Technical Report*). [77(p3-120)]

In 2022, there were five fatal crashes within the IBR study area, four in Multnomah County and one in Clark County (Figure 10).[87,88] This is two short of the seven total identified over a five year span in the DSEIS Transportation Technical Report.

Figure 10. Fatal and serious injury crashes in IBR study area, 2022 Source: ODOT Crash Data Viewer, WSDOT Crash Data Portal.[87,88]



Black residents experience a disproportionate amount of transportation safety concerns in the region. Not only do Black community members experience higher death rates from traffic crashes and visits to the emergency room for traffic-related injuries, they also experience biased behavior, harassment, violence, and unfair policing. This stems from racism and racist systems baked into regional housing, transportation, and law enforcement practices.[89] Involving community in redesign for their neighborhoods can proactively encourage more, better, and safer options for everyone.

Potential Project Impacts

The *DSEIS Transportation Technical Report* relies on the Enhanced Interchange Safety Analysis Tool (ISATe) estimated to predict changes in crash frequency that may occur with and without implementation of the MPLA. ISATe predicts that across the freeway network there will be up to a 28% increase in total crashes with the No-Build Alternative, and up to a 15% increase in crashes with the Modified LPA.[77(p4-159)] The ISATe model assumes fewer crashes will occur with more lanes, and therefore predicts that the MPLA option with two auxiliary lanes would reduce crash frequency by an additional 4% compared to the MPLA with one auxiliary lane, for a total net increase in crash frequency of up to 11%.[77(p4-161)]

The DSEIS Transportation Technical Report does not provide further detail on changes in crash type, severity, location, or time due to uncertainty in ISATe, but notes removal of the bridge movable span could further reduce crashes in the MLPA. ISATe predicts that changes in crash frequencies will be negligible, with the exception of a small increase at the intersection of Evergreen Boulevard and C Street.[77(p4-160)] The *DSEIS Transportation Technical Report* provides a descriptive account that safety outcomes for active transportation modes would improve because of facility improvements, but no additional evidence or analysis is provided. There is inadequate information to conclude to what degree severe injury and fatalities will be reduced with implementation of the MPLA.

Environmental Justice and Health Equity

Urban development that supports safe physical activity is not evenly distributed across the region. Some corridors in the region have higher crash rates than others, known as high injury corridors. Sixty-five percent of high injury corridors on regional roadways are through areas with higher proportions of communities of color, people with low-income, or people with limited English.[90] Who lives in areas that support active transportation today is shaped by past patterns of housing discrimination and disinvestment, disproportionately excluding communities of color and low-income communities.[91] The DSEIS does not assess how changes in travel safety across each mode type might vary by priority environmental justice community.

Transportation Access Literature Review

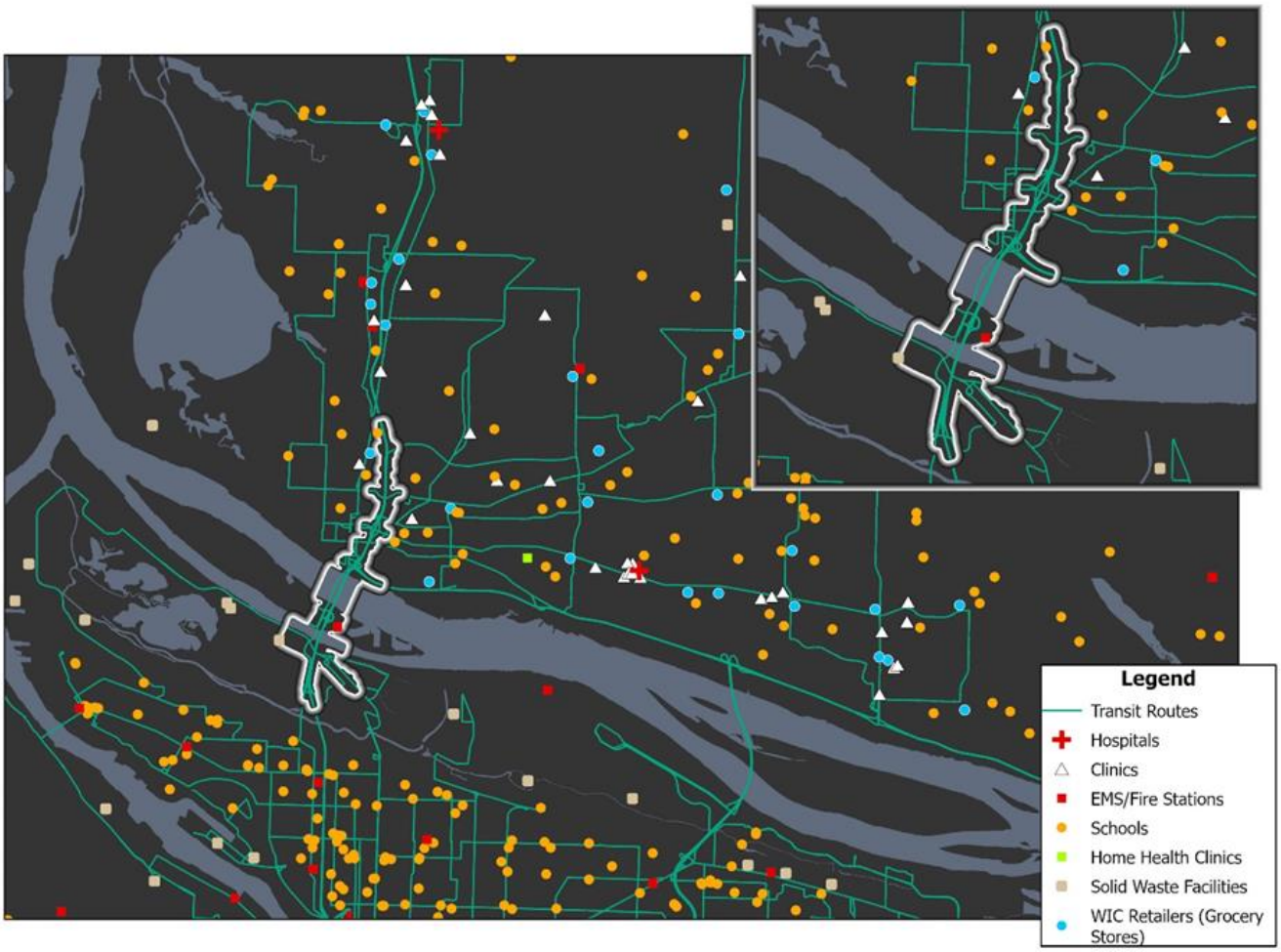
Literature Review

Transportation barriers are a major factor in accessing and maintaining healthcare across the United States. Lack of transportation can lead to delays in accessing health care, which can lead to delayed diagnosis, treatment, and reduced health outcomes. It can also disrupt care through missed appointments, disrupt access to pharmacies for medication, and create longer transit times to access care which requires additional time off work and added childcare burden.[36,92] Of particular concern is how unmet transportation needs impact children's access to health care including mental health care, "obtaining medication, accessing dental care, immunizations, chronic illness care, specialized care, and follow-up emergency care".[93] Children of color, children with vulnerable citizenship status, and children whose caregivers need financial support experience the health care impacts of transportation burden at higher rates.[93]

Potential Project Impacts

The IBR Program will naturally include some amount of disruption to daily life for community members living and working in and around the project area. The map below (Figure 11) includes some (though not all) examples of essential services, access to which should be considered and maintained as much as possible during program planning and execution. Mapping was restricted to data made publicly available by individual states, counties, and local municipalities, which causes some variation in data availability, especially across state lines. Date of most recent update also varies across data sources. Therefore, this map should not be considered a complete or up-to-date picture of the community. Locations like schools, grocery stores, clinics and hospitals, pharmacies, emergency services, transit stops, and public utility facilities are essential to the daily functioning of the community. Disruption of access to these services can have significant impacts on individual and community well-being. Those individuals that will have to find a new route through or around IBR-related construction to reach their essential services are particularly vulnerable.

Figure 11: Essential services and facilities in and near the IBR Program area.



Sources: Oregon Metro RLIS[94] (transit routes including buses and rail lines, hospitals, fire stations, schools, solid waste facilities), City of Vancouver[95] (transit routes including buses and rail lines), Washington Department of Health[96] (clinics, EMS stations, home health clinics, WIC retailers), and Washington State Office of Superintendent of Public Instruction (schools)[97]

Project Construction

Over the course of the construction period travel routes will change due to road closures, lane closures, traffic detours, relocation in bus stops, transit station closures, transit schedule changes, and sidewalk and bicycle lane impacts.[77(p5-3)] Additionally, changes in travel patterns due to construction could lead to increased congestion and diversion on alternative rates, increasing the risk of additional delay, as well as crash frequency (Table 5-1, *DSEIS Transportation Technical Report*).[77(p5-5)] The *DSEIS Environmental Justice Technical Report* also notes that if the sidewalks over the I-5 bridge are closed, access across the river could be cut off entirely for people whose only mode of travel is on foot or by bike, because the I-205 bridge is not a practical distance for an alternative.

These construction-related transportation barriers will affect access to homes, jobs, schools, health care facilities, and other essential destinations. This has the potential to create acute stress, make chronic stress worse, and interrupt access to programming and services that keep people healthy.

Long Term Effects

The improvements in light rail and transit service will generally increase access to jobs and other services in the region. Although, as mentioned above, improvements are not the same among sub groups, and access to jobs for BIPOC residents, communities with limited English proficiency, immigrants and refugees, and people under the age of 25 will not increase as much as it will for white, non-Hispanic residents (Table 4-2, *DSEIS Equity Technical Report*).[82(p4-3)]

Evaluation of potential tolling scenarios in the *DSEIS Environmental Justice Technical Report* found that some environmental justice populations might experience adverse effects. Despite improvements in trip time, reliability, and alternative transportation options, some low-income households may still experience disproportionate financial burden in scenarios where they have no other choice to drive over the bridge and pay the toll.[98(p4-40)]

Environmental Justice and Health Equity

Transportation access to healthcare often disproportionately affects older adults, people with disabilities, veterans, people with chronic health conditions, and people of color. Disproportionate negative impacts are also experienced by pregnant people, people with young children, and people experiencing homelessness.[92] Even when studies controlled for socioeconomic status, they still found higher transportation barriers and decreased healthcare access among communities of color.[99] As mentioned above, tolling may create a disproportionate financial burden on low-income households unable to benefit from improvements in transit and active transportation options, such as someone needing medical care. This could create an additional barrier to health care, as well as other essential services.

Noise

Literature Review

Health concerns associated with noise exposure include cardiovascular disease, diabetes, reduced cognitive functioning, annoyance, stress, sleep disturbance, adverse birth outcomes, and noise-induced hearing loss.[36,100,101] Noise exposure also affects quality of life, mental health, and sleep quality, which are essential for health. Health impacts can result from short, intense sounds as well as loud background noise.

Children, older adults, shift workers, and construction workers are at greater risk for noise-induced health effects.[102] Noise exposure and noise disruptions can cause increased attention issues, decreased reading comprehension, communication difficulties between children and their teachers, and increased stress and blood pressure in both adults and children.[103,104] Students learning in their second, third, or more language may be at an even greater disadvantage than other students when faced with a noisy learning space.[105]

Older adults, shift workers, and people with preexisting sleep disorders are more sensitive to noise-induced sleep disturbance, which can occur when noise levels are as low as 33 dBA.[106] Sleep disruptions strain the cardiovascular system, disrupt circadian rhythms, and raise blood pressure.[107] These sleep disruptions can lead to long-term health problems like cardiovascular disease. Undisturbed sleep is essential for daytime functioning, health and wellbeing.[106]

For workers, the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit for occupational noise is 85 dBA over an 8-hour period and the Occupational Safety and Health Administration (OSHA) requires a hearing conservation program at this level to protect from hearing damage.[108,109] While not regulatory, the U.S. EPA and WHO recommend noise exposure limits to protect against adverse health effects and hearing loss. For 24-hour averaged exposure, the U.S. EPA recommends a 45 dBA (indoor) and 55 dBA (outdoor) exposure limit to protect against adverse health effects, and a 70 dBA exposure limit to protect against hearing loss.[107,110] The WHO recommends limiting road traffic noise to 53 dBA during the day, and 45 dBA at night to prevent adverse health effects.[101] These are all more protective than the A WSDOT (65 dBA), ODOT (66 dBA), and FHWA (67 dBA) noise limits, which are regulatory (see Table 9 below).

Noise pollution, like other types of air and environmental pollution, is not equitably distributed. In the United States, people of color and immigrants are overrepresented in construction jobs with a higher risk of injury.[102] People with lower income and people of color are more likely to be exposed to both more noise and environmental pollution.[101,102] Systemic racism and other inequitable urban development and land use practices historically and presently contribute to poor health outcomes for people of color and people with low income. Exposure to noise pollution further increases risk of adverse health outcomes.

A WHO systematic review on noise interventions and health outcomes found that evidence, though limited, shows that transport noise interventions benefit health.[111] It is generally difficult to consistently study the link between environmental noise interventions and health outcomes. There are several studies on noise levels affected by noise mitigation, but fewer that explicitly study the link between noise mitigation and health outcomes.

Explanation of noise measurements

Sound intensity or pressure is measured in units of decibels (dB). The decibel scale is logarithmic, which means small increases in dB result in increasingly louder sounds to the human ear. For every 3db increase, the sound intensity doubles, and for every 10 dB increase, the sound is 10 times louder. For example, a 10-dB noise is 10 times louder than 0 dB, and a 20-dB noise is 100 times louder than 0 dB. The A-weighting noise scale (dbA) is more sensitive to the range of human hearing.

