Health Impact Assessment:

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Photo: Patrick Robinson, *West Seattle Herald*

HIA Public Comment Report

June 2013

Photo: Paul Joseph Brown

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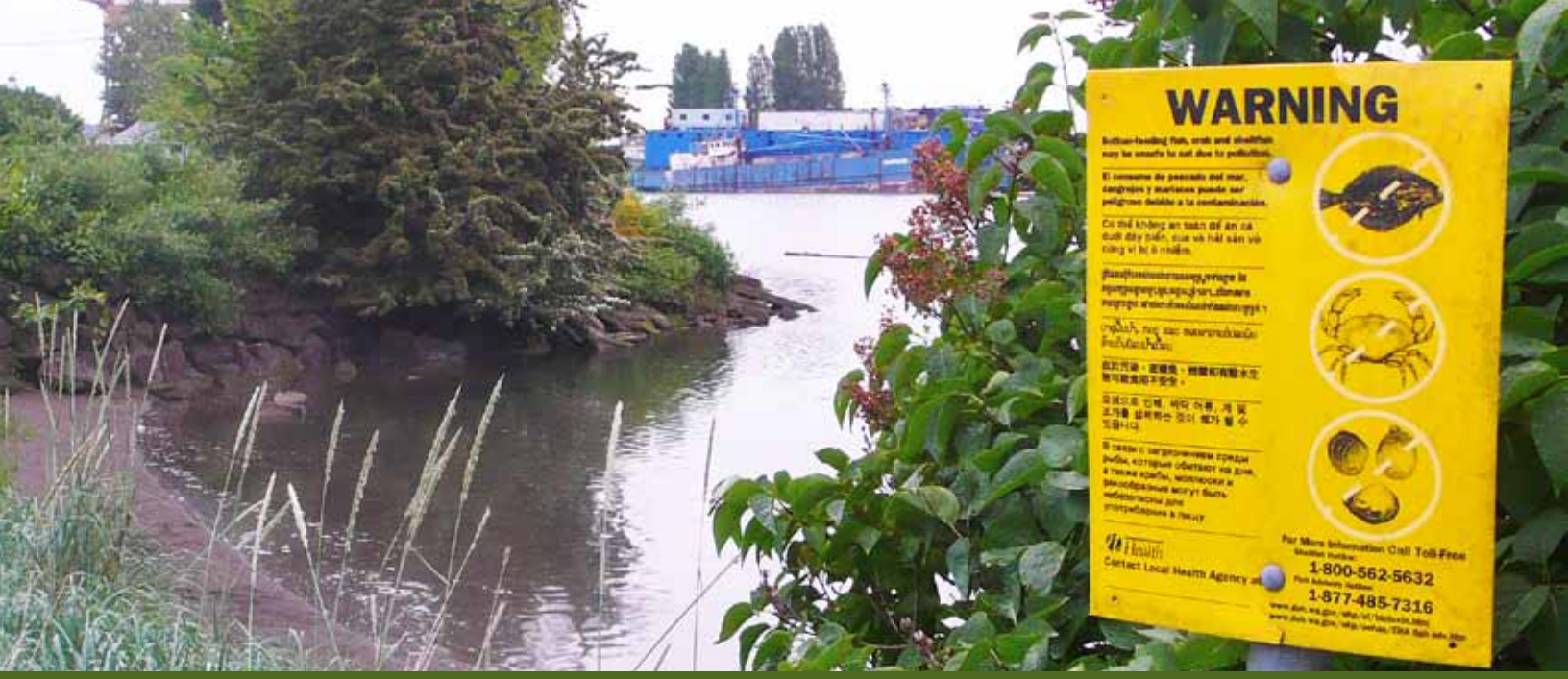
Acknowledgments & Disclaimer

Photo: Derrick Coetzee



Executive Summary and Recommendations

Photo: Linn Gould, Just Health Action

BACKGROUND

More than a century of industrial and urban wastes have contaminated Seattle's lower Duwamish River. The Environmental Protection Agency (EPA) placed the lower Duwamish River on the Superfund List in 2001. On February 28, 2013, EPA released its *Proposed Plan* for cleanup of the site. EPA will accept public comment on the Plan until June 13, 2013.

The Plan calls for capping in place or removing highly contaminated river sediments, plus enhanced and natural recovery for moderately or low-level contaminated sediments. Resident fish and shellfish will be less contaminated but probably still unsafe for human consumption, even after the 17-year period of active cleanup and monitored recovery.

HEALTH IMPACT ASSESSMENT (HIA)

Three partner organizations—UW School of Public Health, Just Health Action, and the Duwamish River Cleanup Coalition/Technical Advisory Group—conducted a Health Impact Assessment of EPA's *Proposed Plan*.

This assessment did not examine alternate cleanup scenarios, although many of the HIA findings and recommendations are probably transferable to whatever remedy EPA selects for its final cleanup decision.

The HIA focused on four vulnerable populations whose health and well-being might be affected by the proposed cleanup. The HIA was guided by Resident and Tribal Advisory Committees, individual community advisors, and a "Liaison Committee," with representatives from EPA, other agencies, and potentially responsible parties. Focus groups were conducted with Duwamish Tribe members and urban subsistence fishers.

WHOSE HEALTH MIGHT BE AFFECTED BY THE CLEANUP?

Local residents: Two residential neighborhoods, South Park and Georgetown, border the Duwamish River and Superfund site. A high percentage of residents are foreign-born and people of color, particularly in South Park. Average household income in both neighborhoods is much lower than the county average, and poverty rates are higher.

Health status is relatively poor compared to the rest of Seattle, with higher existing rates of child asthma hospitalization, diabetes, cardiovascular disease, and lung cancer. There are also more industrial emissions, contaminated sites, and vehicular pollution than in the rest of the city.

Affected Tribes: Three Native American Tribes are potentially affected by the cleanup. The Duwamish Tribe's ancestral lands include the Duwamish River watershed. The Muckleshoot and Suquamish Tribes are federally recognized Tribes with treaty-guaranteed, usual and accustomed fishing places in the central Puget Sound region. Both Tribes actively manage seafood resources on the Duwamish River.

There are no publicly available health data for these Tribes. However, census and health data for Native Americans in Washington State and King County reveal high levels of health problems and risk factors including poverty, unemployment, infant mortality, smoking, obesity, diabetes, heart disease, cirrhosis, asthma, and mental distress.

Subsistence fishers: Many people fish on the Duwamish River for salmon, which are non-resident fish and considered safe to eat. However, some people catch resident fish and shellfish as a food source. This population includes Asian and Pacific Islanders; a variety of immigrant communities and people of color; low-income, homeless, and food-insecure populations; and urban American Indians and Alaska Natives (aside from the affected Tribes).

Workers in local industries: The Lower Duwamish River area is home to Seattle's and King County's largest concentration of industry, including the Duwamish Manufacturing Industrial Center and Port of Seattle. The manufacturing, wholesale trade, transportation, warehousing, and utilities industries in this area employ at least 30,000 workers. In general, these jobs pay good "family" wages. The major potential health impact of concern relates to employment. Employment is one of the strongest favorable determinants of health and well-being.

HOW MIGHT HEALTH BE AFFECTED BY THE CLEANUP?

The proposed cleanup will reduce health risks from seafood consumption and contact with sediments and the shoreline. However, residual contamination in sediment, fish, and shellfish will still be higher than Puget Sound background after cleanup, and EPA predicts resident seafood will still be unsafe for human consumption. The necessary fishing advisories will be more restrictive than elsewhere in Puget Sound, will be required for at least 40 years, and could persist in perpetuity.

- **Contaminant dispersion during construction**
  The health concerns related to cleanup construction activity include possible escape of contaminants outside construction zones. The magnitude of this appears low, however, if environmental dredging technologies, best management practices, and skilled operators are employed.
- **Local residents**
  Most local residents do not eat resident fish from the river, but many visit beaches. EPA predicts the cleanup will approach but may not meet goals for arsenic contact on some publicly accessible beaches. The existing health risk and any risk after cleanup should be limited and manageable with wash facilities at public beaches.

  Construction-related increases in air and noise pollution, and in rail and truck traffic, could affect the health of local residents. However, with the proposed construction strategy, updated fuel standards, and standard EPA policies, there should be limited impact on local residents, beyond the existing high levels of pollution and traffic.

  Cleanup construction will generate new jobs, with beneficial impacts on health for those employed. It is uncertain whether or how many jobs will be given to local residents.

  Environmental improvements from the cleanup will increase aesthetics of the river and surrounding areas. This may spur reinvestment in Georgetown and South Park. Community revitalization could stimulate a number of beneficial phenomena including physical improvement of housing, streetscapes, and open space, growth in community businesses and services, and increased employment and reduced crime.

  Gentrification often occurs alongside community revitalization and is already occurring in Georgetown and South Park. Any cleanup-spurred reinvestment will contribute to this trend. Gentrification can bring health-favorable community benefits. However, these are most likely to benefit higher-income residents, and harmful impacts are most likely to affect lower-income residents.
- **Affected Tribes**
  Tribal health consequences of chemical contaminants are likely to be substantially worse than projected by EPA risk assessment and predictive models. These models only account for biomedical disease outcomes and do not incorporate fundamental aspects of Tribal health and well-being, such as the importance of accessibility to local natural resources, maintenance of cultural traditions, and the significance of self-determination. The EPA risk assessment also does not consider that river-related risks are compounded by existing Tribal health disparities and cumulative risks from chemical and non-chemical stressors.

  Furthermore, although the cleanup will create a cleaner environment for all, inequity between the general population and the Tribes may actually increase. Resident seafood consumption will be relatively safe at a rate typical for the general population rate (e.g., 1 meal per month), but not at the Tribes' seafood consumption rates.

Institutional controls, such as fish advisories, restrict how much seafood can be safely harvested. These restrictions may violate Tribal fishing rights. They also may affect food security, prompting some Tribal members to eat less healthful foods. Physical health may still be affected, since some Tribal members may harvest fish in spite of warnings, to protect their cultural and spiritual health.

It is highly likely that habitat renewal will benefit Tribal health, because the environment and species of cultural importance will be enhanced. This will allow more ceremonies on the river, as well as pride, ownership, and empowerment, all of which are important determinants of Tribal health.

- **Subsistence fishers**

  Fishing practices could be affected substantially during and after active cleanup. Urban subsistence fishing is poorly characterized, but people fish in many local waters, including the Duwamish River, and in spite of advisories and posted signs. Reasons for fishing and for choosing locations include a wide variety of cultural, traditional, practical, aesthetic, and convenience influences.