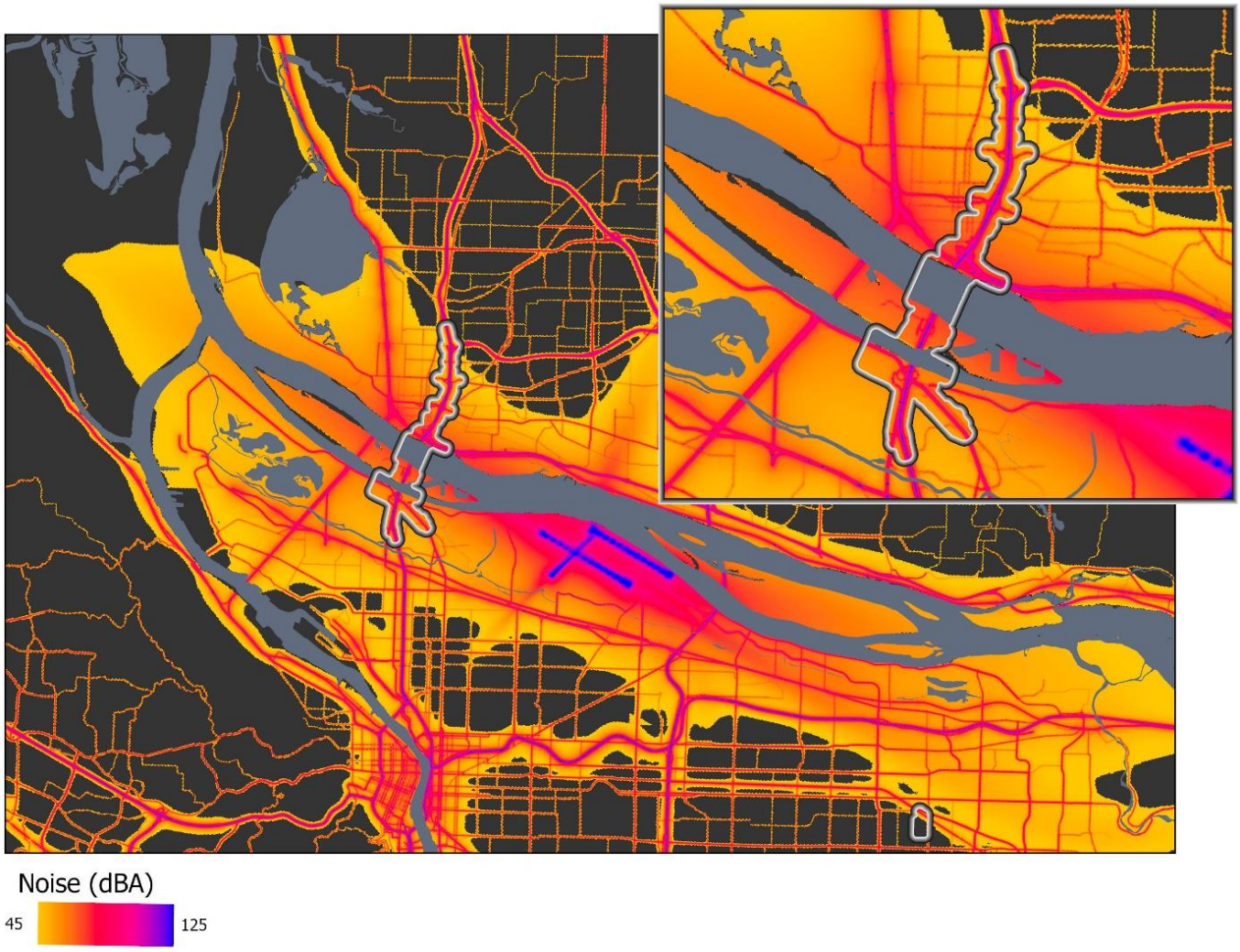
Noise levels are reported using different units and acronyms that describe the how, what, and when of the noise measurement. A-weighting is the standard for environmental noise assessment. In the noise modeling process, some noise levels are weighted differently to account for the fact that people are more sensitive to noise during typical nighttime sleeping hours than during the day, which is why some recommendations include different levels for day and nighttime.

Local Context

In the IBR Program focus area, 30% of individuals have high blood pressure, 14% report poor mental health, and nearly 10% have diabetes.[23]

The project area neighbors Portland International Airport, Pearson Field, Portland International Raceway, and active railways. Road, air, and rail traffic contribute to existing noise pollution, with average 24-hour noise levels ranging from 45 dBA in locations farther from transportation infrastructure and increasing up to 89 dBA near/on roads, railways, and airport locations (Figure 12).

Figure 12. 24-hour average noise levels (decibels A) in and near the project area from road, aviation, and rail traffic in 2020. Source: USDOT Bureau of Transportation Statistics[112]



The DSEIS includes noise measurements to establish existing conditions. Noise measurements were taken from various locations: schools, park trails, residences and hotels, libraries, museums, and athletic fields. The FHWA, ODOT and WSDOT have noise abatement criteria for different categories of indoor and outdoor space (see Table 9).[113]

Table 9. ODOT, WSDOT and FHWA Noise Abatement Criteria for Hourly Average Noise Levels[113]

	ODOT	WSDOT	FHWA
	Noise Abatement Criteria Hourly A-Weighted Sound Level Decibels (dBA)		
Residential (single and multi-family units) (Exterior)	65 dBA	66 dBA	67 dBA
Schools, libraries, hospitals and medical facilities, day care centers, auditoriums, places of worship, active sport areas, trails (Exterior)	65 dBA	66 dBA	67 dBA
Schools, libraries, hospitals and medical facilities, day care centers, auditoriums, places of worship (Interior)	50 dBA	51 dBA	52 dBA
Commercial areas, hotels, offices, restaurants/bars (Exterior)	70 dBA	71 dBA	72 dBA

The Washington State Board of Health's Chapter 246-366 WAC requires noise to be below well WSDOT thresholds, at 55 dBA hourly average, for new school siting and existing instructional school spaces, with exceptions where approved sound reduction is used in construction.[114] In existing indoor spaces, background noise must be below 45 dBA over a 30-second average (with the ventilation system running). Multiple schools are near the project area in Vancouver, including elementary, middle, and high schools, a community college, and the Washington State School for the Blind. Discovery Middle School was the only school location where noise measurements were taken for the DSEIS (Table 2-11, *DSEIS Noise and Vibration Technical Report*).[113(p2-25)] Measurements were also taken at an athletic field at Clark College.

Current traffic noise levels approach or exceed ODOT noise abatement approach criteria in 50 locations in Portland—primarily residences—including 18 floating homes, multi-level apartment units, and one restaurant. There are 110 locations in the Vancouver project where traffic noise levels currently exceed WSDOT noise abatement criteria, including residential locations, offices, and outdoor recreational spaces.

Current noise levels ranged from 57 dBA (Leverich Community Park Disc Golf/Picnic in Vancouver) to 77 dBA (Discovery Middle School and the intersection of Columbia St. and W. 4th St. in Vancouver). Noise levels in residential areas in north Vancouver ranged from 56 to 77 dBA, with loudest areas near noise wall openings or in areas without noise walls. Noise levels for residential floating homes in North Portland ranged from 66 to 69 dBA.

Potential Project Impacts

Project Design

The DSEIS determined that noise walls are the only feasible form of noise mitigation for the project. The DSEIS evaluated 18 potential noise walls, including the removal of existing noise walls and construction of upgraded noise walls, and determined 10 to be feasible and reasonable for consideration in project design. With mitigation, the Modified LPA would have 93 fewer traffic noise impacts than under the No-Build Alternative.

Project Construction

The DSEIS considers construction noise levels over a 9-year period. Maximum noise levels could reach up to 82-94 dBA at the closest receiver locations. In the *DSEIS Noise and Vibration Technical Report*, Table 5-1 details typical construction equipment used for the Modified LPA and demolition, their project use, and maximum noise level. Table 5-2 includes average maximum noise levels for construction activities, including demolition of existing buildings (93 dBA), staging for construction (94 dBA), and other activities like installing signage (91 dBA) (Table 5-2, *DSEIS Noise and Vibration Technical Report*).[113(p5-5)]

Long-Term Impacts

In Portland, the Modified LPA would approach or exceed ODOT noise abatement criteria at 60 residences and one sports field.[113(p4-13)] This varies slightly from the total count of residential exceedances listed in the *DSEIS Noise and Vibration Technical Report* Table 4-1, which is 63 residences. The *Technical Report* modeled noise levels for the Modified LPA, No-Build Alternative, and Existing Conditions. In Vancouver, the Modified LPA would approach or exceed WSDOT noise abatement criteria in 138 locations, including residences, offices, and outdoor space at the Vancouver Community Library and Discovery Middle school. Table 10 includes the number of locations that exceed noise abatement criteria under existing conditions, the Modified LPA, and a No-Build Alternative.

Table 10. Noise exceedances under the Modified LPA, No-Build Alternative, and Existing Conditions

	Modified LPA noise exceedance locations	No-Build noise exceedance locations	Existing Conditions noise exceedance locations
Portland*	65	64	50
Vancouver#	138	151	110
Project Area Total	203	215	160

*Sources for Portland exceedances: Table 4-1 DSEIS Noise and Vibration Technical Report (Modified LPA); Table 4-1 DSEIS Noise and Vibration Technical Report (No-Build); Table 3-1 DSEIS Noise and Vibration Technical Report (Existing Conditions)

#Sources for Vancouver exceedances: Tables 4-4, 4-6, 4-8, 4-10 DSEIS Noise and Vibration Technical Report (Modified LPA); Tables 4-3, 4-5, 4-7, 4-9 DSEIS Noise and Vibration Technical Report (No-Build); Tables 3-2, 3-3, 3-4, 3-5 DSEIS Noise and Vibration Technical Report (Existing Conditions)

In Portland, under the Modified LPA "most locations would experience an increase of 2 to 4 dBA over existing conditions, with increases of up to 11 dBA at one location".[113(p4-12)] Again, since decibels are on a logarithmic scale, a roughly 3-dB increase doubles the intensity of the sound, and a 10-dB increase means the sound is 10 times louder. Compared to the No-Build Alternative, noise levels under the Modified LPA would range from 2 dBA above to 2 dBA below current levels (p. 4-12) Jantzen Beach RV Park would experience the greatest increase in noise levels (4 to 11 dBA increase above Existing Conditions, and 4 to10 dBA above No-Build Alternative).

In Downtown Vancouver, under the Modified LPA, "noise levels would approach or exceed the WSDOT noise abatement criteria at the same 37 multi-family residences as existing conditions along with four additional residences[…]"[113(p4-32)] Modified LPA noise levels would be within 3 dBA of the No-Build Alternative at most locations; some areas will experience up to an 8 dBA reduction or increase under the Modified LPA.

In Fort Vancouver, traffic noise level exceedances for trails would be the same under the Modified LPA and No-Build Alternative. Two residences and two offices would experience increases. "Compared to the No-Build Alternative, traffic noise levels Under the Modified LPA are expected to increase throughout much of the Fort Vancouver area by up to 10 dBA..." and decrease by 4 dBA in other areas.[113(p4-44)]

In Vancouver East of I-5 and North of Mill Plain, the Modified LPA would exceed WSDOT noise abatement criteria at 26 locations, compared to 31 under the No-Build Alternative. West of I-5 and North of Mill Plain, the Modified LPA would exceed WSDOT noise abatement criteria in 54 locations, which is the same number of locations as Existing Conditions and No-Build Alternative, while the specific sites vary slightly. Notably, an up-to-10 dBA increase under the Modified LPA compared to No-Build Alternative is possible for residences near proposed ramp improvements (between E 33rd and E 35th Streets).

Environmental Justice and Health Equity

The Washington State Board of Health's Chapter 246-366 WAC requires noise to be below specified thresholds for new school siting and existing instructional school spaces. In existing spaces, background noise must be below 45 dBA and 70 dB (over a 30 second average).[114] Table 2-11 of the *DSEIS Noise and Vibration Technical Report* states that a 77 dBA noise level was measured at Discovery Middle School.[113(p2-25)] The DSEIS determined that noise walls are the only feasible form of noise mitigation for the project; however, the DSEIS states that the noise wall proposed to reduce noise for Discovery Middle School and seven nearby residences (Noise Wall 1) did not meet WSDOT criteria for reasonableness because its cost estimate exceeded WSDOT reasonable allowance criteria.[109(p7-12)] A shortened wall is recommended for consideration, though it would not reduce noise impacts for Discovery Middle School. As discussed above, children are particularly sensitive to attention, learning, and health impacts of noise exposure. Our recommendations reflect necessary attention toward mitigating noise exposure to lower levels than currently impacting Discovery Middle School and potentially impacting the school under the Modified LPA.

Additionally, the project area is adjacent to Portland International Airport and active railways. Neighborhoods in the project area—particularly Hayden Island, Bridgeton, and East Columbia in Portland, and Columbia Way, Hudson's Bay, Esther Short and Arnada in Vancouver—already experience combined noise pollution of road and aviation traffic. Project construction will add to combined noise levels. Further, potential traffic diversion to the I-205 bridge during construction and/or tolling may increase combined noise and air pollution to neighborhoods east of the project area.

The *DSEIS Environmental Justice Technical Report* describes higher levels of noise and vibration will that negatively and disproportionately impact communities identified as equity priority communities. Seven residences in the Rose Village neighborhood—identified by IBR as a "meaningfully greater EJ area for both low-income and minority populations"—would experience increased noise levels by 2-12 dBA under the Modified LPA.[98(p4-10)] The project currently proposes a noise wall to mitigate noise impacts to affected households in Rose Village. The *DSEIS Environmental Justice Technical Report* also identified the potential for disproportionately high levels of noise and adverse effects in the East Columbia and Esther Short neighborhoods, which are high-priority environmental justice areas identified by the Program.

Climate Change and Health

Literature Review

Changes in climate and the environment can have profound impacts on human health. The Northwest region is already experiencing climate change impacts, and the impacts of climate change on health are projected to increase with warming global temperatures.[115,116]Climate-related hazards such as heat and increasing heat waves, wildfire smoke and air pollution, severe weather and flooding are associated with numerous adverse health outcomes.[116–118] Hotter and longer heat waves are associated with heat-related illnesses, adverse maternal and infant health outcomes, mental health impacts, cardiovascular failure, and death.[119] In addition to extreme heat, climate change also increases the probability of other severe weather events, including flooding, which may cause injury, water contamination, and even death.[120,121]

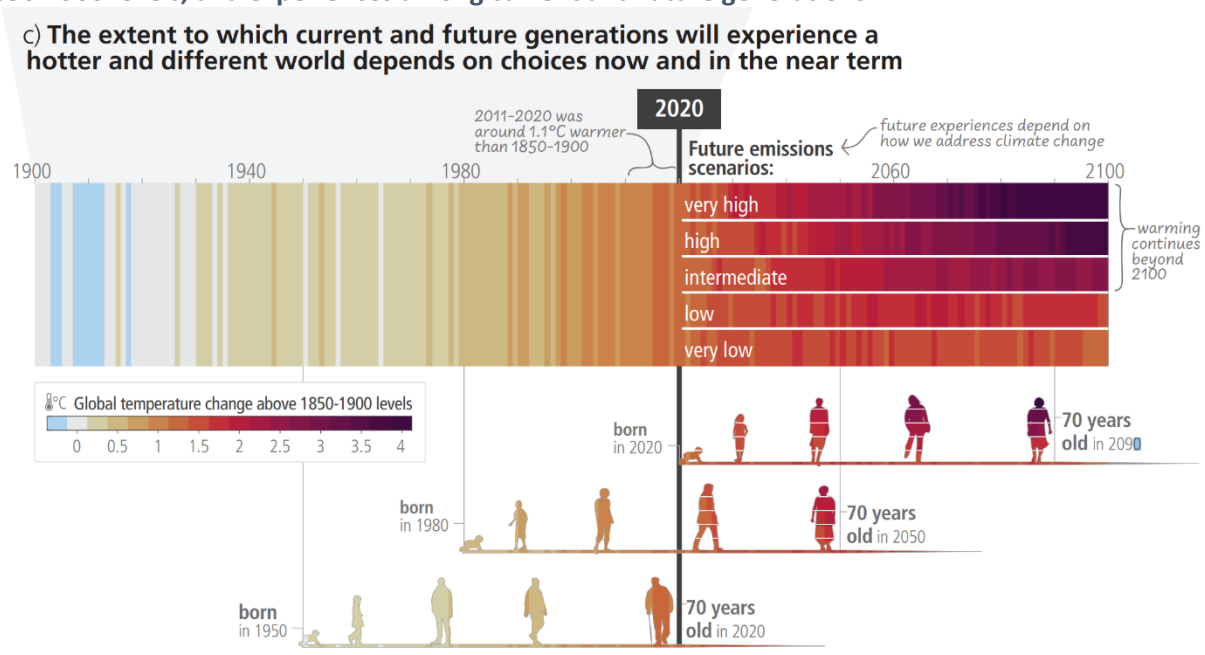
Climate-related hazards can compound to worsen existing exposures.[122] For example, excess heat may also exacerbate existing hazards related to air quality mentioned previously (Charlson et al., 2021; NIH, 2022). Additionally, across hazards, climate change threatens mental health and wellbeing.[42]

Potential Project Impacts

The IBR Program has the potential to affect climate impacts through greenhouse gas (GHG) emissions during project construction and operation of the bridge. The *DSEIS Climate Change Technical Report* outlines opportunities and a framework to limit and reduce GHG emissions to align with local, state, and federal climate and sustainability goals.[123(p1-9-1-13)] The *report* states the Modified LPA is "anticipated to reduce GHG emissions compared to the No-Build Alternative" based on the extension of light rail service, strategies to reduce congestion and idling, opportunity to reduce travel demand, and options to increase mode shift and infrastructure for active transportation.[123(p1-7)] Both the No-Build Alternative and Modified LPA are estimated to result in fewer GHG emissions in 2045 compared to the 2015 baseline based on existing regulatory requirements (*see MOVES model, Air Quality section*) and an expected shift in electric vehicle uptake.[124(p3.19-16)] Assuming adoption of electric vehicles in accordance with Oregon and Washington state rules, the MLPA is estimated to reduce total GHG emissions around 1% (MT CO2e/day) in the traffic subarea in 2045, compared to the No Build Alternative.[124(p3.19-18)] This daily reduction is equivalent to around eleven gasoline-powered passenger vehicles driven for one year.[125] Construction of the new bridge will produce GHG emissions, and construction may impact emissions due to traffic delays.[124(p3.19-19-20)] The *DSEIS Climate Change Chapter* notes "emissions generated from the construction of any of the Modified LPA design options would be similar."[124(p3.19-6)] As mentioned in the Air Quality section, the IBR Program has the potential to mitigate climate impacts through design that encourages and increases opportunity for transportation mode shift. Reducing GHG emissions now and in the short-term can mitigate future climate change impacts and global temperature change that directly and indirectly affect health outcomes (Figure 13).[126]

Hazard-specific potential project impacts are included in sub-sections below.

Figure 13. Overview of future emissions scenarios and projected global temperature change above 1850-1900 levels, and experiences among current and future generations



Source: Intergovernmental Panel on Climate Change, 2023[126]

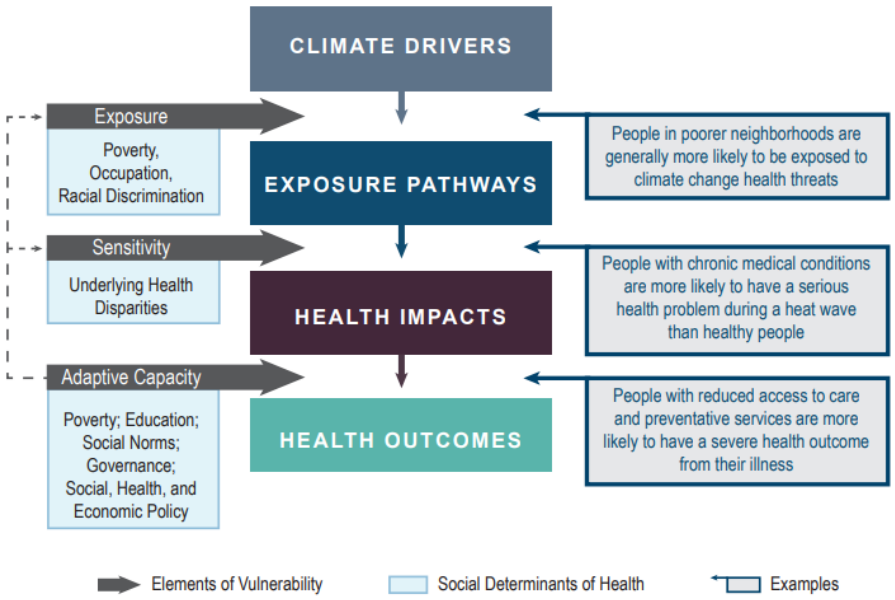
Environmental Justice and Health Equity

Certain groups of people are more vulnerable than others to health stressors from climate-related events like extreme heat, floods, poor air quality, and other similar events. These groups include children, pregnant people, older adults, people with disabilities, and people with chronic medical conditions.[127]

Unjust policies and practices, including historic underinvestment, systemic racism, marginalization, discrimination, and environmental injustice, have resulted in some communities experiencing climate impacts worse than others.[127,128] Some BIPOC communities or low-wealth communities may live in areas that have been historically redlined or faced structural exclusion, areas with outdated or aging infrastructure, and/or areas disproportionately burdened by pollution or climate exposures (environmental justice communities).[129–131] Low income and BIPOC communities often bear an unfair burden of exposure to pollution and climate impacts, yet have contributed the least to greenhouse gas emissions.[116] Historically, major transportation projects have often contributed to environmental injustices and health inequities in low income and BIPOC neighborhoods.[132(pp346-347)] Some social factors, like income, can impact access to resources to adapt to climate change (e.g., ability to afford or access air conditioning, indoor air filters, or flood/disaster insurance).[129,133] BIPOC communities may already experience stressors that influence health, and climate change adds another stressor and threat to health.[134]

People and communities may experience overlapping vulnerabilities that impact health risks from climate change (Figure 14). For example, outdoor workers with asthma or another respiratory condition may be more sensitive and exposed to wildfire smoke than other groups.[131] Children who live in a neighborhood with less trees or greenspace may be more vulnerable to heat compared to adults and those living in more shaded areas.

Figure 14. Overview and examples of how the Social Determinants of Health can impact vulnerability to climate change



Source: Gamble et al., 2016 [116]

In the IBR project area, the average prevalence of high blood pressure and diabetes are slightly higher compared to Clark and Multnomah counties overall (Table 5).[23] A higher percentage of people living below 200% poverty (33%) live in the project area compared to Clark and Multnomah counties overall (Table 4). According to the literature, people with low income may be more burdened by climate change health impacts.[127,135] Additionally, groups particularly susceptible to climate-related hazards represent a notable proportion of the population living in the project area. These include older adults (18%), people with disabilities (20%), people who are unemployed (5.3%), and people without health insurance (7.4%) (Tables 3, 4).[23] Climate change can negatively impact the health of socially vulnerable groups, and Figure 5 displays several socially vulnerable census tracts in the IBR project area compared to the rest of the region.[135] Similarly, the DSEIS states the program focus area includes six schools, six assisted living facilities, and five healthcare facilities. Similar to air pollution impacts, these institutions may include people who are particularly susceptible to climate-related health impacts.

Heat

Literature Review

Extreme heat poses a significant threat to public health and safety, and is the leading cause of weather-related injury and death in the United States.[136] Exposure to heat can result in heat-related illness (including heat cramps, heat exhaustion, and heat stroke), mental health impacts, adverse perinatal outcomes, cardiovascular failure, and death.[119,137–139] High temperatures, heat early in the season, long periods of excess heat (heat waves), and high nighttime temperatures (lack of overnight cooling) are particularly hazardous for public health.[140–142]

The National Integrated Heat Health Information System defines “urban heat islands” as the phenomenon that cities get much hotter compared to rural or vegetated landscapes, due to buildings, unshaded roads, and other paved areas gaining heat during the day and emitting heat into the surrounding air.[143] Therefore, people who live in cities are more likely at risk of heat compared to rural and suburban communities.[144] Within cities, heat exposure and related health impacts may vary by neighborhood. This is due to an inequitable distribution of trees and greenspaces, where some areas may have more heat-absorbing buildings and pavements than other surrounding neighborhoods.[144] Historic redlining and systemic underinvestment may be contributing factors to the inequities in exposure to heat in certain neighborhoods, where a higher percentage of BIPOC communities and low-wealth communities may live.[116,144] Additional equity considerations around heat islands include access to cooling centers, inadequate housing conditions, and a higher cost burden of air conditioning bills.[116,144]

Local Context

Figure 15 displays tree canopy cover around the project area in Clark and Multnomah counties. The IBR Project area has less tree canopy cover (16%) compared to Clark (24%) and Multnomah (25%) counties overall.[145] Tree canopy cover can provide shade and cooling to surfaces, so it is one measure that can be used as a potential estimation of heat exposure.

Figure 15. Tree Canopy Cover in Region and IBR Study Area

From 2016-2022, there were 112 heat-related deaths in the Portland metropolitan area (including Washington, Clackamas, Multnomah, and Clark counties).[146,147] In 2021, the year of the Pacific Northwest heat dome event, the region experienced the highest number of recorded heat-related deaths.

Potential Project Impacts

Analyses included in the DSEIS *Climate Change Technical Report* projects average temperatures and number of extremely hot days will increase during the construction of the bridge and project lifetime.[123(p4-5-4-6)] The report notes infrastructure design considerations "should withstand regular air temperatures well over 100° F" to avoid disruptions to transportation.[123(p4-6)]

The IBR Program may influence exposure to urban heat. There are several opportunities to reduce and mitigate exposure to heat for bridge workers and community members alike—and prevent heat-related illness and death throughout the program's design, construction, and operation. The DSEIS *Climate Change Technical Report* includes information about specific measures to provide shade and cooling for bridge users, especially for pedestrians and bicyclists.[123(p4-6)] To mitigate the urban heat island effect, the program and local agencies could increase greenspace and tree canopy cover and reduce the amount of paved surfaces in areas surrounding bridge.[123(p3-4)] The *Report* specifies monitoring stations along active transportation facilities that track heat to alert bridge users of its safety.[123(p7-4)] The *Report* cites occupational safety rules from Oregon Occupational Safety and Health Administration and Washington Labor & Industries to protect workers from the negative health outcomes of heat exposure.[123(p4-6)]

Environmental Justice and Health Equity

While heat can affect everyone, some communities are more sensitive to heat, may be more exposed, or may have less access to resources to cope with heat. A 2018 study in Portland found that Black, Native Hawaiian or Pacific Islander, Hispanic, and youth populations were most exposed to urban heat.[148] Older adults, infants and children, pregnant people, and people with existing health conditions or who take certain medications may be more sensitive to heat and more at risk for heat-related illness.[149–151] Some communities may be more exposed to heat due to social or structural factors, like where you live or work, including low-wealth communities, people living unsheltered or unhoused, people living in urban heat islands, people without access to air conditioning, people who exercise outdoors, and outdoor workers.[120,152]. According to a 2018 report on climate risks in Washington State, among construction workers "heat related illness is most common among roofing construction and highway/bridge construction workers."[129(pp40-41)]

Wildfire Smoke and Ozone Pollution

Literature Review

Wildfire smoke especially threatens public health in the Pacific Northwest. Wildfire smoke contains several air pollutants, including fine particulate matter ($PM_{2.5}$) that can penetrate deep into the lungs and bloodstream.[153] Exposure to wildfire smoke can cause and exacerbate respiratory, cardiovascular, and neurological diseases, mental health impacts, as well as other impacts to the skin, gut, kidneys, eyes, nose, and liver.[154–156] Wildfire smoke exposure in pregnancy is associated with increased risk of adverse birth outcomes, including preterm birth and lower birth weight in some studies.[153,157] Wildfire smoke exposure has also been linked to premature death.[158]

Ozone is an air pollutant with documented health effects, and higher temperatures increase the production of ozone at ground-level. Ground-level ozone in the air can cause health effects such as sore throat, coughing and breathing problems, susceptibility to infections, and exacerbate existing conditions like asthma, emphysema, and chronic bronchitis.[159]

Local Context

In recent decades, the western United States has experienced an increase in the frequency and severity of wildfires, and associated wildfire smoke.[160] In the last decade, there have been several severe wildfire smoke events impacting the region. The Washington State Department of Ecology identified Vancouver as one of sixteen overburdened communities in Washington highly impacted by air pollution, specifically high levels of $PM_{2.5}$.[50] The Portland-Vancouver metropolitan area also experiences high ozone levels, especially on hotter days.