  It is very likely that some fishers and their families will be exposed to chemical contaminants in seafood during and after the cleanup. Fishing activity might decrease during active cleanup, but it is likely that some people will continue to fish there. Many alternative locations are subject to fish advisories, particularly within close travel distances. After the active cleanup, the cleaner and restored habitat may entice fishing. Although seafood will pose less health risk at that point, the persisting risks could still be substantial for people with high rates of fish consumption.

  Some subsistence fishers who are not able to fish elsewhere or purchase fish will likely experience food and nutritional insecurity. A fish diet has health benefits, particularly for children, and these benefits can be lost if fish consumption is reduced. Other protein sources cost more than self-caught fish, leading to economic hardship. A dietary void could be filled with cheaper, less healthful choices.

  Social and cultural traditions could be disrupted if fishers reduce or discontinue fishing. There is not enough information to assess how likely this would be, but the loss of social ties could be an important impact on health and well-being.

  These potential impacts on subsistence fishers would pose disproportionate harm for lower-income people, people of color, immigrants, and non-English speakers, and particularly for children.

- **Institutional controls**

  The assessment of affected Tribes and subsistence fishers identified important issues related to institutional controls (ICs). We identified additional issues that have not been considered in the *Proposed Plan* which may affect cost considerations.

  The *Proposed Plan* does not appear to follow EPA guidance to evaluate ICs as rigorously as any other response alternative. For example, the EPA Feasibility Study included hundreds of pages about various cleanup alternatives, but only 7 pages about ICs, plus only 3 pages in the 82-page "Detailed Cost Estimates" Appendix. The estimated cost of ICs is relatively low compared to an example of enhanced community outreach (Palos Verdes Shelf Superfund Site) that was featured in the EPA Environmental Justice Analysis accompanying the *Proposed Plan*.

  This is consistent with a pattern identified by the U.S. Government Accountability Office (GAO) in a 2005 review of EPA's IC practices. GAO determined that EPA has increasingly relied on ICs over time but inconsistently considers all the necessary factors to ensure that planned controls will be adequately implemented, monitored, and enforced.

  The implementation of ICs increases already existing cumulative risks among Tribal and subsistence fisher populations by adding a psychosocial stressor that is likely to have additional health ramifications. In addition, the application of ICs increases already existing inequities among vulnerable populations by expecting them to modify their behavior when cultural, spiritual, or food security reasons prohibit change.

- **Local workers**

  Manufacturing, wholesale trade, transportation and warehousing businesses in the Lower Duwamish area face a variety of pressures that could influence their productivity and economic viability, and that could stimulate changes in land use analogous to ongoing residential gentrification in local neighborhoods.

  It is plausible that the proposed cleanup of the Lower Duwamish River and related decisions could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employment. Alternatively, it is plausible that existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of

a blighted river, and if this stimulated industry revitalization and economic robustness.

This assessment considered four major categories of possible cleanup-related effects: cleanup job creation, cleanup costs and business liability, business uncertainty, and industry revitalization. Any potential effects of the proposed cleanup plan on workers and employment in the Lower Duwamish area industries would not occur in a vacuum. Therefore, the assessment also considered the context in which any cleanup-related effects would occur.

The assessment findings will be summarized in our Final HIA Report. Meanwhile, our findings are provided in a detailed addendum in this report.

WHAT'S MISSING FROM THIS PICTURE?

Identifying information gaps is an important goal for any HIA, almost as important as identifying health impacts. One important gap is the limited planning for **institutional controls**, as discussed earlier. The health consequences of residual chemical contamination and institutional controls are potentially substantial, and these could pose disproportionate harm for the Tribes and lower-income subsistence fishing households. It is not possible to adequately assess these potential health impacts, given the gaps in information.

Another important gap in the Plan is the lack of formal connection to a **source control** plan. The cleanup goals for contaminant reduction, and the certainty of achieving those goals, depend critically on the timing and extent of source controls. It is not possible to fully assess the potential health impacts of residual contamination without knowing the timing and extent of source controls. Adding clear source control goals and objectives to the Plan, and defining required source control programs and actions, could reduce uncertainty and contribute to improved health outcomes by defining requirements to reduce pollutant loading to the site.

OPPORTUNITIES

Seattle is at the cusp of a new era. Beginning with the cleanup, and accompanied by source control and natural restoration efforts, the Lower Duwamish River and surrounding area have a chance to become a regional asset and symbol of pride, rather than an environmental stigma. There will be opportunities to turn river cleanup and restoration into a national model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own. In this report, we provide recommendations to pursue equitable and sustainable revitalization, including a proposed Duwamish Valley Revitalization Task Force.

EQUITY

It is critical that there be meaningful and collaborative participation with the affected communities in all efforts to prevent harm from the cleanup, maximize benefits, and promote health equity.

The City of Seattle and King County are Potentially Responsible Parties for the cleanup, and they are also responsible for protecting and improving the health and well-being of all people in their jurisdictions. At face value, cleaning up the Duwamish River will address both responsibilities. However, without targeted interventions, the proposed cleanup could result in unanticipated harms to vulnerable populations, and continue or even exacerbate existing health inequities.

The EPA, City, and County each have prominent policies that make commitments to consider equity, race, and/or justice in decision-making. We call upon each to uphold these commitments in planning the cleanup and related actions, and in planning for predictable health effects of those actions.

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* The following chapters provide more information about each recommendation

RECOMMENDATIONS*

Directed to EPA

Construction measures

- Negotiate transport routes and associated mitigation measures for cleanup-related truck and rail traffic with potentially affected residents.
- Use modern clean engines or those with best available emission controls, cleanest available fuels, and "green remediation" techniques to minimize air emissions, plus effective noise and light minimization measures during active cleanup.

Jobs for community members

- Provide cleanup job training and placement assistance to local community members.

Institutional controls

- Apply institutional controls, including educational signage and washing stations, at local beaches until health protective standards are met.
- Institutional controls should go beyond restrictive and informational actions, such as fish advisories. Interventions should emphasize positive alternatives, such as identifying, encouraging, and providing options for safe fishing and healthful fish consumption. There is a clear need for innovative thinking.
- Efforts to promote safer fishing should acknowledge that the target audience is more than just people who currently fish on the Duwamish River, and should include people who may fish there in the future.
- All efforts to provide information and promote safe and healthful fishing options should: a) be culturally appropriate for each audience, b) be designed to help people make informed choices, and c) engage and empower people to participate meaningfully in planning, implementation, and monitoring for success.
- Follow EPA guidance for institutional controls, especially to evaluate them as rigorously as other alternatives.
- Evaluate the true health impact of institutional controls to vulnerable populations.
- Develop a robust Institutional Controls Program Implementation Plan to protect all vulnerable populations who consume seafood from the Duwamish River, to be funded by Potentially Responsible Parties as long as institutional controls are in effect.

Actions to protect Tribal health

- Collaborate with Tribes to more fully address their health concerns about the river cleanup.
- Restore Tribes' traditional resource use in accordance with Treaty Rights.
- Ensure that site-related institutional controls are temporary, not permanent.
- Establish a "Revitalization Fund" to enhance Tribal empowerment and health, until institutional controls are removed.

Directed to City of Seattle and King County

Equity policies

- Ensure equity in all policies and efforts for environment and community development, in accordance with Seattle's Race and Social Justice Initiative and King County's Equity and Social Justice Ordinance.

Community revitalization

- Foster local economic strength and sustainable access to needs.
- Enhance human and natural habitat in local neighborhoods.
- Increase community engagement by supporting and funding local grass roots initiatives that build social cohesion.

Gentrification pressures

- Coordinate management of future reinvestment and urban development by formalizing a coalition of agencies and community organizations to monitor and guide new development.
- Preserve affordability and produce affordable housing.
- Promote and protect home ownership.

Directed to City of Seattle, King County, and Port of Seattle

- Selection of firms for cleanup construction and related activities should, as much as possible, give priority to firms that are based in Seattle or King County.
- Selection of the final remedy (cleanup plan) and the process for allocating liability should attempt to reduce or eliminate uncertainty for affected businesses, whenever possible.
- Convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.

* The following chapters and Technical Reports provide more information about each recommendation

Photo: Courtesy of Duwamish River Cleanup Coalition "Duwamish Alive"

Introduction

More than a century of industrial and urban wastes have contaminated water, sediments, beaches, fish, and shellfish in the lower Duwamish River with a mix of 41 toxic chemicals.

In 2001, the United States Environmental Protection Agency (EPA) placed 5.5 miles of the lower Duwamish River on the Superfund National Priorities List, requiring a Remedial Investigation and Feasibility Study. The Remedial Investigation, including a Human Health Risk Assessment of current cancer and other health risks from toxins in sediment, was finalized in 2010.[1] The Feasibility Study of cleanup alternatives was finalized in 2012. The Human Health Risk Assessment identified four chemicals of most concern for human health: PCBs, cPAHs, arsenic, and dioxins/furans.[2] The major pathways of concern for human health are resident fish or shellfish consumption and sediment contact. Each pathway poses excessive risks for cancer and "non-cancer" outcomes, such as cardiovascular, neurological, liver, immunological, and developmental problems. Early Action cleanups have begun or been completed at five extremely contaminated locations prior to long-term cleanup.

On February 28, 2013, EPA released its *Proposed Plan* (Plan) for overall site cleanup. The Plan is accompanied by two appendices, although these are not formally part of the Plan: *Environmental Justice Analysis* and *Source Control Strategy*. EPA will accept public comment on the Plan until June 13, 2013, and expects to issue a final cleanup order in 2014.

Three partner organizations—University of Washington (UW) School of Public Health, Just Health Action, and the Duwamish River Cleanup Coalition/Technical Advisory Group (EPA's Community Advisory Group for the site)—have conducted a Health Impact Assessment (HIA) of EPA's proposed cleanup Plan. This HIA was supported with a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts, plus funds from the UW Rohm & Haas Professorship in Public Health Sciences.

This is the "*Public Comment Report*" for our HIA to be submitted to EPA during the public comment period for the *Proposed Plan.* The report is supported by a collection of Technical Reports, which provide detailed information about the HIA methods, assessments, and recommendations. All reports will be available on the UW Duwamish Superfund Cleanup HIA website: *http://deohs.washington.edu/hia-duwamish*

PROPOSED CLEANUP PLAN

EPA selected its proposed cleanup Plan ("5C+") based on a Feasibility Study of eleven cleanup alternatives published in 2012. The Plan calls for:

1. Human Health Risk Assessment = quantitative process used by EPA to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future.
2. PCBs = polychlorinated biphenyls; cPAHs= carcinogenic polycyclic aromatic hydrocarbons

- Capping of 24 acres of highly contaminated sediments in place.
- Removal of 84 acres of highly contaminated sediments that cannot be capped.
- Enhanced natural recovery of 48 acres of moderately contaminated sediments by adding a thin layer of clean material to "kick-start" the river's natural sedimentation.
- Monitored natural recovery of 256 acres of relatively low-level contaminated sediments, with sampling to determine if concentrations of contaminants are declining over time.
- Institutional controls: administrative measures to prevent people and the environment from being exposed to remaining contamination, using legal tools such as easements or covenants, and informational tools such as fishing advisories.

The Plan sets cleanup goals for the four chemicals of concern for human health. The goals were chosen to protect health or be equal to Puget Sound background concentrations, whichever is higher. However, the EPA Human Health Risk Assessment and models of future concentrations in the Feasibility Study predict that the Plan's goals will not be fully achieved. Resident fish and shellfish will probably still be unsafe for human consumption, even after the 17-year period of active cleanup and monitored recovery. In that event, the Plan calls for a study to determine if: (a) additional cleanup action or (b) a "technical impracticability" waiver is warranted, requiring an additional EPA order.

WHAT IS HEALTH IMPACT ASSESSMENT?

Health Impact Assessment (HIA) is a systematic process used "to characterize the anticipated health effects, both adverse and beneficial, of societal decisions…. Characteristics of HIA include a broad definition of health; consider-ation of |economic, social, or environmental health determinants; application to a broad set of policy sectors; involvement of affected stakeholders; explicit concerns about social justice; and a commitment to transparency."[3]

For this HIA we use the World Health Organization definition of health, "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[4]

WHAT IS THE SUBJECT OF THIS HIA?

EPA's *Proposed Plan* is the subject of this HIA. This assessment does not examine harms or benefits that might result from alternate cleanup scenarios, although many of the HIA findings and recommendations are probably transferable to whatever remedy EPA selects for its final cleanup decision. Our focus on the *Proposed Plan* does not indicate our approval or disapproval of this EPA-favored cleanup alternative.

WHAT IS THE PURPOSE OF THIS HIA?

The purpose of this HIA is to examine potential unintended and under-considered health impacts—desirable or undesirable—of the *Proposed Plan* and related decisions. The HIA examines whether some people might experience disproportionate impacts: fewer new opportunities or greater health burdens.

We examined potential impacts for four distinct populations that have strong connections to the Duwamish River:

1. Local residents
2. Tribes
3. Non-tribal subsistence fishers
4. Workers in local industries

Figures 1 and 2 show the major potential health impacts and causal pathways that we examined for these population groups, including these major population effects:

- Construction effects
- Restrictions on Tribal rights or practices
- Restrictions on non-tribal fisher practices
- Residential and industry gentrification
- Beneficial effects (and opportunities) for Tribes and for local communities and businesses

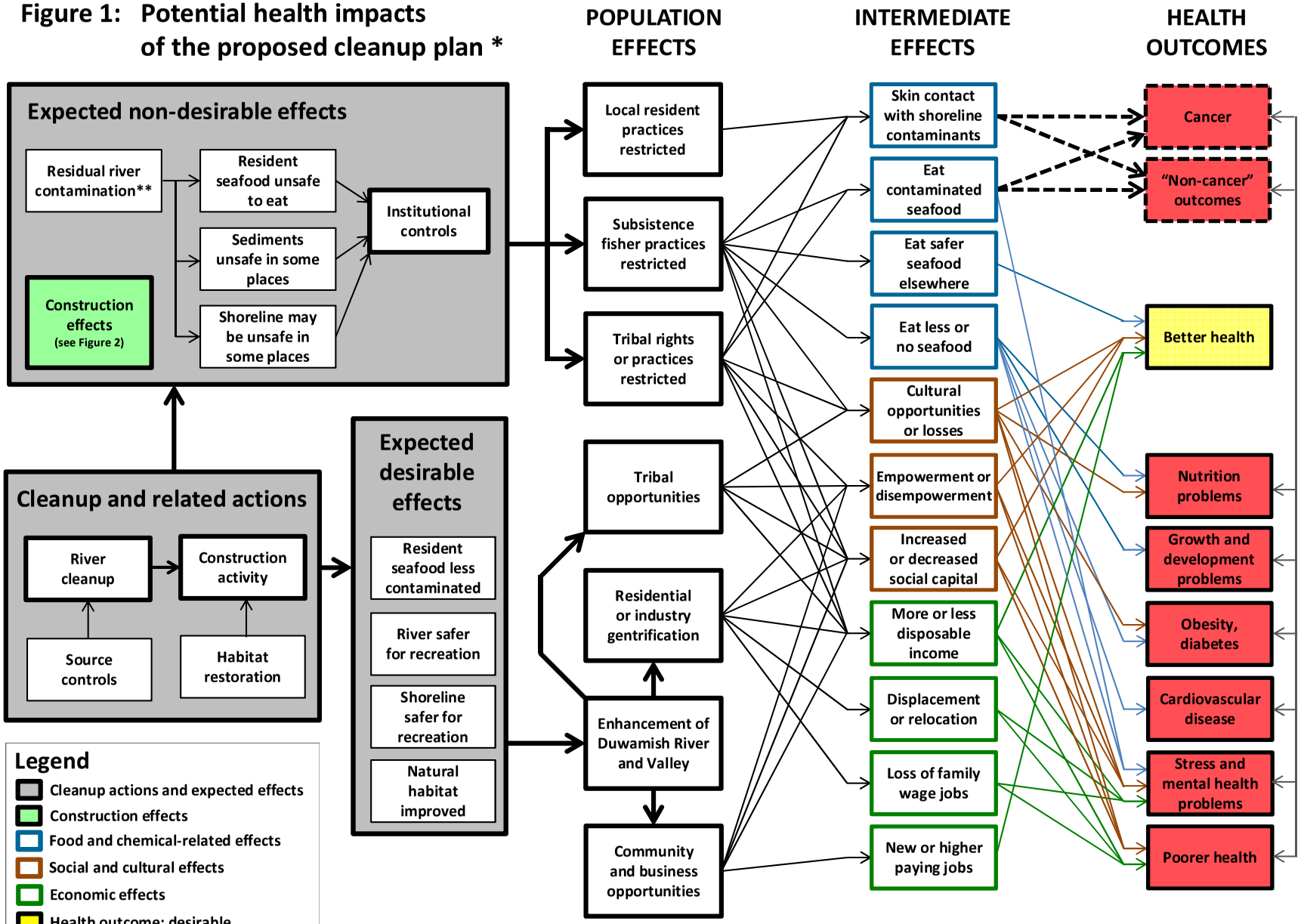
We examined these major intermediate health effects:

- Food and chemical-related effects
- Social and cultural effects
- Economic effects

The figures illustrate the complexity and interactions between these effects and a variety of health outcomes, beyond those considered in the EPA Human Health Risk Assessment.

3. Bhatia R. *Health Impact Assessment: A Guide for Practice*. Oakland, CA: Human Impact Partners, 2011
4. Preamble to the Constitution of the World Health Organization, entered into force in 1948.

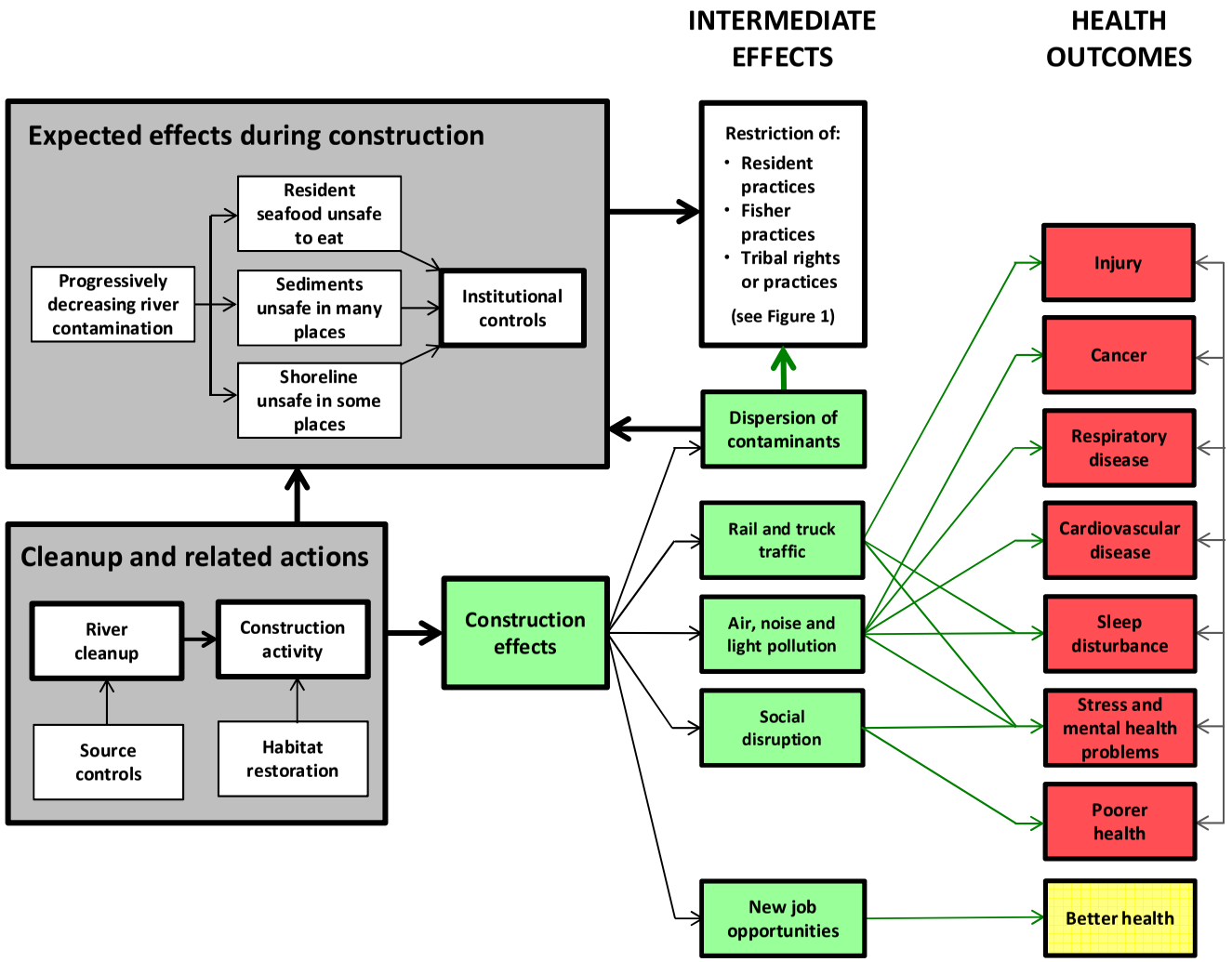
Figure 1: Potential health impacts of the proposed cleanup plan *



* This diagram should be interpreted in the context of possible cumulative impacts on health attributable to the depicted impacts *plus* health impacts unrelated to the proposed cleanup. Gray arrows on the right are reminders that causes of poor health can be synergistic.