Ten percent of adults in the IBR project area have asthma (Table 5).[23] Asthma prevalence is similar in Clark and Multnomah counties overall.[23] While there may be several factors contributing to asthma and other chronic respiratory conditions, asthma is an important health outcome as people with asthma may be more impacted by poor air quality.

Potential Project Impacts

The DSEIS *Climate Change Technical Repor*t notes the region will "see an increase in severe smoke events" in the future.[123(p4-9)] Severe smoke events could impact bridge construction and use, including impacts to visibility and exposure to air pollution among bridge workers, pedestrians, bicyclists, transit users, and community members.

There are several opportunities for the IBR Program to mitigate exposure and protect public health during smoky conditions and poor air quality, including provision of training and protective equipment for workers, reducing construction or transportation pollution during severe smoke or ozone events, and planning for smoke-related disruptions for active transportation users, such as intermittent closures or detours. The DSEIS *Climate Change Technical Report* cites state rules to protect workers during smoky conditions.[123(p4-9)] The Program should consider cumulative effects of air pollution when planning for high wildfire smoke or ozone days.

Environmental Justice and Health Equity

People with existing health conditions (such as asthma, Chronic Obstructive Pulmonary Disease (COPD), diabetes, chronic kidney disease, or heart disease), older adults, pregnant people, infants, and children are especially at risk of air quality-related health outcomes.[155,158,161] Outdoor workers, including those working in construction, transportation, or agriculture, are particularly at risk of wildfire smoke exposure and long periods of air pollution.[153,162] Nationally, low-income populations and BIPOC communities are overburdened by air pollution.[153] Racism in housing, including historic redlining, housing segregation, and neighborhood disinvestment, has contributed to inequities in exposure to air pollution.[153] Further disparities around air pollution exposure may persist due to inequitable access to air conditioning and air filtration in homes and schools in low-income neighborhoods and BIPOC communities.[153]

Severe Weather and Flooding

Literature Review

Severe weather, including snow, ice, or windstorms, flooding, and thunderstorms can impact health directly, as well as disrupt infrastructure vital to health and wellbeing (such as electricity, transportation, healthcare, safe water, and sanitation). Winter storms can cause injury and increased risks of falls, hypothermia, frostbite, mental health impacts, and death.[163] Flooding can cause immediate risks to human health, such as injury and death. Flooded waters can be contaminated and lead to human illness.[163–166] Flooding may also pose risks to human health through disruption of critical services (e.g., roads, transportation, drinking water) and disrupt wastewater infrastructure.

Local Context

Human-induced climate change has altered weather patterns and increased the frequency and intensity of extreme weather events. Future trends in weather events, particularly precipitation predictions, are uncertain. However, there is some evidence that extreme precipitation and flooding event will increase due to climate change.[167,168] A general upward trend in precipitation should be expected in the Lower Columbia River Basin, with additional risk for winter atmospheric river flooding.[169]

Impacts of severe winter weather on health outcomes can include increased falls and cold-related illnesses. In January 2024, emergency department visits for falls, cold-related illness and other health impacts increased during a severe winter weather event in the region.[170]

Potential Project Impacts

Severe storms or weather events could impact transportation and create barriers to access essential services in the region, such as healthcare. Bridge design should account for severe weather and flooding to minimize the impact of future events. The *DSEIS Climate Change Technical Report* provides an estimation of precipitation intensity and floodplains. However, the *Technical Report* may use outdated data sources and underestimate the future flood risk in the area, translating into greater vulnerability to health risks for bridge users and nearby communities.

The DSEIS *Climate Change Technical Report* notes a predicted increase in the intensity of precipitation during winter months and less snowpack across the Columbia River Basin. The cited model is current and consistent with other precipitation models in scientific literature.[171] Stormwater and flood management will be especially important to mitigate the effects of excess precipitation.

The Annual Exceedance Probability (AEP) is a statistical measure used to describe the probability of a specific event occurring in any given year. This statistic is often used to describe the probability of a severe flood. For example, floods with an AEP of 1% are often referred to as a “100-year flood”, or a flood with a 100-year recurrence interval. These estimates are updated regularly to adjust for changing climate and weather patterns.

The *DSEIS Climate Change Technical Report* provides 100-year recurrence interval floodplains mapped by FEMA corresponding to the immediate vicinity of the project area.[123(p6-6)] FEMA flood profiles are measured by FEMA flood insurance studies (FIS). The most recent FEMA FIS for Vancouver, Washington and Portland, Oregon references United States Army Corps of Engineers (USACE) studies from the 1970s.[172]

However, the USACE recently updated their AEPs for the Lower Columbia River Basin in 2022. In their report, the authors note that the FEMA effective flood profiles may not stay aligned with updates from the USACE. Furthermore, USACE estimates a higher water surface elevation corresponding to a 100-year flood than estimated by the annual FEMA effective FIS at the I-5 Bridge.[172(p72)]

The *DSEIS Climate Change Technical Report* does not specify the FEMA FIS year in their presented floodplains map and notes that "more of the study area will be subject to flood risk in the coming century". Still, the map may not accurately represent the region currently at-risk of damage due to a 100-year flood and requires further review.
See more in the Water Quality section.

Environmental Justice and Health Equity

Children, older adults, and people with compromised immune systems are more at risk of the health impacts of contaminated water.[165,173] Systemic underinvestment and outdated water system infrastructure in low-income communities can disproportionately expose these communities to unsafe water.[165] People with disabilities may face barriers to access risk communications or resources during severe weather events or climate hazards. Some people with disabilities may require ongoing medical care, which puts this population at risk during climate events that overwhelm the healthcare system or result in power outages.[174] People with limited English proficiency may face language barriers that restrict access to healthcare, social services, and risk communications.[135]

Mental Health and Climate Change

Literature Review

The impacts of climate change on mental health are a growing area of research. Severe weather and disasters can have immediate mental health impacts from trauma, loss of livelihood and displacement, such as shock, post-traumatic stress disorder (PTSD), and compounded stress and anxiety.[42,116] A 2021 scoping literature review by Charlson et al. found that many climate-related hazards were "associated with psychological distress, worsened mental health, and higher mortality among people with pre-existing mental health conditions, increased psychiatric hospitalizations, and heightened suicide rates".[139] While more gradual exposures to climate change (including increased temperatures, changes in weather patterns, etc.) and mental health impacts are less researched, chronic mental health impacts may include depression, anxiety, suicide, substance abuse, violence, and loss of personal and community belonging.[42] Further, sense of loss of environmental landmarks and place, impacts to plant and animal species, and other environmental effects may increase feelings of hopelessness, fear, and depression.[42,175]

Local Context

In the project area, an estimated 14% of adults reported poor recent mental health (Table 5).[23] The prevalence of reported poor mental health is comparable in Clark and Multnomah counties overall.[23] While these estimates are not specific to climate change, the current landscape of mental health in the region is consequential as climate change can disproportionately impact those with existing mental health conditions and/or contribute to new stressors and mental health impacts.

Potential Project Impacts

As previously stated, the DSEIS projects changes to climate across bridge construction and operation. The DSEIS *Climate Change Technical Report* did not include information about climate change impacts on mental health.

The IBR Program has the opportunity to influence climate change impact, community connectedness, safety, transportation, healthcare access (including access to mental health services), and the built environment through the project. All of these determinants can individually and cumulatively affect mental health.

Environmental Justice and Health Equity

Climate change impacts the natural environment, posing threats to mental, spiritual, and cultural health, wellbeing, and traditional practices among Tribal and Indigenous communities.[42,116,139,176] Climate change may exacerbate the impacts of intergenerational trauma and health inequities as a result of systemic racism and settler colonialism.[42,116,139] People with existing mental health conditions may be more impacted by trauma and distress from climate-related hazards or events.[42,139] Youth may be more at risk of climate-related mental health impacts, and are likely to experience more cumulative effects of climate on mental health in their lifetimes.[42,139,175]

Social Determinants of Health

The World Health Organization defines social determinants of health as “the non-medical factors that influence health outcomes” and estimates that between 30-55% of health outcomes are dependent on these determinants.[177] The term broadly encompasses social and environmental conditions – or the conditions in which people are “born, grow, live, work, and age”. This often includes neighborhood conditions, but also spans social factors like housing, education, and occupation. These systems affect health in complex and overlapping ways, often determining access to health-promoting resources. They also shape the level of stress someone experiences. Long term stress for social or environmental causes, like poverty or racism, activates biological systems that lead to inflammation, hormonal dysregulation, and chronic disease.[178]

In this analysis, we review housing and displacement, income and employment, access to greenspace, and Indigenous social determinants of health. It is important to note that transportation access is also a social determinant of health. Discussion of transportation access is in the *Transportation and Active Transportation* section.

Housing and Displacement

Literature Review

Housing influences health through four primary pathways: quality, affordability, stability, and location. Homes that are free of molds/pests and have essential amenities and thermal control promote good health. Housing that is located near healthy food options, parks, living wage jobs, and transit support access to health promoting opportunities and needs.[179] Affordability and stability are linked to health via stress. Expensive housing that leaves less budget for other needs, and the fear of losing housing, can lead to constant stress and cortisol release. Chronic stress contributes towards poorer mental health outcomes, reduced immune system function, metabolic and cardiovascular outcomes, and mortality.[180] Housing loss through foreclosure and gentrification-related displacement are associated with poorer well-being outcomes, including depression, anxiety, and self-reported health.[179,181]

Local Context

The IBR study area intersects with 14 neighborhoods in Clark and Multnomah County (ten and four respectively).

There are an estimated 1,366 people across the whole houselessness spectrum in Clark County, and an estimated 11,153 in Multnomah County.[182,183] Data on houseless community members is difficult to collect and maintain over time. Estimates included in Table 11 below come from the *DSEIS Equity Technical Report* and county point in time counts. Houseless residents are distributed throughout the IBR study area. The *DSEIS Equity Technical Report* Table 5-2 cites estimates that 349 houseless residents reside in Multnomah County in Inner Northeast Portland and North Portland, and 625 houseless residents in Clark County.[82(p5-5)]. These estimates come from point in time counts conducted in 2022 and are outdated, are likely undercounts, and do not delineate the full spectrum of people experiencing housing instability that reside in emergency or transitional shelters. There are two safe rest villages within the study area in North Portland (Sunderland RV park and N Portland Rd (in development)).

Table 11. Housing demographics in IBR Study Area, Clark County, and Multnomah County. Sources: ACS 5-Year Estimates 2018-2022[+75], CDC EJI [^23], DSEIS Equity Technical Report*[82], Clark County Point in Time Count[++182], City of Portland/Multnomah County Joint Office of Homeless Services Audit Report[^^183]

Mode	IBR Study Area	Clark County	Multnomah County
Total Housing Units[+]	12,651	196,557	317,308
Percentage who Rent[^]	52%	33%	43%
Percentage of Renters who are Paying at Least 30% of Household Income on Rent in the Past 12 Months[+]	50.1%	48.4%	48.9%
Percentage of Homeowners with Mortgage who are Paying at Least 30% of Income on Mortgage Payments in the past 12 Months[+]	23.3%	25.7%	30.1%
Houseless Populations	974 (2022)*	1,366 (2023)[++]	11,153 (2024)^^

Potential Project Impacts

The *DSEIS Environmental Justice Technical Report* Table 4-4 states the Modified LPA will displace people living in 43 residences through property acquisition.[98(p4-17)] The *DSEIS Equity Technical Report* details that the Modified LPA would displace 32 floating homes in North Portland Harbor.[82] On the south shore of North Portland Harbor, the Modified LPA would displace three floating homes and one residential unit on land. In Clark County, the Modified LPA would displace seven residences and include partial acquisition of 10 residential parcels for permanent right-of-way. The design option that shifts I-5 west would displace 33 residential units of the Normandy Apartments in the Esther Short neighborhood (*DSEIS Equity Technical Report*, Table 5-1).[82(p5-2)] These displacements could affect resident mental health by causing stress and anxiety regarding moving, disrupt existing social networks, and increase the distance to employment or regular essential services.