** "Residual" river contamination = above Puget Sound background.

Figure 2: Potential health impacts of proposed construction *



* This diagram should be interpreted in the context of Figure 1, as well as possible cumulative impacts on health attributable to the depicted impacts *plus* health impacts unrelated to the proposed cleanup. Gray arrows on the right are reminders that causes of poor health can be synergistic.

RESOURCES AND METHODS USED FOR THIS HIA

We relied on guidance from a variety of sources throughout this HIA, including:

- Stakeholder guidance—regular meetings and communication with our advisors:
  - Resident Advisory Committee, with representatives from South Park; Georgetown; Nickelsville, a homeless encampment; Puget Sound Sage, a nonprofit organization; and a former state legislator representing the South Park and Georgetown area and formerly affiliated with the nonprofit, Homesight
  - Tribal Advisory Committee, with representatives from the Suquamish and Duwamish Tribes. The Muckleshoot Tribe chose not to participate on the committee
  - Liaison Committee, with representatives from EPA, other agencies, and potentially responsible parties
  - Non-tribal fishing communities, via semi-structured interviews with individual community advisors and key informants
- Technical guidance from the Health Impact Project (Katherine Hirono, Aaron Wernham), Habitat Health Impact Consulting (Marla Orenstein), and Decision Research (Jamie Donatuto, Robin Gregory)

We used a wide assortment of information sources for the HIA, including:

- Peer-reviewed literature, published reports, and credible internet-based materials
- Data obtained from public databases or provided by individual organizations (e.g., Urban Indian Health Institute)
- Semi-structured interviews with selected community advisors and key informants
- Focus groups: one with members of the Duwamish Tribe; and multiple with non-tribal subsistence fishers

We conducted the HIA in six steps, which is standard in HIA practice:

- Screening
- Scoping
- Assessment
- Recommendations
- Reporting
- Evaluation

The methods used in each step are detailed in a "Methods" Technical Report.

The UW Human Subjects Division approved our interview and focus group procedures. The Duwamish Tribal Council approved procedures and use of information for the Tribal focus group.

We developed our recommendations in collaboration with many stakeholders. Our community advisors and focus groups guided and informed selection, prioritization, and wording of recommendations. Our Liaison Committee provided advice about wording, feasibility, and best decision-makers to receive individual recommendations.

PRINCIPLES AND VALUES OF HEALTH IMPACT ASSESSMENT[5]

- Democracy: emphasizing the right of people to participate in the formulation and decisions of proposals that affect their lives, both directly and through elected decision-makers.
- Equity: emphasizing the desire to reduce inequity that results from avoidable differences in the health determinants and/or health status within and between different population groups.
- Sustainable development: emphasizing that development meets the needs of the present generation without compromising the ability of future generations to meet their own needs…. Good health is the basis of resilience in the human communities that support development.
- Ethical use of evidence: emphasizing that transparent and rigorous processes are used to synthesize and interpret the evidence, that the best available evidence from different disciplines and methodologies is utilized, that all evidence is valued, and that recommendations are developed impartially.
- Comprehensive approach to health: emphasizing that physical, mental, and social well-being is determined by a broad range of factors from all sectors of society (known as the wider determinants of health).

5. Adapted from the International Association of Impact Assessment (Quigley 2006)

Photo: Paul Joseph Brown

Effects of the proposed cleanup plan on local residents

Detailed information, including references, for this chapter is in the "Local Residents" addendum in this report.

COMMUNITY PROFILE

South Park and Georgetown are residential neighborhoods bordering the Duwamish River and Superfund site. Because of this proximity, residents are at risk for health effects related to the EPA Plan. A high percentage of residents are foreign-born and people of color, particularly in South Park. Average household income in both neighborhoods is much lower than the county average, and poverty rates are higher. In South Park, unemployment rates are 50% higher than the county average, and 78% of children at the local school qualify for free or reduced-price lunch.

CURRENT HEALTH STATUS

Health status is relatively poor in South Park and Georgetown, and for the 98108 ZIP code overall, which also includes Beacon Hill. Heart disease rates in South Park and Georgetown are 47% higher than the county average, while life expectancy is eight years shorter. In ZIP code 98108, childhood asthma hospitalization rates are more than twice the county average, and rates of lung cancer, diabetes, and death from stroke are all higher. Environmental exposures, such as air pollution, industrial releases, and contaminated sites, are among the highest in the city. However, environmental benefits, such as tree canopy, are less than elsewhere in Seattle.

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

Construction: air and noise pollution

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited

Distribution: Disproportionate harm from noise for South Park residents; air impact not disproportionate[6]

Health outcomes: Diesel engine emissions contain high concentrations of particulate matter and other pollutants that, if inhaled, can cause or aggravate cardiovascular disease, asthma and other respiratory diseases, or cancer. Noise from construction equipment or vehicles can disturb attention or concentration ability, affect mental well-being, and cause or contribute to stress or other mental health problems. At night, noise or light pollution from construction activity could disrupt sleep patterns, with impacts on physical and mental well-being.

Assessment: Air pollution is already a significant problem in the Duwamish Valley, produced by vehicle emissions from highway traffic and port activity, and emissions from

6. Distribution refers to differences within the impacted community, and not disproportionate health impacts between the impacted community and the rest of Seattle, which exist and are substantial (see Gould and Cummings,*Duwamish Valley Cumulative Health Impacts Analysis*, 2013).

industry point sources. Noise is also a significant existing issue, related to the same sources plus the King County International Airport (Boeing Field). Construction activities are likely to generate air pollution, although this will likely be a limited increment beyond existing pollution. The EPA Feasibility Study estimates of cleanup air emissions were based on use of conventional fuels during construction and are probably over-estimated. Updated fuel standards and EPA policies are designed to greatly reduce air pollutants, and the associated health impacts are expected to be limited.

Construction: rail and truck traffic

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited

Distribution: Disproportionate harm to Georgetown residents

Health outcomes: Increased truck traffic volume can increase risk of injury from pedestrian or vehicle collisions, or incidents triggered by road wear. Traffic congestion can disrupt community cohesion and quality of life. Increased traffic volume, vehicle idling, and rail freight transport could contribute to local air and noise pollution, as described above.

Assessment: If truck transport of dredged sediments between the river and rail facilities is required, then neighborhood impacts are likely, and could be moderate in magnitude. However, the reported plan to minimize the use of truck transport is expected to limit the magnitude of this impact. Anticipated cleanup-related rail traffic is estimated at 1–3 trainloads per month, a small addition to the 65–85 freight trains per day on local rail lines. These incremental impacts are expected to be of limited magnitude. Cleanup-related truck and rail traffic will primarily affect Georgetown residents.

Construction: job opportunities

Direction of effect: BENEFICIAL

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Restorative equity effect; benefit to unemployed or lower-income residents

Health outcomes: Employment is one of the strongest favorable determinants of health. Employment, job training, and skill development generate personal income and increase the likelihood of future employment and income stability. These can contribute to personal and family adaptive capacity, improved healthful practices, better access to and ability to pay for health care, reduced risk for cardiovascular and other major diseases, and extended lifespan.

Assessment: Cleanups at other Superfund sites demonstrate the potential to generate cleanup-related jobs, including for local residents. In 2012, the Hudson River (New York) Superfund cleanup generated 350 jobs, including 210 filled by local residents. There is similar potential for local residents during the Duwamish River cleanup. While jobs will certainly be generated here, with beneficial impacts on health for those employed, whether those jobs will be given to local residents is currently uncertain.

Construction: dispersion of contaminants

Direction of effect: ADVERSE

Likelihood: Possible

Magnitude: Limited

Distribution: Disproportionate harm to fish consumers and beach users

Health outcomes: As established in the EPA Human Health Risk Assessment, chemical contaminants in Duwamish River sediments and beaches can cause cancer and other chronic or developmental health effects.

Assessment: Past dredging performance at other Duwamish River cleanup sites has been mixed, but the most recent and comparable dredging projects are promising in terms of minimizing construction-related dispersal of contaminants. The likelihood that contaminated material will escape outside the construction zone is low if proven and latest environmental dredging technologies, best management practices, and skilled operators are employed. If contaminated material is not spread during dredging, then contamination of resident seafood will also be minimized.

Chemical contamination on beaches

Direction of effect: ADVERSE

Likelihood: Possible

Magnitude: Limited

Distribution: Disproportionate harm to beach users in both communities

Health outcomes: As established in the EPA Human Health Risk Assessment, chemical contaminants in Duwamish River sediments and beaches can cause cancer and other chronic or developmental health effects, via skin contact, inhalation, or ingestion.

Assessment: Beaches throughout the lower Duwamish River have been evaluated. Several publicly accessible beach areas exceed state health standards for direct contact for one or more of the chemicals of concern. EPA predicts that its cleanup Plan will approach but not meet direct contact goals for arsenic on some publicly accessible beaches. There are uncertainties in the predictive model, particularly the potential influence of source controls. The state is discussing whether to make the arsenic standard more protective.

Community opportunities: revitalization

Direction of effect: BENEFICIAL

Likelihood: Possible to likely

Magnitude: Limited to substantial

Distribution: Disproportionate benefit to higher-income residents

Environmental improvements resulting from the Duwamish cleanup will likely increase the real and perceived aesthetics of the Duwamish River and the esteem of areas surrounding the Superfund site. This may spur reinvestment in Georgetown and South Park. The flow of resources into these neighborhoods will likely contribute to evolution of their character. Community revitalization could stimulate a number of beneficial phenomena including physical improvement of housing stock, streetscapes, and open space, commercial growth via development of viable community businesses and services, and social benefits from increased employment and reduced crime. Such revitalization is typically considered "equitable" if it leads to the creation and long-term maintenance of economically and socially diverse communities.

Health outcomes: Revitalization and improvements in the physical, economic, and social conditions in Georgetown and South Park could beneficially affect the health of local residents. Increased home values and equity could increase residents' financial ability to maintain and improve their housing and improve overall adaptive capacity. Housing improvements could also reduce health risks in home environments. Community improvements may foster more active lifestyles, increased community interaction, and greater social capital. New local services and amenities could expand resources available to residents and provide employment opportunities. Finally, increased local median incomes have been associated with decreased local exposures to disease.