The DSEIS notes the IBR Program will follow the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA), a federal law that establishes minimum standards of support for persons displaced through property acquisition due to a federal project. The URA goals include providing relocation assistance and ensuring displaced individuals find decent, safe, and sanitary housing. For residential displacements, the IBR Program must provide relocation advisory services to displaced owners and tenants, give 3 months advance notice of property possession, and cover costs for moving and added costs of rent or purchase of comparable replacement housing.

Construction of the Modified LPA may cause the displacement of encampments in the area. Forced relocation can cause several harms of houseless community members, including the loss of personal belongings and needed medical items, displacement into more hazardous conditions, and disruption of community networks and social supports.[184] The *DSEIS Equity Technical Report* states understanding the full impact of the Modified LPA on the houseless community will require in-depth outreach with service providers and notes the IBR Program will coordinate with these organizations to offer services to unsheltered people that are directly affected by construction.[82(p5-5)]

Environmental Justice and Health Equity

The DSEIS states that acquisitions will cause displacement in the Esther Short, East Colombia, and Rose Village neighborhoods, high priority EJ areas. This could affect community cohesion and access to community resources and services. The analysis balances these impacts with non-specific improvements in transit access, reliability, and connectivity for all communities.

Aspects of the gentrification process like increased housing costs, sociocultural erasure, and transformation of available amenities affect physical and mental health, and create inequities between racial and class groups.[185] The *DSEIS Environmental Justice Technical Report* states that the Modified LPA could catalyze increases in property values and rents in affected areas. These increases in financial burden from rent and property taxes could create additional stress and worsen mental health.[186]

Income and Employment

Literature Review

Employment can introduce several health-promoting and health-negating factors into a worker's daily life that vary widely by sector and occupation. The cumulative net effects of employment contribute toward overall life and health span.[187] Income is the most strongly associated aspect of employment related to improved health outcomes and life expectancy, usually granting access to better medical care, housing opportunities, food security and other health-promoting basic needs.[188,189] Stability in job status protects mental health, while insecurity leads to stress, cortisol release, and associated health impacts.[190] Long commutes place time limits on workers. More time commuting typically means less physical activity, less time to prepare food at food, and less time to sleep.[191]

Local Context

A majority of workers that cross the I-5 bridge are Clark County residents commuting into Oregon (79%). The employment rate of the IBR study area is similar to Clark and Multnomah Counties overall (Table 12). Employment in the construction sector is slightly higher in the project area than the percentages in the surrounding counties. Life expectancy in the IBR program area ranges from 75 to 79. This is in the middle-to-lower ranges among life expectancy in Clark and Multnomah counties overall (Figure 4).

Table 12. Income and Employment Demographics in IBR Study Area, Clark County, and Multnomah County, ACS 5-Year Estimates 2018-2022

Mode	IBR Study Area	Clark County	Multnomah County
Employment Rate	95.4%	94.8%	94.5%
% Employment in Construction Industry	10.1%	9.2%	5.1%

Potential Project Impacts

The total program cost for the IBR Program is an estimated $6 billion. An investment of this size is expected to stimulate economic activity. The IBR Program estimates construction will drive $3.6 billion in net new economic activity and 13,460 new person-year jobs (one person working full time for a year). The program has committed to a 15% Disadvantaged Business Enterprise participation goal, will incorporate DBE best practices throughout program implementation, and will develop a DBE and capacity-building strategy to support economic opportunities for workers of color, workers with disabilities, and young workers.

Between 32-35 businesses and 600-742 employees are projected to be impacted due to property acquisitions required for construction. Table 13 outlines effects on businesses and employees. A majority of businesses impacted are in Multnomah County, but a greater share of workers employed in Clark County are projected to be affected. The *DSEIS Economics Technical Report* also notes additional businesses that remain may be affected as well if they find it difficult to attract or maintain customers either during the construction period or that traveled to the area for the original grouping of businesses that no longer remains.[192] Mitigations noted include a phased construction schedule to minimize business access impacts, as well as business outreach to identify additional supports for construction-related issues. The IBR Program must also comply with URA requirements for nonresidential displacements, which include provision of relocation advisory services, 3 months advance notice before land possession, and covering costs for moving and reestablishment expenses.

Table 13. Expected Business Displacements and Affected Employees, DSEIS Economics Technical Report[192]

Area	# of Businesses Displaced	# of Employees Affected	Notes
Oregon Mainland	7	41	Primarily marine-related light industrial and commercial-retail
Hayden Island	15	159	Primarily food service and retail that serves the island
Downtown Vancouver	10-13	400-542	Primarily commercial office and retail, larger range considers impact of I-5 Mainline Westward Shift option

The *DSEIS Economics Technical Report* states a potential concern related to business displacement is the need for employees to find new jobs.[192] This disruption in job stability could affect worker mental health. If these employees end up with longer commutes, they may have less time for health-promoting activities like sleep, healthy food preparation, or physical activity.

Environmental Justice and Health Equity

Communities that have greater income inequality tend to have poorer health outcomes.[193] There is a strong association between depression and income inequality, which disproportionately impacts women and people of color.[194] Upward economic mobility influence health and well-being. Economic mobility prospects matter for health and well-being. In the United States, incremental increases in early intergenerational upward mobility are associated with incremental decreases in mortality, with the greatest magnitude occurring for Black men.[195]

BIPOC community members, women, people with disabilities, LGBTQ+ groups, and single-parent households are more likely to experience poverty and face more barriers in finding and maintaining employment. In the region, people experiencing economic instability cite several conflating and intersectional barriers to stability, including housing instability, financial burden of medical care, discrimination, mental health concerns, individualist 'bootstrap' culture, inability to secure stable jobs with living wages, lack of insurance benefits, and limited advancement opportunities.[78]

The *DSEIS Environmental Justice Report* states that implementation of the Modified LPA would displace 10 businesses in the Esther Short neighborhood and 3 businesses in the Rockwood neighborhood (high-priority low-income neighborhoods), and no specific benefits to low-income or minority populations are projected. It also notes that the loss of service industry jobs on Hayden Island may disproportionately impact low-income and workers of color. The analysis states this loss is balanced by the non-specific jobs and economic development opportunities the project will bring for all communities. However, Modified LPA-induced changes in transit access to jobs is expected to have larger benefits for white, non-Hispanic residents in the study are than BIPOC residents, immigrants and refugees, and people under the age of 25.

Greenspace

Literature Review

Access to greenspace has been shown to have a positive impact on the health and mental health of both individuals and communities.[196,197] Some of the physical health benefits include decreases in cortisol, risk of diabetes, risk of preterm birth, in rates of hypertension, asthma, heart disease, and all-cause mortality.[197] Greenspace has also been linked to increases in physical activity. Studies have even compared the impact of walks in different urban environments and found that a walk on an urban road with trees resulted in significant decreases in tension, fatigue, and anxiety.[196] At the community level, greenspaces have been shown to increase social interaction and decrease social isolation, to improve air quality, reduce noise impacts, and reduce urban heat island effects.[197]

Access to greenspace has not been available to individuals and communities equally. “Most studies reveal that the distribution of such space often disproportionately benefits predominantly White and more affluent communities,” and this is “increasingly recognized as an environmental justice issue”.[198] While the benefits of access to greenspace have been shown over many studies, increasing greenspaces without seeing the larger context can create a paradox that may negate some positive impacts. Increases in greenspace can lead to increased housing costs that could "lead to gentrification and displacement of the very residents the greenspace strategies were designed to benefit”.[198]

Potential Project Impacts

The Modified LPA will change the connection to the Columbia River Renaissance Trail by making it both safer and wider.[199(p4-10)] This could have a positive health impact by increasing safety and connectivity to parks and trails. Other trail improvements included in the Modified LPA include: “improved intersections, sidewalks, and bike lanes” connected to the Discovery Historic Loop Trail, and an improved shared-use path through Old Apple Tree Park.[199(p4)] The Modified LPA includes “improved bicycle pedestrian, highway, and transit access” to parks in Portland and Vancouver “which could make access to parks easier”.[199(p6-1)] Increased access to parks and greenspace would have a positive impact on individual and community health.

The DSEIS indicates that noise levels could increase throughout many parks in the project area closest to the bridge and highway including East Delta Park, Fort Vancouver National Historic Site, Marshall Community Center, the Leupke Senior Center, Marshall Park, Clark County Recreation Fields, Leverich Community Park, Burnt Bridge Creek Trail, Kiggins Bowl Sports Fields and Stadium (IBR Parks and Recreation Technical Report). It also indicates that noise could decrease in the Lower Columbia River Water Trail, Lewis and Clark National Historic Trail, Vancouver Waterfront Park, Old Apple Tree Park, Arnada Neighborhood Park.[199]

See Noise Section for more information about health impacts of noise.

Indigenous Social Determinants of Health

Carroll et al. 2022 define Indigenous social determinants of health as "the conditions specific and unique to Indigenous communities that impact health and wellbeing".[200,201] While not a complete list, some of these conditions include: "Indigenous knowledge, language and identity, land and kinship, sovereignty, and structural and systematic factors".[200] The Seven Directions Center for Indigenous Public Health has identified these factors that contribute to the health of American Indian/Alaska Natives and acknowledges that this list may not encompass all of the important factors for all Indigenous communities.

"Indigenous communities support healthy vibrant lives embedded in their own Indigenous knowledge, values, and traditions. Even today, despite settle-colonial efforts to either wipe out or totally assimilate individuals and collectives, Indigenous nations continue to bring health and well-being to their communities and convey knowledge to future generations".[201] "Over the past 500 years, colonization weakened Indigenous systems that helped to maintain community health (e.g. traditional food systems, access to clean water, Indigenous languages, access to land) and replaced them with unsupported and underfunded systems, leading to disproportionate systemic health disparities, including some of the highest rates of diabetes, suicide, and cardiovascular diseases".[202] "Comprehensive community-driven, nation-based reclaiming and defining of Indigenous health and well-being is necessary to establish and address the broad array of determinants of health and well-being in Indigenous communities".[201]

The IBR Program poses a risk of disrupting connection to traditional cultural activities and could impact the ability to access culturally specific health care for American Indian/Alaska Natives. Many of the Cowlitz Indian Tribe's members reside outside of Washington and their access to their ancestral lands and ceremonies will be diminished and must be addressed in the planning of the project. Specifically, the impacts of tolling will increase the burden to tribal members traveling to access culturally specific healthcare, access cultural activities, and access ancestral land.

The IBR Program is engaged in tribal consultation with federally recognized tribes of Washington state and Oregon, and one tribe that is not currently a federally recognized tribe. Appendix A of the DSEIS describes the tribal consultation and process. It reiterates the commitment to government-to-government consultation with tribes and to incorporate input into decision-making processes. Our recommendations include encouragement to the IBR Program, and all partner agencies, to meaningfully engage in tribal consultation and implement input from tribes at every stage of decision-making to mitigate harm to American Indian/Alaska Native communities.

Water Quality

Literature Review

Safe and clean water is essential for the health of humans, animals, and the entire ecosystem. There are many ways that public health is concerned with clean water including sanitation, drinking water, fish and shellfish consumption, water recreation, and harmful algal blooms.

Drought is a public health concern that can impact water quantity and quality.[203,204] Decreased water flow in rivers and streams can concentrate contaminants, reduce nutrients, and lower oxygen levels – which all pose risks for water quality, aquatic life, and potentially human health.[205,206] Drought can also impact groundwater availability and aquifer recharge, which is an issue for populations reliant on water systems from groundwater.[205]

Climate change can affect water quality through warmer temperatures, changes to precipitation and severe weather, amount, timing and melting of snowpack, and availability of water.[207] Longer periods of heat and higher temperatures impact surface water temperatures of oceans, rivers, lakes, ponds, and streams. Warmer water temperatures can create more hospitable environments for harmful algae and other toxins. Some harmful algae can produce toxins and create "blooms" of cyanobacteria (harmful algal blooms, or HABs) that can make people sick when drinking, swimming, or recreating in contaminated water or eating fish that were exposed. Cyanobacteria exposure can lead to gastrointestinal illness, irritation of skin, eyes, nose, or throat, and potentially liver damage.[208]

Potential Project Impacts

The Troutdale Aquifer is designated by the United States Environmental Protection Agency as a Sole Source Aquifer and provides fresh water to the City of Vancouver. The water quality technical report notes that a "sole source aquifer report for the Modified LPA would be prepared and submitted to the EPA once the Draft SEIS is out for agency review." That information should be made available to the public to review for awareness of potential impacts and/or precautions being taken.

There is currently very little treatment of stormwater from the bridge into receiving waters. According to the *DSEIS Water Quality and Hydrology Technical Report,* the Modified LPA "includes a stormwater conveyance system" that "would reduce total suspended solids, particulates, and dissolved metals to the maximum extent possible before runoff reaches surface water or is infiltrated".[209(p4-1)] New and updated stormwater infrastructure that complies with all regulatory standards would have a positive impact on water quality.

The *DSEIS Water Quality and Hydrology Technical Report* Section 5.1.2 points out many potentials for negatively impacting water quality including contamination from equipment, groundwater contamination, contamination of surface water, turbidity in water, contamination of water due to disturbances in riverbed sediment during in-water work, and construction materials and byproducts falling into the river during construction and demolition.[194] While we appreciate that "all reasonable precautions would be taken to avoid and minimize water quality" at all stages of the project, the responsibility to protect water quality could not be more consequential.

Hazardous sediments and contaminants

Both the *DSEIS Water Quality and Hydrology Technical Report* (Section 5) and the *DSEIS Hazardous Materials Technical Report* (Section 5.3) discuss the need to sample and analyze the levels of hazardous sediments and toxic contamination.[53,209] We agree and advocate for sampling, testing, analysis, and publication of data to understand the potential contaminants and toxic material that could impact water quality during in-water construction. In our review of the DSEIS, we did not find a detailed plan for sampling and analysis of riverbed sediment prior to in-water work occurring. Our recommendations reflect the need to document and release a detailed plan to show any potential contaminants, hazardous sediment, and toxics so partners and the public can understand potential risks.