To secure such health benefits from community revitalization, existing residents must be able to remain in the improved neighborhoods. Achieving overall health gains from revitalization could hinge on avoiding residential displacement due to economic and social pressures, and sustaining equitable distribution of benefits to both existing and new residents.

Assessment: The HIA team analyzed data on institutional and grass roots programs for promoting equitable revitalization, to interpret prospects for influencing future development in Georgetown and South Park. Many programs and tools exist that could foster more equitable revitalization during future reinvestment and development in these communities. However, multiple Census-based indicators indicate that gentrification is already in progress and is likely to continue in both neighborhoods. Any cleanup-spurred reinvestment is likely to contribute to that trend. Thus, the health of current Georgetown and South Park residents may substantively benefit from strategic interventions to forestall gentrification and foster equitable revitalization.

Residential gentrification

Direction of effect: BENEFICIAL

Likelihood: Possible to likely

Magnitude: Limited to substantial

Distribution: Disproportionate benefit to higher-income residents

AND

Direction of effect: ADVERSE

Likelihood: Very likely

Magnitude: Substantial

Distribution: Disproportionate harm to lower-income residents

A process of gentrification often occurs alongside community revitalization, fundamentally changing neighborhoods. Gentrification generally involves physical improvements of housing stock, influx of higher-income residents, displacement of original residents, and overall change in neighborhood character that increases social polarity and decreases diversity.

Health outcomes: Changes in housing markets and residential conditions may have pronounced effects on the health of residents. Increased home values and equity will increase financial ability to maintain and improve housing and can improve overall adaptive capacity. Housing improvements may reduce harmful environmental exposures at home. Community improvements can facilitate active life practices, community

interaction, and increased social capital. New local services and amenities can improve resources available to residents and expand employment opportunities. Increased local median income is associated with decreased local exposure to disease.

On the other hand, increased housing costs could displace households into cheaper, lower quality, or more crowded housing, with increased risk for injuries, rodent infestation, infectious diseases, and stress or mental illness. Reduced disposable income could constrain adaptive capacity, healthful practices, and ability to meet basic health needs, all of which increase risks for cardiovascular and other major chronic diseases. Relocation to other lower-cost areas could increase distance to employment options and reduce access to healthy foods, transportation, quality schools, and supportive social networks. Real or perceived barriers between residents and decreased contact among neighbors may foster isolation, erosion of social capital, and disempowerment among existing residents. Low social and economic capital are independently associated with poor health outcomes and, when combined, contribute to an increased burden of poor health.

Assessment: Census-based demographic and economic data reveal a shift in the past decade toward increasing incomes in South Park and shrinking minority populations in Georgetown. Multiple indicators reveal that gentrification is already in progress and is likely to continue in both neighborhoods. It is likely that any cleanup-spurred reinvestment will contribute to this trend. Harmful impacts are most likely to affect lower-income residents, and benefits are most likely to affect higher-income residents. Strategic interventions to forestall gentrification and foster equitable revitalization could substantively benefit the health of current Georgetown and South Park residents.

Photo: Linn Gould

RECOMMENDATIONS

Directed to EPA

Cleanup construction and contamination

1. ***Use proven and latest environmental dredging technologies, best management practices, and skilled operators to minimize the spread of contaminated sediments during dredging.***

   Two recent sediment dredging projects on the Duwamish River used GPS-directed environmental dredgers and experienced operators with little to no spread of dredged material offsite. A similar approach, backed by strict monitoring, can reduce the dispersal of toxins into the water and fish tissue during future sediment removal actions.

2. ***Negotiate transport routes and associated mitigation measures for cleanup-related truck and rail traffic with potentially affected residents, particularly in Georgetown.***

   Final off-loading and transport routes for dredged sediments have not yet been determined but are expected to avoid using truck transport as much as possible. Most truck traffic, and all rail transport, will likely impact Georgetown residents but can be minimized by negotiating transport routes and related mitigation measures with affected residents.

3. ***Use modern clean engines or those with best available emission controls, Ultra Low Sulfur Fuels (ULSF), biofuel blends, compressed natural gas conversions, and no-idle and other "green remediation" techniques to minimize air emissions, plus effective noise and light minimization measures during active cleanup.***

   Using modern engines or engines with best available emission control technology will help reduce emissions. In recent years, new federal rules have required commercial rail freight and most commercial trucks to upgrade to ULSF, dramatically reducing harmful diesel emissions. ULSF can also be used in cleanup construction equipment. Biodiesel blends, no-idling, and additional EPA green remediation policies may further reduce emissions. Noise minimization measures, similar to those recently used during the South Park Bridge construction project, will also help prevent health impacts.

4. ***Provide cleanup job training and placement assistance to local community members and affected residents.***

   Training for cleanup-related jobs, job readiness skills, and job placement assistance programs can help ensure that affected residents benefit from cleanup employment and income opportunities. Examples of successful programs used elsewhere are EPA's Superfund Jobs Training Initiative and King County's Brownfields Job Training Program.

5. ***Apply institutional controls, including educational signage and washing stations, at local beaches until health protective standards are met.***

   Several contaminants currently pose low-level health risks to residents who frequently use local beaches. Measures should be taken to inform residents of potential risks and provide wash facilities for hands, feet, shoes, and pets after visiting Duwamish River beaches. These measures should be retained until it is confirmed that health-protective standards have been met.

Directed to City of Seattle and King Country

Community revitalization

1. ***Foster local economic strength and sustainable access to needs.***

   Promotion of local economic security could benefit Georgetown and South Park residents through expanded employment options, increased ability to access needed goods and services, and greater political power associated with a stronger local tax base. Possible options include:

   - Continue Seattle's Office of Economic Development and local community organization support of the local business environments in Georgetown and South Park
   - Improve local job security and increase median incomes via employment programs such as the EPA Superfund Job Training Initiative
   - Offset increasing costs of living in Georgetown and South Park by expanding secure local access to quality foods. Promote participation in urban agriculture at Marra Farm. Ensure availability of nutritious foods from local food banks and schools

2. ***Enhance human and natural habitat in local neighborhoods.***

   With reinvestment in Georgetown and South Park, an influx of residents could emphasize opportunities to enhance neighborhood conditions through public improvements. In particular the public management of transportation, open space, and natural resource issues could noticeably improve the neighborhoods. Possible options include:

   - Create vibrant streetscapes via Seattle's Complete Streets program
   - Increase public access to the Duwamish River, safe open space (designed according to principles of Crime Prevention Through Environmental Design), and shared recreational area through Seattle's Shoreline Street Ends program and additional land use conversion programs. If possible, expand public open space along the shoreline at Boeing Plant 2
   - Enhance local ecological services, pollutant source control, and aesthetics through Low Impact Development stormwater systems (swales, rain gardens, etc.), and tree planting and preservation programs
   - Improve aquatic recreation by minimizing combined Sewer Overflow discharge into the Duwamish River

3. ***Increase community engagement by supporting and funding local grass roots initiatives that build social cohesion.***

   Alongside formal institutional approaches, there are a variety of grass roots initiatives achieving community revitalization in Georgetown and South Park. Hands-on local service, in parallel with broader institutional programs, may help avoid situations in which vulnerable residents, such as the elderly or those facing language barriers, fail to receive attention to their needs. In addition, beyond basic needs, creative efforts in Georgetown and South Park are transcending individual, institutional, and corporate interests to extend the richness of community to all local residents.

Residential gentrification

1. ***Ensure equity in all policies, programs, and tools regarding environment and community development, in accordance with Seattle's Race and Social Justice Initiative and King County's Equity and Social Justice Ordinance.***

   Consistent with the Seattle initiative and King County ordinance, all policies, programs, and tools should be culturally appropriate and should serve residents regardless of barriers presented by age, language, race, ethnicity, and citizenship status.

2. ***Coordinate management of future reinvestment and urban development by formalizing a coalition of agencies and community organizations to monitor and guide new development.***

   A broad palette of institutional and organizational responses must be simultaneously integrated to promote neighborhood revitalization while forestalling adverse effects of gentrification. The EPA endorsed such a coordinated approach in a recent publication, *Creating Equitable, Healthy, and Sustainable Communities*. Other precedents for such proactive and comprehensive response include EPA's Urban Waters efforts, Green Zones initiatives in California, and the Let Us Build Cully Park project in Portland, Oregon.

3. ***Preserve affordability and produce affordable housing.***

   If cleanup-spurred reinvestment results in improved housing stock and substantially increased rents in Georgetown and South Park, then ensuring the continued availability of affordable housing may help existing residents remain in the improved neighborhoods. Possible options include:

   - Promote local development of affordable housing via land use code incentives, tax incentives, and public funding
   - Facilitate tenant assistance by Seattle Housing Authority and community organizations

4. ***Promote and protect home ownership.***

   If reinvestment results in substantially increased home values in Georgetown and South Park, then higher costs of ownership may prevent some prospective owners from buying homes. Financial difficulties may increase for both existing and new homeowners due to more precarious mortgages and increased tax liability. Possible options include:

   - Expand home ownership by low-income families by promoting use of down-payment assistance, Homestead Community Land Trust, and other programs
   - Address increased tax liability from rising home values via counseling, and existing and new tax deferral, exemption, and relief programs
   - Preserve home ownership through the Seattle Foreclosure Prevention Program

Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG

Effects of the proposed cleanup plan on Tribes

Detailed information, including references, for this chapter is in the "Tribes" addendum in this report.

COMMUNITY PROFILE

Three Native American Tribes—the Duwamish, Muckleshoot, and Suquamish—are potentially affected by the Duwamish River cleanup.

The **Duwamish** Tribe's ancestral lands are throughout Elliott Bay and the Duwamish River watershed. In 1851, the Duwamish people occupied 17 villages and 90 longhouses. The Tribe currently has nearly 600 enrolled members. The Tribe's current Longhouse is on the Duwamish River, at the site of the Tribe's historic winter fishing village, a National Historic Site. Chief Seattle was the first signer of the 1855 Treaty of Point Elliott, but city fathers fought a proposed Duwamish reservation. As a result, the Duwamish Tribe currently has neither the federal recognition nor treaty fishing rights granted to other Tribes.