There are a number of waterways within the project area that are listed under 303(d) of the Clean Water Act for failing to meet water quality standards, including the Columbia Slough, Burnt Bridge Creek, Columbia River (including North Portland Harbor), and Fairview Creek (DSEIS Water Quality and Hydrology Chapter). Described in Table 3.14-2 of the DSEIS Water Quality and Hydrology Chapter, these waterways include pollutants such as toxics like polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dichloro-diphenyl-trichloroethane (DDt) metabolites, vinyl chloride, and dissolved oxygen.[210] Projected impacts, if any, are not described in the DSEIS in relation to these pollutants and the potential for increased turbidity during in-water work.

Emerging contaminants

The *DSEIS Water Quality and Hydrology Technical Report* states that best management practices (BMP) have been shown to reduce many pollutants from runoff but the effectiveness of removing "polycyclic aromatic hydrocarbons (PAHs), microplastics, and constituents of emerging concern (CEC), including 6PPD-quinone, are less well known because the fate and transport of these pollutants remains unclear".[209(p3-5)]

6PPD stands for the chemical N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine and is used on all kinds of tires to reduce degradation, or breaking down, which helps the tires last longer.[211]As tires drive on the road, small dust and particles come off the tires due to friction and contain 6PPD that is carried into waterways as stormwater runoff. 6PPD has been found to highly toxic to coho salmon and is killing fish before they can lay their eggs and killing juvenile salmon disrupting the lifecycle of this critical species. It is also harmful to other fish including rainbow trout and brook trout. The impacts of 6PPD on human health are still being studied.

Integrating stormwater best practices into the new bridge will help improve water quality and protect the waterway, the ecosystem, and human health. Since the understanding of these toxics, and their impact, continues to grow every day it is important for the program to actively seek out updates to best management practices from the Washington State Department of Ecology and Oregon State Department of Environmental Quality to reduce 6PPD and 6PPD-q. In 2022, directed by the Washington State legislature, the Washington State of Ecology published "6PPD in Road Runoff: Assessment and Mitigation Strategies."[212] This document suggests best management practices (BMPs) to reduce 6PPD including source control BMPs, flow control and runoff BMPs. The highest level of effectiveness of these practices would reduce 6PPD and would have a positive impact on ecosystem health.

The 10-year construction period of this project creates an opportunity to be adaptable to learning about and implementing new best management practices as the understanding of this critical issue develops.

Dust, construction and demolition
In addition to the air quality concerns posed by fugitive dust from construction and demolition, a fugitive dust plan should include assessment of dust makeup, impacts on water quality and mitigation that will be taken. The age of the current bridge brings concerns of the chemical makeup and potentially toxic materials used during the time period it was built, specifically lead and asbestos. Demolition of the current bridge over the water brings the potential for toxic fugitive dust to settle onto the Columbia River and negatively impact water quality, aquatic plant life, and animal species living in the river. There is not sufficient information in the DSEIS for analysis of the demolition plans or fugitive dust mitigation plan and how it could impact water quality.

Future water availability
The *DSEIS Climate Change Technical Report* includes "increased drought" as a regional hazard experienced currently or projected in the future.[123] The Project area may be impacted within the bridge's lifetime by drought conditions that affect water availability and water quality in the Columbia River, as well as in surrounding water bodies.

Environmental Justice and Health Equity

From our review, the DSEIS does not make a clear connection between impacts to water quality and equity priority communities. Overall, the information in the DSEIS suggests that new stormwater infrastructure in the Modified LPA would positively affect water quality, which would benefit the general population, inclusive of equity priority communities. Further, we were unable to conduct community engagement for this health analysis to gather community-based information about environmental justice and health equity concerns around potential water quality impacts. There are likely more connections between water quality, environmental justice, and health equity, particularly regarding subsistence fishing and Indigenous social determinants of health, that are important for the community and that we were unable to sufficiently assess. There is insufficient information in the DSEIS to assess potential environmental justice and health equity impacts on water quality.

Discussion

There is **sufficient evidence** in the DSEIS for the following potential health impacts of the Modified LPA:

- **Potential protective elements and positive health impacts**
    - **Transportation and active transportation:** The extension of light rail services and addition of enhanced pedestrian and bike facilities will likely increase physical activity and improve health. Expanding design and policy decisions that encourage people to walk, roll, bike, or use transit, rather than drive, would increase health benefits.
    - **Access**: Bringing the bridge, and auxiliary connections, up to or exceeding standards under the Americans with Disabilities Act (ADA) would improve access for all. Using inclusive or universal design, which centers around older adults, people with disabilities, and children, would increase benefits.
    - **Heat**: Providing shade and cooling for bridge users, especially active transportation users, could provide protection from heat-related health outcomes.
    - **Employment:** The project would drive a temporary increase in construction-related employment. Increased access to light rail and transit services could increase access to jobs and other essential services. Increasing contracting for Disadvantaged Business Enterprises, Minority Business Enterprises, Women Business Enterprises, and Small Business Enterprises would increase equitable distribution of these benefits.
    - **Access**: The Modified LPA includes plans to expand connections between active transportation networks, trails, and parks. Increased access to greenspace would have a positive impact on health.
    - **Water quality**: Improvements to stormwater infrastructure would have positive health impacts on water quality, and the health of the ecosystem.
    - **Safety:** Replacement of the existing I-5 bridge will result in a structure with greater seismic resilience, minimize the risk of a bridge collapse during an earthquake, and support safety, regional travel, and access to essential services.

- **Potential harmful elements and negative health impacts**
    - **Air quality:** Given the existing high traffic volumes along the I-5 interstate bridge, people who live nearby are subjected to greater concentrations of air toxics and are at risk of experiencing additional air quality burdens. The DSEIS estimates a 33% increase in VMT under the Modified LPA by 2045 and increase in freight traffic volumes, which could increase particulate matter and negatively impact air quality.
    - **Transportation and active transportation:** Transit access to jobs for BIPOC residents, immigrants and refugees, and people under the age of 25 did not increase as much as it did for white, non-Hispanic residents. This indicates disparities would continue to remain, likely reinforcing disparities in opportunities for physical activity.
    - **Tolling**: Tolling would have a disproportionate impact on low-income community members and could negatively impact access to essential services like health care and culturally specific health care.

- **Access**: Construction delays on roads, delays to bus routes and light rail service, and closures of sidewalks and active transportation paths may negatively impact access to homes, jobs, schools, health care facilities, and other essential destinations. These impacts may be greater for those that do not have car access.
- **Noise**: The Modified LPA would approach or exceed noise abatement criteria at 65 locations in Portland and 135 locations in Vancouver, including Discovery Middle School. Children and their learning comprehension are particularly affected by noise. The DSEIS describes higher levels of noise and vibration will negatively and disproportionately impact communities identified as equity priority communities.
- **Displacement**: The IBR Program will acquire land displacing 43 homes and could also displace houseless residents in the project area. Between 32-35 businesses and 600-742 employees could be impacted due to property acquisitions. Equity priority communities of East Columbia, Rockwood, Esther Short, and Rose Village would be disproportionately impacted.
- **Access**: The IBR Program could negatively impact access to traditional cultural activities, culturally specific health care, and access to ancestral lands for American Indian and Alaska Native communities.

There is **insufficient evidence** for several topic areas to determine potential health impacts of the Modified LPA.

- **Climate change and health:** The DSEIS anticipates the Modified LPA will reduce greenhouse gas emissions (GHG) compared to the No-Build Alternative. Construction of the Modified LPA will produce GHG emissions. Several climate-related hazards are projected to impact the region throughout the construction and operation of the Interstate Bridge, including heat, wildfire smoke, severe weather and flooding. The health effects of climate change are not equally distributed, and several communities are disproportionately affected by climate change - including IBR Equity Priority communities. More information is needed about how the Program will mitigate climate change impacts to Equity Priority Communities and what protective elements for health and climate justice will be included in final design and construction plans.
- **Air quality:** Due to the large geographic area used to conduct the air quality analysis, and the statement in the DSEIS that localized health impacts due to air quality cannot be reliably quantified, more information is needed to reliably assess air quality impacts. This is the basis of our recommendation for air quality monitoring and further air quality assessment, including dispersion modeling. Air dispersion modeling incorporates data appropriate for analyzing potential health impacts on a local scale.
- **Road safety:** The DSEIS states that crashes will increase by 15% under the Modified LPA, mainly due to estimated increases in traffic volumes. The DSEIS does not provide clear information on how crash frequency would change by travel mode, crash type, severity, location, or for environmental justice communities. There is insufficient evidence in the DSEIS to conclude to what degree severe injury and fatalities would be reduced for active transportation users.
- **Fugitive dust**: There is insufficient information about mitigation plans for fugitive dust during construction and how that could impact air quality and water quality.
- **Water quality**: There is insufficient information in the DSEIS regarding a plan to sample and analyze hazardous sediments and toxic contamination prior to in-water work.

Addressing the gap of insufficient information

As identified above, there are a number of places throughout the DSEIS where there is insufficient information to determine health impacts. There are also many decisions to be made for the final EIS, design decisions, and local decisions that could change the assessment of the project having either a positive, negative, or neutral impact to health. At this stage, we are only able to comment on the current proposal, but want to note the potential for changes throughout the design and construction phases of this project.

A project of this scale is composed of large-scale decisions that on their face could be beneficial for health, such as improvements to active transportation. However, implementation of these decisions and plans has the potential to tip the scales one way or the other toward improving or harming health. To continue the example of expanded active transportation, if bike and pedestrian paths are implemented in a way that makes those paths safe, accessible, connected to essential services, and free from exposure to pollution and noise, then they could have a positive health impact. If they are implemented in a way where there are no sight lines from vehicles, budgets for active transportation are cut to prioritize lanes of vehicle traffic, and there is high exposure to noise and traffic pollution, then they could have a negative health impact.

There is opportunity at every stage of this project to prioritize the health and safety of the citizens of Washington, Oregon, and anyone using the bridge. That is why our recommendations fall under the general categories of designing with health in mind and constructing with health in mind, so that the program can prioritize sustainability and health throughout the lifetime of the project. In addition to our recommendations, we propose that the IBR Program adopt a “health in all policies” approach into their decision-making.

Addressing Environmental Justice and Health Equity

Through program policy and implementation, the IBR Program has the opportunity to make positive changes and take action toward equity in affected communities. The decisions that could positively impact health in a community can also provide other co-benefits that further equity and environmental justice. For example, since communities of color experience a stronger urban heat island effect, program decisions that increase tree canopy cover could provide multiple benefits including reducing the urban heat island effect, improving air quality, positively impacting ecological health, improving access to active transportation with increased shade cover, and improving mental health benefits.

When weighing design and policy decisions, a health in all policies approach allows the decision to be evaluated for potential co-benefits of each decision. Decisions that increase environmental justice and health equity should be prioritized due to the co-benefits of improving community and ecological health.

There are many places throughout the DSEIS where the Program notes disproportionate impacts to equity priority communities. While mitigation of harm is the most important, it is also the minimum that the project could strive for. Every instance of disproportionate impact is the roadmap to show where increased benefits could be concentrated.

Health in all policies approach + Meaningful community engagement and tribal consultation
This health analysis and our recommendations reflect the importance of a health in all policies approach through this and upcoming stages of decision making. “Health in all policies is a collaborative approach to improving the health of all people by incorporating health considerations into decision-making across sectors and policy areas”.[213] Health in all policies is a framework, while health impact assessments are the tool, but both have a shared goal of presenting evidence-based health information to decision-makers.