The **Muckleshoot** Tribe is a federally recognized Tribe, composed of descendants of the Duwamish and Upper Puyallup people. The Muckleshoot Reservation, established in 1857, lies along the White River in Auburn. The Tribe currently has about 1,660 enrolled members. The Tribe has usual and accustomed fishing places, guaranteed by the Treaty of Point Elliott and upheld by the 1974 Boldt Decision. The Tribe conducts seasonal, commercial, ceremonial, and subsistence netfishing operations in the Duwamish River.

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"Good air, water, food resources, self-sufficiency, involvement anywhere you can help."

The **Suquamish** Tribe is also a federally recognized Tribe. The Tribe traditionally lived along the Kitsap Peninsula, including Bainbridge and Blake Islands, across Puget Sound from present Seattle. The Tribe has about 950 enrolled members, half of whom live on the Port Madison Reservation. The Tribe has usual and accustomed fishing places, guaranteed by the Treaty of Point Elliott and the Boldt Decision. The Suquamish Tribe actively manages seafood resources just north (downstream) of the Duwamish Superfund site.

CURRENT HEALTH STATUS

There are no publicly available health data that are specific to the Duwamish, Muckleshoot, or Suquamish Tribes. Therefore, we present findings for the American Indian and Alaska Native (AI/AN) population for King County and Washington State (see Table 1).

The AI/AN population shows significantly poorer health or socioeconomic status than the general population for

nearly 80% of the examined parameters. AI/ANs are:

- 2.6 times as likely to be in poverty
- 2.8 times less likely to have a college education
- 1.9 times as likely to be unemployed

AI/ANs in King County are:

- 1.9 times as likely to smoke
- 2.1 times more likely to have diabetes
- 1.7 times more likely to be obese

All three of these factors are associated with heart disease, which is 2.3 times as common in the AI/AN population, and is the leading cause of death in the United States for both Natives and the general population. There are also significant disparities in infant mortality rates, mental distress (stress, depression, and problems with emotions), cirrhosis deaths, and asthma.

TRIBAL CONCEPT OF HEALTH

The Native American concept of health traditionally embodies a holistic perspective. One Tribal Advisory Committee (TAC) member described individual health as "being at one with the universe, being in a state of non-conflict." The well-being of the community is also important, encompassing collaboration, social cohesion, and empowerment. Additionally, health incorporates well-being of the environment, as described by a Duwamish Tribe member, "Good air, water, food resources, self-sufficiency, involvement anywhere you can help."

The health and well-being of Native peoples are potentially affected in many ways by chemically contaminated sites. In addition to biophysical effects identified in the EPA Human Health Risk Assessment, there can be a constellation of mental, emotional, and spiritual effects related to temporary and permanent changes in the land, ecosystems, and their interactions with culture and community. Even when areas are remediated and made substantially cleaner, residual contamination is still likely to disproportionately affect Tribes.

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"It's our spiritual food so it feeds our soul; so it might poison our body, but then we'd rather nourish our soul."

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

The proposed cleanup will reduce sediment contamination levels and will therefore decrease seafood tissue concentrations over time. However, residual contamination above Puget Sound background levels, plus restrictions on river usage, could affect health in ways beyond those described in the conventional EPA Human Health Risk Assessment (Figure 1).

Note: The chapters for the Local Resident and Subsistence Fishing populations use separate "health outcomes" and "assessment" subsections to summarize potential health impacts. This chapter, however, summarizes potential impacts using an integrated format that was approved by the HIA Tribal advisors and better reflects Tribal concepts of health.

Residual contamination

The conventional EPA Human Health Risk Assessment has shown that the Tribes are disproportionately impacted by the Duwamish River Superfund site's baseline contamination relative to the general population. In addition, residual risks after cleanup will continue to be substantial, and are predicted to exceed Puget Sound background. Tribal health outcomes are likely to be worse than predicted by the EPA risk assessment because:

- The risk assessment approach only accounts for cancer and "non-cancer" biomedical disease outcomes and does not incorporate fundamental aspects of health and well-being such as the importance of accessibility to local natural resources, maintenance of cultural traditions, and significance of self-determination that are affected by residual contamination.
- Any river-related risks are compounded by existing Tribal health disparities and cumulative risks from both chemical and non-chemical stressors such as poverty, stress, food security, and concerns about self-determination, which were not considered in the EPA risk assessment.

Furthermore, although the cleanup will create a cleaner environment for all, disproportionality and inequity between the general population and the Tribes may actually increase. Resident seafood will be relatively safe to eat at the general population seafood consumption rate of one meal per month, but not at the Tribes' seafood consumption rates (see Technical Report for details).

Table 1: Health indicators for American Indian/Alaska Native (AI/AN) and general populations in Washington State and King County

Indicators	Washington State		King County	
	AI/AN	General Population	AI/AN	General Population
Sociodemographics				
Poverty (%)	26.3 *	12.1	25.1 *	9.7
College Education (%)	13.2 *	31.0	16.0 *	44.8
Unemployment (%)	16.4 *	7.6	10.9 *	5.7
Mortality				
Cancer mortality per 100,000	170.3	177.7	177.3	165.6
Heart disease mortality per 100,000	185.5	168.5	176.5	152.6
Heart health				
Heart disease %)	4.9 *	3.5	6.3	2.8
Smoking (%)	31.3 *	15.9	23.7 *	12.1
Diabetes (%)	11.5 *	7.3	12.2 *	5.9
Obesity (%)	39.0 *	25.6	35.3 *	20.1
Maternal and child health				
Infant mortality per 1,000 live births	9.7 *	5.1	13.2 *	4.5
Low birth weight (%)	7.6 *	6.3	6.9	6.
Mental health				
Mental distress (%)	19.1 *	9.9	15.7 *	8.3
Wellness				
Cirrhosis deaths per 100,000	31.6 *	9.1	24.3 *	7.8
Asthma (%)	17.3 *	9.2	17.3 *	8.1

Table shows average value for most recent available 5-year period. Sources: US Census, US National Center for Health Statistics, US Behavioral Risk Factor Surveillance System. See table in "Tribes" addendum in this report for details.

* Significant difference between AI/AN and general populations ($p<0.05$)

Institutional controls

Institutional controls, such as fish advisories due to residual contamination, restrict the amount of seafood that can be safely harvested by the Tribes. This is likely to affect Tribal population health in three ways:

- Restrictions and man-made despoliation violate Tribal fishing rights, which will lead to substantial disempowerment, an established determinant of health.
- Restrictions can affect food security and may prompt Tribal members to switch to alternative food sources that are not as healthy. This may cause other health problems including but not limited to obesity, diabetes, heart disease, and cancer.
- Restrictions may affect physical health since Tribal members may harvest fish in spite of biomedical warnings in order to protect aspects of their cultural and spiritual health. As expressed by a Swinomish elder, "It's our spiritual food so it feeds our soul; so it might poison our body, but then we'd rather nourish our soul."

The decision to impose institutional controls, such as seafood advisories until recovery is complete, or possibly in perpetuity, will disproportionately affect the Tribes relative to the general population.

Habitat renewal

It is highly likely that more extensive and healthier habitat will improve Tribal health, because the overall environment and species of cultural importance to the Tribe will be enhanced. The Duwamish Tribe focus group reported that the Tribe will have more ceremonies on the river if there is more habitat, resulting in feelings of pride, ownership, and empowerment, all important determinants of health.

Photo: Paul Joseph Brown

RECOMMENDATIONS

Directed to EPA

1. ***Collaborate with Tribes to more fully address their health concerns about the river cleanup.***

   The *Proposed Plan* Remedial Action Objective 1 is to reduce to protective levels the human health risks associated with consumption of contaminated Lower Duwamish Waterway resident fish and shellfish by adults and children with the highest potential exposure. Despite the EPA Human Health Risk Assessment's inadequacy in accounting for cumulative risks that may affect the Tribes, it still shows that residual contamination will negatively affect the Tribes' health. One approach to account for Indigenous health concerns beyond a conventional risk assessment is to utilize the Indigenous Health Indicators method established by Donatuto and colleagues (Table 2, "Tribes" Technical Report). Indigenous Health Indicators may differ between Tribes and must be developed separately. A formal partnership with each affected Tribe is necessary to pursue this approach. Although the TAC already considers current cleanup plans inadequate because of residual risks above Puget Sound background levels, a partnership like this could provide evidence to determine whether the Plan should be more protective for Tribal health.

2. ***Restore Tribes' traditional resource use in accordance with Treaty Rights: institutional controls need to be temporary, not permanent.***

   A long-term goal of the Tribes is to fully express their 1855 Treaty of Point Elliott, which firmly established the right to harvest fish at usual and accustomed grounds and stations. As long as institutional controls are in effect, these treaty rights cannot be fully expressed. This may result in health effects, including disempowerment, cynicism, and decreased access to harvest. The definition of temporary institutional controls needs to be defined and negotiated with the Tribes.

3. ***Establish a "Revitalization Fund" to enhance Tribal empowerment and health, until institutional controls are removed.***

   The Tribal populations suffer significant disparities in health relative to the general population, before even considering ramifications of the *Proposed Plan*. As described, institutional controls are disempowering because they limit established fishing treaty rights granted to the Tribes.

   We recommend that the Responsible Parties direct resources to the Tribal communities to redress some of the inequities that will be compounded by institutional controls. A Tribal "Revitalization Fund" for each affected Tribe should be established and funded as long as institutional controls are in effect to help address existing health inequities compounded by the compromised status of the river. Revitalization funds could improve community health through established determinants of health, including empowerment and ownership of the process. While each affected Tribe should control its own fund and select its own appropriate actions, one example from the TAC is using funds to build a new hatchery to enhance salmon stocks. Based on historical and ongoing cumulative impacts, a Revitalization Fund could be used to remedy disparities in housing, transportation, jobs, etc., in order to offset site-related health impacts.

   An example of a similar fund is the Harbor Community Benefit Foundation (http://hcbf.org). The Foundation was established by a formal agreement between the Port of Los Angeles and community, environmental, health, and labor organizations. The Foundation is funded by the Port of Los Angeles to improve community health, access to open space, and economic opportunities until cumulative impacts from Port activities are reduced.

Photos, left to right: Paul Joseph Brown; BJ Cummings, Duwamish River Cleanup Coalition/TAG; Linn Gould, Just Health Action

Photo: Paul Joseph Brown

Effects of the proposed cleanup plan on subsistence fishing populations

Detailed information, including references, for this chapter is in the "Subsistence Fishing" addendum in this report.

Subsistence fishing is defined for this HIA as non-sport fishing performed to provide food occasionally or frequently for the fishers and their friends and families.

COMMUNITY PROFILE

Urban subsistence fishing is important nationally and locally for various reasons. There is little information with which to characterize the local fisher population. Surveys indicate that a large fraction of the local fisher population is comprised of Asian and Pacific Islanders (API), reflecting the large API community in King County. Surveys also document fishing by a variety of immigrant populations and people of color; low-income, food-insecure populations; and urban American Indians and Alaska Natives aside from the affected Tribes.

CURRENT HEALTH STATUS

There are no data available to characterize the health status of subsistence fishers. However, it is known that immigrant, low-income, and food-insecure populations generally face a number of health challenges that affect disease burden. These often include language barriers, unemployment, and transportation barriers. For example, the foreign-born population in King County is three times as likely to speak a language other than English at home, half as likely to have a high school diploma, more likely to have no health insurance coverage, and more likely to fall below the poverty level.

FISHING PRACTICES

Focus groups and interviews with local non-tribal subsistence fishers suggest that many people fish for a variety of cultural and traditional reasons: for recreation and relaxation, as a convenient and inexpensive source of perceived healthy and culturally relevant food, and as an opportunity to spend time with friends and family. Many of these fishers catch and consume fish from numerous waterways in the region. Popular fishing locations identified through focus groups include Des Moines, Tukwila, Green Lake, Lake Washington, Elliott Bay, Alki Beach, and Snohomish County. People do fish on the Duwamish River, in spite of advisories and posted signs. Reasons for choosing fishing locations vary by population and include convenience, accessibility, cultural and traditional significance, water quality, visual cleanliness of the river and riverbank, and species of fish available to catch.

INSTITUTIONAL CONTROLS

Seafood advisories and posted signs are currently in place along the Duwamish River. They will continue to be used as institutional controls during and after the cleanup to reduce exposure to contaminated seafood.

The EPA's 2013 *Environmental Justice* [*EJ*] *Analysis* of the proposed cleanup Plan discussed using a community-based social marketing approach such as one used for the Palos Verdes Shelf Superfund site. The *EJ Analysis* also described possible "offsets," such as fish trading and sustainable aquaculture projects, to mitigate potential health consequences of residual contamination and institutional controls.

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

Fishing practices and health could be impacted during or after active cleanup. Potential health impacts are likely to vary substantially by population. We considered potential impacts in three major areas: exposure to chemical contaminants, food and nutritional insecurity, and disruption of social and cultural traditions.

Exposure to chemical contaminants

Direction of effect: ADVERSE

Likelihood: Very likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to lower-income and non-English speaking people, and people who fish for social, cultural, or traditional reasons

Health outcomes: The cancer and non-cancer risks of continued fishing are described in the EPA Human Health Risk Assessment.

Assessment: Some communities, including API and low-income populations, have relatively high rates of fishing and fish consumption. During the cleanup, visible evidence of cleanup activity could decrease fishing on the Duwamish River and could reduce consumption of seafood caught from the river. However, it is likely that some people will continue to fish there, because of convenience, preferences, or limited transportation options.

During and after the cleanup, some people who now fish on the Duwamish River may decide to fish in alternate locations, including other local urban waters. It is likely they would continue their level of fishing activity and caught-seafood consumption unless constrained by added travel time or costs. These fishers, and the people with whom they share their catches, will probably experience reduced exposure to toxicants, compared to people fishing on the Duwamish River. However, many alternate locations identified in our focus groups are subject to fishing and fish consumption advisories, particularly waters within close travel distances. Seafood caught and consumed from these alternate locations could still present substantial health risks.

Existing advisories and signs have not dissuaded fishing on the Duwamish River. The institutional controls for the proposed cleanup are not well described, which stands in stark contrast to the extent of assessment and planning conducted for cleanup activities. Institutional controls have limited likelihood of success, unless they better address the complex cultural context surrounding fishing and seafood consumption in this region. Some of the "offsets" described in the EPA *EJ Analysis* might appeal to some fishing populations; however, our limited focus group experience found mixed or negative responses to some of the options.

After active cleanup, people who currently do not fish in the Duwamish River might begin fishing there because of real and perceived improvement in river safety and visual appeal. Although seafood caught and consumed from the cleaner Duwamish River would pose less risk than at present, the persisting health risks could still be substantial.

These potential impacts will disproportionately affect fishers who: do not know about or understand fishing advisories; do not identify the risk of fishing and seafood consumption as substantial compared to the convenience, dietary, social, or cultural benefits of fishing on the Duwamish River; or have limited options to travel to other, safer waters. These impacts are likely to be disproportionate for lower-income people and people of color.

Food and nutritional insecurity

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to low-income and food-insecure people

Health outcomes: A fish diet has distinct health benefits, including omega-3 fatty acids and other nutrients with protective value against high blood pressure, cardiovascular disease, and stroke. These nutrients also promote healthy brain development and growth in infants and children. Reduced fish consumption could adversely affect health by loss of these benefits. Furthermore, other protein sources are more costly than self-caught fish. People might experience food insecurity or fill a dietary void with less healthful choices.

Assessment: It is likely that some individuals will decrease or even discontinue fishing activities because of visible cleanup activities and expanded fishing advisories. Some people may choose to replace self-caught fish with store-bought fish, leading to increased economic hardship, especially among the region's low-income and food-insecure fishing populations. However, one undesirable consequence of "effective" advisories could be a net reduction in healthful fish consumption by fishers and their families. This reduction could be worsened by replacement with lower cost and readily available foods that are less likely to be healthful than fish.

Disruption of social and cultural traditions

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to people who fish for social, cultural, and traditional reasons

Health outcomes: Disruption of cultural or traditional practices could affect personal and social identity, and create stress or anxiety, with impacts on well-being and mental health. Decreased contact within fishing communities may foster isolation and erosion of social capital. Low social capital is independently associated with poor health outcomes and, particularly if combined with low income or existing social marginalization, could contribute to an increased burden of poor health. Decreased fishing activity could be replaced with indoor or sedentary activities, with a net decrease in exercise and nature contact, both of which are associated with poorer health. Regular exercise, even at low to moderate levels of exertion, reduces the risk of obesity, hypertension, and cardiovascular disease.

Assessment: In published literature on urban fishers and in our focus groups, commonly reported reasons for fishing include: traditional and cultural significance, particularly eating a self-caught rather than purchased fish; exercise; spending time with family and friends; and relaxation. It is possible that some people currently fishing on the Duwamish River will reduce or discontinue fishing and consuming self-caught fish, rather than traveling to alternate locations, with some loss of social ties. There is limited information to assess how likely this would be, but the health impact could be limited or moderate. The impact would disproportionately affect lower-income people with limited time or transportation.

Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG

RECOMMENDATIONS

Directed to EPA

1. ***Institutional controls should go beyond restrictive and informational actions, such as advisories to avoid contaminated fish. Interventions should emphasize positive alternatives, such as identifying, encouraging, and providing options for safe fishing and healthful fish consumption.***

   Advisories have repeatedly proven to have limited effect on the targeted fishing practice, locally on the Duwamish River and elsewhere. Efforts to dissuade fishing on the Duwamish River may have the best chance to be truly effective and least discriminatory if people are provided other, healthier options that will directly address and satisfy the reasons that they harvest or consume fish or shellfish.

2. ***There is a clear need for innovative thinking about how to discourage fishing (for resident fish and shellfish) on the Duwamish River and how to promote safe and healthful fishing alternatives. Possible options to explore in consultation with fishing communities include*:**

   Consider some of the "offsets" identified in the EPA Environmental Justice Analysis for the Duwamish River cleanup.

   Our focus groups with local fishers suggest that acceptance and cultural appropriateness of offsets will vary between and within populations. Some of the listed options might appeal to some fishing populations, but we found mixed or negative responses to some of the options.

   Provide a sufficient and reliable supply of fish to food banks in the communities where current and prospective fishing populations are located.

   One survey of local food bank clients found 40% of client families fished for food, including 8% who fished in the Duwamish River. Providing a reliable source of fish for these lowest-income and food-insecure populations through programs such as SeaShare may alleviate at least their dietary drivers for fishing, and may give them flexibility to be more selective in choosing locations when they fish for other reasons (e.g., cultural tradition, family recreation, etc.).

   Establish community supported fishery (CSF) programs—analogous to community supported agriculture (CSA) programs—in communities where fishing populations are located.

   As with CSA programs, CSFs allow members to purchase shares of fish and other seafood caught by local fishers. These shares provide members with a regular source of lower-cost fish and shellfish, and directly benefit local fishers with financial support.

   Build and maintain urban fishing ponds near the affected fishing communities.

   Reasons for fishing vary between populations. Many people fish for cultural and recreational reasons in addition to fishing for an inexpensive source of food. Other states have developed urban fishing ponds to provide safe, local fishing locations for urban or land-locked communities. Allowing people to keep and consume the fish they catch would encourage continued fish consumption while maintaining fishing activities. Catch-and-release ponds would also allow for continued opportunities for exercise, nature contact, and socializing. Urban fishing ponds were generally well supported by focus group participants, who agreed that these locations should be aesthetic and relatively natural environments to maximize the appeal for fishers.

3. ***Efforts to promote safe or safer fishing practices should acknowledge that the target audience is more than just people who currently fish on the Duwamish River. The target audience includes people who might fish on the Duwamish in the future. Any intervention effort should include plans to periodically reassess if all appropriate populations are being served.***

   A cleaner river after active cleanup may eventually attract people who do not currently fish on the river, either because of misperception that resident fish are then safe or because fishing there is a best or better option in a limited set of options. It is important to note that some minority or immigrant populations that are presently small in number in the Seattle area are projected to grow, and the composition of the urban fisher population may change over time.

4. ***All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should be culturally appropriate and relevant for each target audience, and should be designed to help individuals make informed choices.***

   Current and prospective future fishers on the Duwamish River are highly diverse in terms of race,

ethnicity, nationality, and language. Their reasons for fishing and fish consumption are equally diverse. There are probably no interventions that will broadly address the perspectives and needs of all groups, without tailoring the intervention for individual groups. Methods to ensure that individuals have the information and awareness to make informed choices could include:

Distribute maps to fishing communities that identify regional fishing locations, the associated advisories or concerns about contamination, and the types of fish available to catch that are safe for consumption.

Fishers could more easily choose safer, less contaminated fishing locations if they have clear descriptive information on other local fishable waters. These maps and other materials would need to account for the different languages and levels of literacy and numeracy in the diverse fishing communities. This could be accomplished by involving members of affected communities in developing, reviewing, and distributing these materials.

Incorporate community engagement efforts to develop outreach and educational strategies around fish advisory awareness.

The methods used for the Palos Verdes Shelf Superfund cleanup site represent one good community-participation model to consider. We emphasize, however, that the most valuable lessons to learn from this model relate to community engagement and participation, and not the primary focus on fish advisories. This model could be useful for some populations but not others.