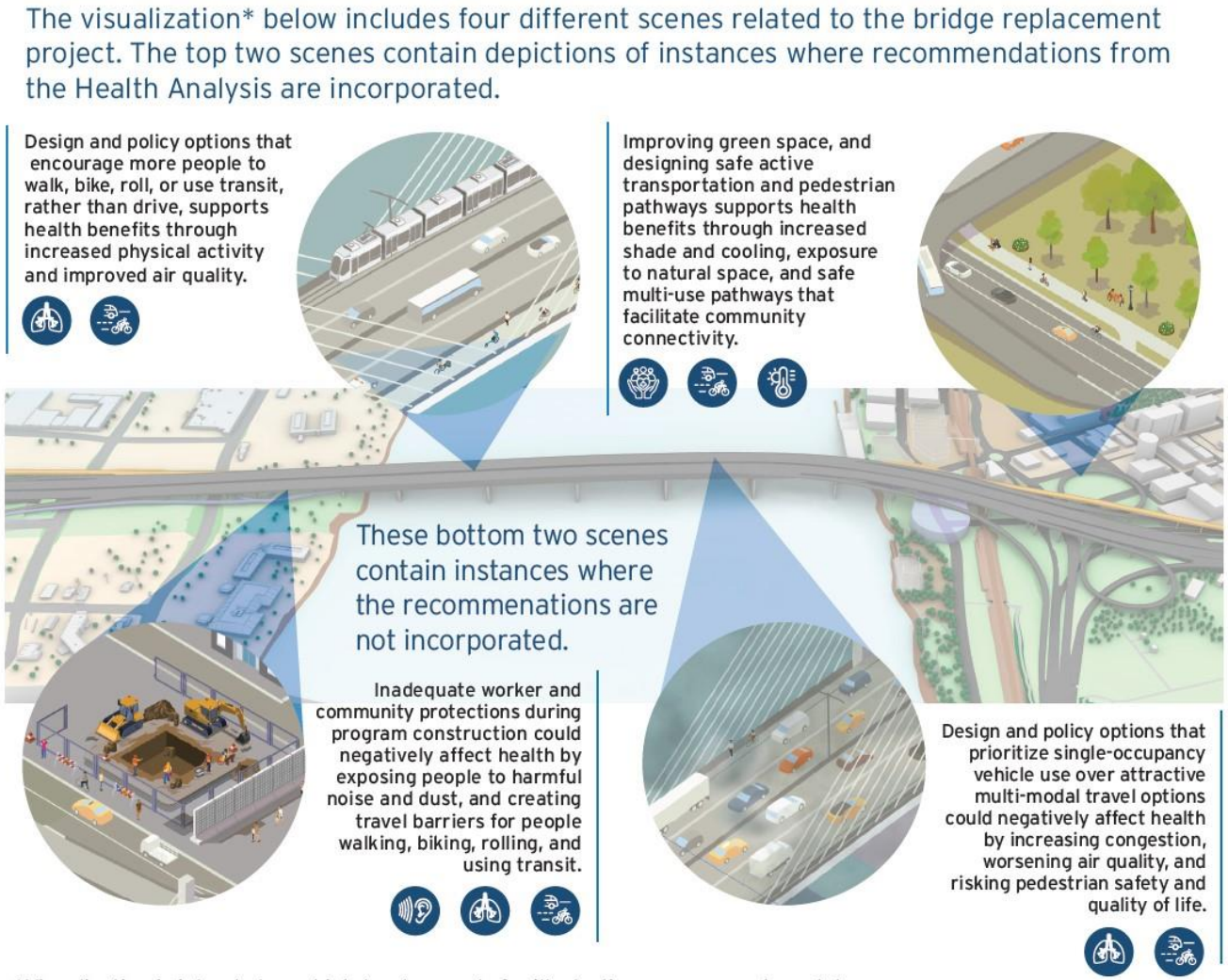
As described previously, individual and community health are made up of intersecting influences such as the built environment, current and historical disparities, and cumulative impacts of these many factors. To fully realize health equity, the public health system needs to be integrated with other systems that impact health, such as transportation. This approach allows for opportunities for collaboration to solve complex problems, identify and work toward shared goals across agencies and projects, and de-silo efforts to allow for more innovative and efficient use of resources.[214]

The IBR Program has an extraordinary opportunity to adopt a health in all policies approach throughout the design and construction phases of the project so that the lifetime impact of this project is positive. We are ready to continue to support the important work to ensure the equitable distribution of the transportation, economic, ecological, disaster resilience, and other benefits of replacing the Interstate Bridge between Washington and Oregon.

Our recommendations reflect the shared public health values of health equity, environmental justice, and ecological health. Each recommendation touches on one or more of our topic themes of air quality, transportation and active transportation, climate change and health, noise, social determinants of health, and water quality. Under each general recommendation there are more specific and tangible recommendations for implementation.

We appreciate any and all feedback from the IBR Program about our assessment. We also look forward to a detailed response about which recommendations the program plans to adopt, and how they will implement them.

Figure 16: Visualization of potential cumulative effects of implementing recommendations of the Health Analysis



**Visualization is intended as a high-level example for illustration purposes only and does not reflect property impacts or indicate that decisions on design options have been made. River crossing graphic adapted with permission from the IBR Program.*

Recommendations

To reduce negative health impacts of the IBR Program, we recommend decision-makers design, construct, and maintain a program that prioritizes human health and safety, ecological health, and environmental justice.

Our recommendations are organized in four themes:

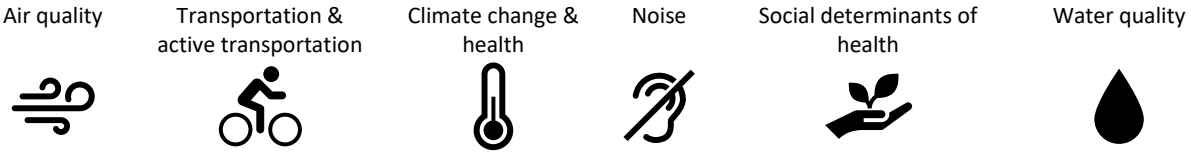
- Prioritize sustainability, transparency, communication and health for the lifetime of the project (p. 79-80)
- Provide additional information and modeling to better understand potential health impacts (p. 81)
- Design with health and equity in mind (p. 82-86)
- Construct with health and equity in mind (p. 87-89)

Our recommendations are guided by the following principles:[101]

1. Equitably reduce environmental exposures. Reducing environmental exposures in one area should not come at the expense of increased environmental exposures in another area.
2. Promote interventions to reduce environmental exposures, improve health, equitably distribute benefits, and monitor impacts on health outcomes.
3. Coordinate approaches to control environmental health risks across sectors.
4. Inform and involve communities that are affected by changes in environmental exposures.

Recommendations were developed and informed by peer-reviewed literature, best practices from previous health impact assessments on similar transportation infrastructure projects, and potential health impacts and mitigation identified during assessment of the DSEIS and other identified sources.

An icon or multiple icons accompany each recommendation. The icons indicate which topic area and associated health outcomes could be improved by implementation of the recommendation.



Prioritize sustainability, transparency, communication and health for the lifetime of the project

Transparency is central to building and maintaining trust. Community members will be affected by the IBR Program. It is critical that community members are both able to access information about how the program will affect them and able to share information, complaints, or questions with the program about how the program is affecting them.

The following recommendations support transparent communication and prioritize health during the lifetime of the program:

1. **Institute accessible systems for real-time two-way communication about project design and construction impacts to keep community members informed of project impacts, and the program informed of community impacts.**
    a. All communications materials should be written in plain language, available in multiple languages, and compatible with assistive technologies.
    b. With implementing agencies and contractors, coordinate a communication plan with multiple accessible platforms (e.g., website, social media, email and physical newsletters, text alerts, hotline) that are updated in real time so that the community can know when and where construction is happening; expected changes to transit, driving, or pedestrian routes; potential environmental impacts; and who to contact with questions, comments, or concerns.
        i. This should include notifying specific audiences with construction schedules well in advance: 1) emergency responders so they can be prepared during an emergency; 2) pedestrians and cyclists to know when it is safe to traverse portions of the road or access detours; and 3) affected residents, businesses, and commercial properties.
        ii. Communicate with community members and affected residents on types, time, duration, and potential health effects of construction well before and throughout construction activity. This should include details about noise, air quality, transportation and active transportation impacts.
        iii. Develop and maintain a centralized hotline and website for complaints, questions, or issues during and after construction. This should include coordinating with agencies responsible for controlling environmental exposures (e.g., noise, dust) during planning and construction and when responding to complaints.
        iv. Use visual technology such as 3D models and QR codes placed around the project area to help with visual understanding of design and construction plans.

2. **Prioritize health in program policies and decision-making throughout the lifetime of the program by incorporating regular engagement with community members, health department staff, and Tribal governments.**
    a. Provide funding to maintain health analysis team to continue to track and identify opportunities to include public health recommendations into the project. This can include:
        i. Incorporating health department staff into ongoing design committees or advisory councils
        ii. Proactive engagement and communication between program staff and public health to identify decision points and opportunities for health-focused decision-making well in advance
    b. Develop a monitoring, evaluation and reporting plan with clear responsibilities and accountability for the lifetime of the program. This should cover:
        i. Health, health equity, environmental justice and environmental indicators affected by the project, including health topics identified in this assessment and other topics that community and Tribal partners identify
        ii. Agencies responsible for measuring those indicators
        iii. Summaries of community complaints or comments and actions taken by the program or partner agencies to address them
        iv. Monitoring and timely reporting of any project-related issues that are context- and location-specific to support rapid response and reduce additional issues, including:
            1. Any injuries that are work related, transportation related, or non-workers injured in the project areas
            2. Any project-related noise, dust, emissions, or other environmental exposure disturbances
    c. Both before tolls go into effect, and after tolls are operational, ODOT and WSDOT should maintain a toll equity accountability committee or establish another structure where equity voices are at the table in a consistent, transparent, and resourced way to ensure long term accountability.
        i. Implement best practices from the Equity and Mobility Advisory Committee recommendations to the Oregon Transportation Commission.[215]

Provide additional information and modeling to better understand potential health impacts

Developing and sharing enhanced assessments of estimated impacts of the IBR Program on residents, people passing through and near the project area, and workers will increase the opportunity for incorporation of tailored strategies that more adequately protect health at the individual, project, and systems levels.

3. **Compile and release to the public more information about demolition plans for the current bridge infrastructure, including potential air quality, noise, and water quality impacts. This could include:**
    a. A detailed noise assessment and mitigation plan with noise heat mapping, predicted noise levels, and any overlap in noise-emitting activities with construction (e.g., if demolition and new construction are happening at the same time).
    b. Details about materials in existing infrastructure that could release contaminants into the air upon demolition, including lead and asbestos, and a detailed mitigation/abatement plan.
    c. Details about materials in existing infrastructure and the riverbed that could release sediments and contaminants into the water upon demolition, and a detailed mitigation/abatement plan.

4. **Expand information about potential air quality, safety, and connectivity impacts of design and construction.**
    a. Include air dispersion modeling of potential impacts of construction-related traffic diversion through neighborhoods adjacent to the project area.
    b. Include analysis of potential disruptions to regular transit, road, and active transportation routes that may affect community members' access to workplaces, health care services, social services, and other community services.
    c. Include analysis of severe injury and fatalities reduction for active transportation users and detail about mitigation features to prevent injury and fatalities.
    d. Collect and include pedestrian and bicycle counts from days where environmental threats (i.e., wildfire smoke) are not influencing travel behavior.

5. **Compile and release to the public additional information about potential air quality, safety, and connectivity impacts of tolling-related traffic diversion through neighborhoods.**

6. **Develop and release to the public a detailed sampling and analysis plan of riverbed sediment including potential contaminants, hazardous sediments, and toxics.**

Design with health and equity in mind

Design decisions early on are an important opportunity to make upstream, preventive health interventions that support healthier communities. Intentional planning with an environmental justice lens provides the opportunity to not only prevent disproportionate harms from design, but to address past harms and current disparities through infrastructure investments. Designing the IBR Program area with health at the forefront will be more beneficial to the community for decades to come.

The following recommendations prioritize health through program design:

7. **Design active transportation (bike lanes, sidewalks, and multi-use trails) and public transportation that is accessible to all to improve air quality and physical activity.**
    a. Design decisions should prioritize transportation system designs that reduce vehicle miles traveled, reduce single-occupancy vehicle capacity, increase physical activity, and increase access to transit.
    b. The design team should make considerations to include light rail station investment and design that encourage walkability and accessibility in surrounding areas. They should account for increased utilization, and opportunities for shade and cooling to protect users from heat.[216]
    c. Sidewalk and active transportation design should be centered around older adults, people with disabilities, and people with children, also known as inclusive design or universal design.

8. **Design safety features to reduce injury for active transportation users and vehicle users.**
    a. Design should prioritize pedestrian safety and active transportation user safety by integrating design features to reduce vehicle speeds. The design team should use a safe systems and health impact pyramid lens to evaluate ongoing transportation infrastructure decisions to reduce risk to all users.[84,85]
    b. Create active transportation spaces that feel safe and increase visibility. Use signage, lighting and lane markings on shared use paths to reduce the risk of bicycle-pedestrian, vehicle-pedestrian, and vehicle-bicycle collisions.
    c. Design and install suicide barriers that are tall and unclimbable. Install appropriate multilingual signage displaying the 988 National Suicide Prevention and Mental Health Crisis Hotline as required by Washington RCW 39.04.420.[217]

9. **Improve greenspace and tree canopy cover to improve air and water quality, provide shade, and increase natural spaces.**
    a. Use green infrastructure to improve air quality, infiltrate stormwater, increase climate resilience, improve habitat for wildlife, and increase physical activity.[218]
    b. Use landscaping materials throughout the project area, along sidewalks, roadways, trails, shared use paths, and at transit stops to soften the concrete footprint and reduce the urban heat island effect.
        i. Use native drought- and pest-resistant vegetation to support climate resilience and local biodiversity.
    c. Coordinate with the City of Portland and City of Vancouver to meet or exceed local tree canopy cover goals of 28%-33% in the project area, reduce the urban heat island effect, create shade, and reduce potential erosion into surface water.[219,220]
        i. Reduce removal of existing trees, vegetation and greenspace, and include provision of tree canopy, vegetation, and/or bridge shade structures to create shaded area for respite from heat and sun exposure.[221,222]
    d. Reduce large expanses of pavement and impervious surfaces to limit stormwater runoff and reduce urban heat island effect.

10. **Design with sustainable materials and standards to reduce greenhouse gas emissions.**
    a. Follow sustainability guidelines outlined in local government jurisdictions' sustainability and climate action plans to reduce the effects of climate change on health. The IBR Program should score highly in quantifiable sustainable practices associated with roadway design and construction.[221]
        i. For example, following the Greenroads Rating System, the IBR should score 80 points or higher.[223]
    b. Develop and implement a preferred scenario that meets or surpasses the greenhouse gas emissions reduction target set for the region to reduce the effects of climate change on health. Refer to local cities, counties and state climate action plans and requirements regarding greenhouse gas emissions, where applicable.[224–226]

11. **Prioritize resilience to extreme weather events, climate change, and seismic events to improve safety.**
    a. Develop spaces, pathways, and other facilities built to withstand extreme weather events and changes in climate (e.g., heat waves, wind and ice storms, flooding, sea level rise and storm surge, extreme rainfall) to adapt to climate change, and to prevent injury, illness, and death from extreme weather.[123,222]
        i. This includes design that makes it easier and quicker to clear ice, snow, and other extreme precipitation from pathways.

12. **Maintain and improve good air and water quality in the project area to protect physical and mental health.**
    a. Use innovative storm water management practices along the corridor to sustainably reduce vehicle pollution from entering waterways to prevent water contamination and waterborne illness.[221]
        i. Plan for more severe and frequent storms/precipitation to limit increases in stormwater runoff.
        ii. Reduce exposure of vehicle runoff infiltrating the water system.
        iii. Treat stormwater runoff from all areas impacted by the IBR Program.
    b. Maintain wetland water quality and protect/repair nearby wetlands.
    c. Follow all federal, tribal, state, territorial, and local requirements around water quality to protect aquatic life, local wildlife ecosystems and prevent water- and foodborne illness.
    d. Use innovative design features to improve air quality for active transportation users along the corridor. This could include planting vegetation between shared use paths to improve air quality and provide additional protection from vehicles.
    e. Follow all federal, tribal, state, territorial, and local requirements to protect and improve air quality.
    f. Protect and honor Native water rights by contributing to a healthy river and healthy ecosystem because “the ability to exercise these treaty rights to fish is completely dependent upon clean water and healthy ecosystems”.[227]

13. **Minimize noise in the project area to protect nearby neighbors and populations disproportionately affected by noise.**
    a. Re-examine mitigation measures for the 65 locations in the Portland project area and 135 locations in the Vancouver project area that will exceed noise standards under the Modified LPA as a way of protecting the health of residents in these areas.
        i. Re-examine mitigation measures for Discovery Middle School. Children and their learning comprehension are particularly affected by noise. If project design is unable to reduce noise exceedances for Discovery Middle School, work with Discovery Middle School to implement appropriate sound insulation as per ODOT and WSDOT noise mitigation considerations (e.g., ventilation systems, storm windows, air conditioning).
    b. Use multiple methods (e.g. freeway lids, noise walls, quieter pavement, landscaping) to reduce noise in the project area for the lifespan of the project and for all bridge users (pedestrians, cyclists, local businesses, residents).
        i. Design sound walls, and other noise reduction strategies, should prioritize the reduction in noise and be sure not to result in additional problems like disruptions of sidewalks and trails, barriers to community connectivity, or creating large concrete structures.
    c. Help residents implement noise reduction strategies before construction begins: identify and work with highly affected residents to determine mitigation during construction, such as installing double pane or sound- and dust-proof windows, installing air conditioning, sealing doors and windows, and reinsulating walls and ceilings; and providing hotel vouchers during the noisiest/overnight operations if certain noise levels are exceeded.[228]
        i. Consider lessons from the Port of Seattle Sound Insulation Repair and Replacement Pilot Program assessment (expected in 2025) as a potential model for a residential noise insulation program by a major transportation infrastructure project/port.[229]

14. **Improve connectivity and community cohesion to promote access to community and essential services.**
    a. To support reductions in racial health disparities, prioritize active transportation and transit connections to important destinations to support place-based physical activity, especially destinations identified by BIPOC communities.[230]
    b. Maintain access and, where possible, increase connectivity to key neighborhood services and assets by promoting street connectivity and walkability.[74] These include parks, schools, worksites, libraries, grocery stores, food pantries, restaurants, banks, social clubs, gas stations, laundromats, post offices, places of worship, harvesting and fishing sites, cultural and natural landmarks, hospitals and healthcare facilities, including behavioral health and substance misuse treatment facilities.
    c. Create activity-friendly routes (i.e., pedestrian, bicycle, or public transit access) that allows for multiple and convenient route options to everyday destinations by walking, biking, and rolling.[74]
    d. Use design elements (e.g. freeway lids, pedestrian bridges) to improve East/West connectivity and accessibility within the program area.
    e. Incorporate design elements that highlight local art, history, and culture, including naming the bridge, to enhance community connection.

15. **Center equity and focus on local businesses in contracting to improve economic opportunities for underrepresented groups.**
    a. Identify and commit to a plan for increasing the contracting opportunities for Disadvantaged Business Enterprises, Minority Business Enterprises, Women Business Enterprises, and Small Business Enterprises that are awarded contracts for designing, building, and operating the program.[215]
    b. Consider abiding by the Washington State Healthy Environment for All Act that establishes a "goal of directing 40 percent of grants and expenditures that create environmental benefits to vulnerable populations and overburdened communities".[231(p1)]

16. **Minimize home and business loss, and proactively support displaced residents, businesses, and employees.**
    a. Before property acquisition and displacement begins, develop and implement comprehensive strategies and funding options to address the relocation and housing needs of people displaced by the program, including housed and unhoused community members. These should build on and provide a holistic approach to Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA) requirements and the objective to lessen the emotional and financial impact of displacement. This could include:
        i. Ensuring continued access to local and culturally important food, transportation, health care, and social services to displaced people and families.
        ii. Evaluating the feasibility of 'Right to Return' options for displaced residents, either in continued housing relocation assistance or in new housing options if any are developed using project funds.
        iii. Working with families and neighbors to assist with coordinated relocation for those that are interested, and to maintain community linkages because moving can be particularly difficult for children and older adults.
        iv. Working with families to relocate within their child's school district, and if possible, moving over the summer as not to disrupt school year learning.
        v. Working with organizations like the Council for the Homeless and Columbia River Mental Health to develop strategies and investments to support the movement of people experiencing homelessness within the project area into housing and avoid further stress, traumatization, and distrust of government. Partner with homeless service providers to conduct outreach and to identify accommodation and support strategies to assist people in finding permanent housing options.[232]
        vi. Assisting displaced residents to find housing options for rent or purchase within the project area that meet their accessibility needs, health and safety needs, and are sustainable. This includes that homes are LEED certified, lead abated, and remediated for mold; have heat pumps, screened windows, air filters, ventilation; and are pet-friendly for individuals and families with pets.
    b. Identify strategies to reduce business impacts like business and employee displacement. This could include assistance and support to displaced employees in the job search, and displaced businesses in searching for new properties that meet their needs.
    c. Identify strategies to provide mental health and other support services to individuals who will be displaced from their home or disconnected from their social network due to residential or business displacement, at no cost to the individual.

Construct with health and equity in mind

Construction is expected to take approximately a decade. It is important to center worker and community health in construction plans, contracts, and operations.

The following recommendations prioritize health during the multi-year construction phase of the program:

17. **Meet and exceed, where possible, state and local requirements for noise, air quality and water quality to protect the health of workers, community members, and the ecosystem.**
    a. Ensure that construction vehicles meet state and local requirements for clean diesel contracting, and retrofit diesel construction vehicles to curb air pollution prior to the start of construction.
    b. Maintain construction equipment in good working condition to reduce emissions and noise.
        i. Reduce traffic-related air pollution from combustion of fuel, tire wear and brake wear during operation of the project.
        ii. Use approved noise control devices for generators, compressors, and similar equipment. Use OHSA approved broadband back-up warning devices on all construction vehicles and equipment.
    c. Develop a workforce transportation plan with contractors (e.g., incentivize active transportation and public transit options, carpooling) to reduce expected increased single-occupancy vehicle transportation to construction sites, and to reduce noise, air pollution, and GHG emissions.
    d. Adjust the construction schedule to maximize quiet time for residents.
        i. Limit loud-noise construction activities performed within 300 meters of an occupied dwelling unit between 7:00pm and 7:00am, as reported as noise abatement time constraints in the DSEIS.
        ii. Limit the operating periods for equipment that produces loud noise, such as pile drivers and concrete cutters, particularly during nighttime periods.
    e. Measure employee noise exposures and implement a hearing loss prevention program per state and federal noise level regulations over an 8-hour shift. The recommended exposure limit is 85 dBA over an 8-hour period.
    f. Limit in-water operations to November 1 – February 28 to protect fish, wildlife, and habitat resources per Oregon Department of Fish and Wildlife and U.S. Army Corps of Engineer regulations.[233,234]

18. **Design and mark routes during construction to protect pedestrians and active transportation users from injury and environmental exposures.**
    a. Develop safe and clearly marked alternative routes and maintain temporary paths for pedestrians, bicyclists, strollers, wheelchair users, and other active transportation users during the construction period, rather than simply closing sidewalks and bike lanes.
        i. Coordinate with and incorporate adjustments for ongoing and future Safe Routes to Schools efforts and for bike bus groups used by both adults and children in the project area (for example, Bike Bus PDX[235]).
    b. Direct alternate or detour vehicle routes away from high pedestrian areas, schools, places of worship, and other community centers to decrease likelihood of vehicle-related pedestrian injury.
        i. Include speed abatement measures (ex. speed humps, temporary signals, reduced speed limit signs) to reduce potential for crashes and injury.
    c. Reduce construction hazards to motorists, pedestrians, and cyclists from hazards such as large dust and debris "kickup", concentrated air pollution, and excess noise that could lead to unsafe areas and elevated exposures.

19. **Maintain community connectivity through reliable access to transit, neighborhood services, and regular transportation routes.**
    a. Reduce obstacles to business access, local and culturally important food—including harvesting and fishing sites—transportation, health care services, schools, places of worship and other essential community services during construction.
    b. Increase transportation assistance programs during construction to reduce disruption in accessing medical care, behavioral health care, social and educational services, especially for older adults and people with disabilities. Expand those programs and financial assistance.

20. **Protect workers and community members on high-risk days for high heat and poor air quality events.**
    a. Create and implement plans for extreme heat during the construction period, including recommended or designated times for active transportation users to travel through the project area during cooler times of day to prevent heat-related illness and death.
    b. Utilizing Washington State Department of Health guidance, take steps to reduce construction-related air pollution on days when the Air Quality Index reaches 'Unhealthy for Sensitive Groups' due to wildfire smoke or high ozone to protect outdoor workers and communities at increased risk.[236] WADOH guidance available at https://doh.wa.gov/sites/default/files/2024-06/821-174.pdf.
    c. Create and implement plans to ensure worker safety and protection, accounting for overlapping exposures, health sensitivities, and disproportionate impact to outdoor workers, including easy and reliable access to personal protective equipment.[152,162]
        i. Ensure that workers understand their rights, have adequate access, and have training to take protective steps with respect to climate hazards, such as extreme heat and severe weather, wildfire smoke, and air pollution exposure. These include access to water, shade or cooling, breaks, bathroom facilities, and personal protective equipment.[237,238]

21. **Establish systems for continuous monitoring for noise and air quality during and after program construction, ensuring that pre-construction conditions are measured as a baseline.**
    a. Use the World Health Organization's most recent Air Quality Guidelines and the Oregon Air Toxics Benchmarks to track air quality indicators near the project area and in neighboring communities.
    b. Coordinate with Washington State Department of Ecology, Oregon Department of Environmental Quality, Southwest Clean Air Agency, and community members to install and regularly analyze data from air quality monitors in the project area. This may include funding installation and maintenance of air quality monitors in the project area.
    c. In line with recommendation 1 above, identify a point of contact and appropriate communication methods for community members to use if they have questions or complaints about noise or air quality.
    d. Coordinate with schools, early learning facilities, and childcare facilities to install noise and particulate matter monitors at sensitive locations in the program area. Expand collection of noise measurements to include schools and early learning facilities near the program area beyond but inclusive of Discovery Middle School.

22. **Implement workforce development and support programs to develop and retain a diverse workforce.**
    a. In accordance with the recommendations of the IBR Workforce Market Study, develop comprehensive workforce development programs, including higher education, internships, apprenticeships, and targeted training in high-paid trades, with a focus on increasing BIPOC, underrepresented, underserved community participation and preparing students in high schools and community colleges for construction and trade jobs.[239]
    b. Prioritize services and policies for working families and caregivers, including childcare, and access to breast and chest feeding and pumping space.

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Appendix A

Additional Details on Methods

1. IBR Program data sources
    a. The working group reviewed select draft technical reports and chapters from the draft DSEIS prepared in February 2024 and then cross-checked with DSEIS documents published in September 2024, including:
        i. Acquisitions Technical Report
        ii. Air Quality Technical Report
        iii. Climate Change Technical Report
        iv. Climate Change Chapter 3.19
        v. Economics Technical Report
        vi. Energy Technical Report
        vii. Environmental Justice Technical Report
        viii. Equity Technical Report
        ix. Hazardous Materials Technical Report
        x. Neighborhoods and Populations Technical Report
        xi. Noise and Vibration Technical Report
        xii. Parks and Recreation Technical Report
        xiii. Transportation Technical Report and Appendices
        xiv. Transportation Chapter 3.1
        xv. Water Quality and Hydrology Technical Report
        xvi. Water Quality and Hydrology Chapter 3.14
        xvii. Wetlands and Other Waters Technical Report
    b. The working group consulted with writers of the DSEIS technical reports to ask questions and clarify technical information.
2. Baseline conditions & health pathways
    a. Methods:
        i. Literature review of meta-analyses & systematic reviews of topic indicators (exposures) and associated health outcomes
        ii. Description of baseline health conditions using comparable local data (state/regional or national as backup to comparable local data option)
            1. CDC EJI
            2. ACS Census
            3. CDC SVI
            4. CDC PLACES
            5. Additional data sources (sources listed in text)
3. Environmental justice & health equity
    a. Methods:
        i. Describe any known environmental justice and health equity topics addressed in the literature review and as they relate to information in the DSEIS
        ii. Describe EJ and health equity details using national mapping data (CDC EJI, additional data sources)
4. Recommendations
    a. Determined by assessment findings
    b. Review of existing HIAs conducted on transportation infrastructure projects of similar scope

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iv. City of Cincinnati Health Department. *Interstate 75 Focus Area Study Health Impact Assessment*.; 2010. https://www.cincinnati-oh.gov/sites/health/assets/File/I75FocusAreaHIA.pdf
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c. Recommended by phases of project:
i. Program design
ii. Contracting & construction (up to 10 years)
iii. Program lifetime (50-100 years)