Partner with fishing community members to develop specifically tailored risk communication interventions.

The community-engagement model used in Georgia by Derrick and colleagues (2008) is a good example of an effective approach to developing a culturally tailored risk communication strategy to increase knowledge of contamination and fish advisories and improve ability to make informed choices.

5. ***All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should engage and empower members of fishing populations so they can participate meaningfully in all stages of any prospective interventions, from initial conception and planning through implementation and follow-up monitoring.***

   The methods used by Burger and colleagues (2013) in New Jersey provide an excellent model for effectively engaging community members as research partners in planning and implementing research, evaluating and interpreting findings, and developing and disseminating risk communication information. Community-based participatory methods can best ensure that interventions will account for the knowledge, beliefs, and cultural, social, and economic needs of fishers and their families. Although these methods are more time and resource intensive than traditional agency or "expert" driven approaches, they are more likely to ensure success.

Photo: Paul Joseph Brown

Institutional controls and health

This section discusses important institutional control (IC) issues that were identified in the subsistence fisher and Tribal sections of this report. Our additional research suggests that ICs are likely to have health impacts that have not been considered in the *Proposed Plan*. We offer additional recommendations that were not provided in the subsistence fisher and Tribal sections.

The models of future river sediment and fish and shellfish tissue concentrations predict that the Plan's health-protective goals will not be fully achieved. Resident fish and shellfish will probably still be unsafe for human consumption and higher than Puget Sound background levels, even after the 17-year period of active cleanup and monitored recovery. Therefore, the Plan is critically dependent on ICs to protect human health during and after cleanup of the river. The ICs are projected to last at least 40 years and could persist in perpetuity.

ICs are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. They are generally divided into four categories: proprietary controls, governmental controls, enforcement and permit tools with IC components, and informational devices. The Plan states that proprietary controls and informational devices will be the two main controls used for this site.

State and local guidelines and advisories exist for many water bodies in Washington State and are non-enforceable. The EPA issues nationwide advisories and makes state-level information publicly available online. Signs along the Duwamish River attempt to inform fishers of these advisories at some fishing locations in a variety of languages.

IC SHORTCOMINGS IN THE *PROPOSED PLAN*

There is ample evidence that seafood advisories posted along the Lower Duwamish River do not work. First, seafood advisory signs are often missing from common fishing areas. Second, despite current advisories, it is common to observe people fishing on the river right next to or across from fishing advisory signs (see photo at the start of this chapter). Finally, the *Proposed Plan* acknowledges that fish advisories are ineffective.

Focus groups with subsistence fishers found that the advisories often do not effectively communicate the risks associated with contamination and, even if these risks were understood, do not offer alternative means of fishing or consuming fish. There are no known programs that conduct outreach to subsistence fishers from the LDW to assist them in understanding seafood contamination, finding alternatives, or empowering affected groups.

Fishing is important to Tribal and subsistence fisher populations for food security as well as social and culturally-important reasons. Residual contamination will potentially impact the health and well-being of these two populations, as described in the preceding chapters and our technical reports.

Without including ICs, the preferred alternative will not meet Remedial Action Objective 1 (RAO 1), protecting the health of people consuming resident seafood. In acknowledging its inability to achieve RAO 1 in the foreseeable future, EPA made the following statements about ICs in the *Proposed Plan*: ICs are needed to reduce exposure to residual contamination; more dredging would decrease reliance on ICs; and informational devices have historically limited effectiveness according to published studies and EPA's experience. Furthermore, EPA's Environmental Justice Analysis identified several community and Tribal concerns about the use of ICs, including the burden placed on Tribes exercising their treaty rights and on other people who fish in the Lower Duwamish River.

There are three important ways that the application of ICs fails to adequately protect vulnerable populations, in addition to those described in the preceding chapters:

1. ***EPA IC guidance and costs:*** The EPA asked the U.S. Government Accountability Office (GAO) to review the extent to which ICs are used at hazardous waste sites and whether controls are properly implemented, monitored, and enforced. The GAO report reviewed 268 sites and found a general trend where ICs are increasingly relied upon, with contaminants being left in place rather than being removed completely, even though the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) explicitly prefers permanent removal and treatment compared to more temporary measures. The GAO recommended that EPA review its IC recommendations, methodologies, and guidance documents in order to ensure that ICs are effective during the time they are needed and that appropriate contingencies are in place for the long term. The report also found that remedy decision documents commonly lacked information about: implementation including timing of ICs, responsibility for monitoring of effectiveness, and enforcement responsibility. EPA generally agreed with GAO's recommendations.

   The Feasibility Study (FS) and *Proposed Plan* do not appear to have followed EPA IC guidance. Specifically, IC guidance cites three important recommendations: (1) understand the strengths, weaknesses, and costs for planning, implementing, maintaining, and enforcing ICs, (2) evaluate ICs as rigorously as any other response alternative, and (3) develop procedures to coordinate with implementing entities early and often throughout the cleanup process.

   With respect to evaluating ICs as rigorously as other remedial alternatives, it is noteworthy that EPA wrote hundreds of pages in the FS considering the merits of various other remedial alternatives, while ICs only covered 7 pages in the FS and 3 pages in the 82-page "Detailed Cost Estimates" Appendix.

   In addition, ICs were estimated to cost approximately $15 million over a 50 year period for seafood consumption advisories, public outreach and education, which is about 5% of the total $305 million cleanup. A $15 million price tag (or $300,000/year) is relatively small, particularly in comparison to the Palos Verdes Shelf Superfund site IC example described in the EPA Environmental Justice Analysis. The Record of Decision (2009) for that site estimated IC costs of $1.43 million/year. At this rate, a 50-year period of similar ICs for the Lower Duwamish River would cost about $72 million. This estimate is most likely conservative because of the additional need to consider Tribal Treaty rights.

   Furthermore, this price still only partially accounts for direct costs, since the adverse human health effects are not addressed. For example, it has been suggested that cost estimates should include the costs of degrading Tribal seafood, which can subsequently lead to poorer health. In the 2007 U.S. v. Washington "Culverts" case, the District Court held that "implicitly incorporated in the treaties' fishing clause is the right to have the fishery habitat protected from man-made despoliation." It is outside of the scope of this HIA to calculate health costs; however, they could be substantial.

2. ***ICs add to existing cumulative risks to vulnerable populations:*** In previous sections, this HIA has described subsistence fisher and Tribal population's socioeconomic and health disparities. Furthermore, the HIA has described that cumulative exposures, defined by the EPA as "the combined threats from exposures via all relevant routes to multiple environmental stressors, including biological, chemical, physical, and psychosocial entities", make Tribes and subsistence fishers more vulnerable to contamination relative to the general population. The application of ICs that vulnerable populations are expected to follow, to fully protect health, is an added psychosocial stressor that is likely to have health ramifications.

3. ***ICs add to already existing inequities:*** Both the HIA, in a previous section, and the EPA *Environmental Justice Analysis* have determined that residual contamination disproportionately falls on vulnerable populations. The application of ICs is also inequitable because vulnerable populations are expected to change their behavior (e.g, stop/limit eating seafood or learn new ways to cook seafood, etc.) even though harvesting seafood is deeply rooted in cultural traditions that are important both to subsistence and to family and community cohesion. Research (and this HIA) shows how this type of undesired "behavior change" has increased health inequities in these populations, including increases in obesity, diabetes, depression, and more.

RECOMMENDATIONS

Directed to EPA

EPA is therefore stuck between the need to resolve a technological problem (residual contamination due to incomplete cleanup), for which ICs are required, and a health problem (risks to vulnerable populations), for which there should be no ICs. In order to better protect human health, EPA should enact measures to protect vulnerable populations as long as ICs are in effect.

1. ***EPA should follow its own institutional control guidance recommendations:***
   - Characterize the strengths, weaknesses, and costs for planning, implementing, maintaining, and enforcing ICs
   - Evaluate ICs as rigorously as any other response alternative
   - Develop procedures to coordinate with implementing entities early and often throughout the cleanup process
2. ***EPA should evaluate the true health impact of institutional controls to vulnerable populations. Options to consider are:***
   - Conduct cumulative health assessments to accurately account for multiple physical and chemical stressors that affect Tribes and subsistence fishers that make them more vulnerable to contamination. These cumulative risks would illustrate health impacts higher than traditional risk assessments predict.
   - Determine a realistic cost estimate of IC programs so that potentially responsible parties understand their future and very long-term costs relative to the cost of more cleanup now.
3. ***EPA should develop a robust Institutional Controls Program Implementation Plan (ICPIP) to protect ALL vulnerable populations who consume seafood from the Duwamish River to be funded by Potentially Responsible Parties as long as ICs are in effect.***

   In acknowledging that ICs will have to be used until residual contamination levels decrease, they should be as temporary as possible.
   - The remedy decision document should refer to the ICPIP with information about implementation, including timing of ICs, responsibility of monitoring effectiveness over time, and responsibility of all parties.
   - An IC Task Force should be established and include a leader from each affected community. Current and prospective future fishers on the Duwamish River are highly diverse in terms of race, ethnicity, nationality and language. Based on what was learned in HIA focus groups and key informant interviews, there are at least 15 communities for outreach including but not limited to: the three affected tribes, urban American Indians and Alaska Natives; food bank clients; homeless communities; Asian Americans and Pacific Islanders, and several second generation low income populations.
   - The IC Task Force should incorporate a community based participatory approach to engage and empower affected populations so that they can participate meaningfully in all stages of any prospective interventions, from initial intervention and planning through implementation and follow-up monitoring for success. The preceding Tribal and Fisher chapters provide information about community based participatory approaches.

Effects of the proposed cleanup plan on workers and employment in local industries

Photo: Paul Joseph Brown

COMMUNITY PROFILE

The Lower Duwamish River area is home to Seattle's and King County's largest concentration of industry, including the Duwamish Manufacturing Industrial Center and Port of Seattle. The manufacturing, wholesale trade, transportation, warehousing, and utilities industries in this area employ at least 30,000 workers. In general, these jobs pay good "family" wages.

HEALTH OUTCOMES

The major potential health impact of concern relates to employment. Employment is one of the strongest favorable determinants of health and well-being. Steady employment with a decent wage allows individuals and families to live in safe home and safe neighborhood with access to basic services, purchase healthful food, and ensure education for their children. Steady employment and a decent wage can also provide income and time to enjoy pleasures of life, exercise, and be able to deal with unanticipated life challenges. Good jobs with benefits may provide health insurance which allows access to health care, preventive, and health promotion resources. Together, these factors can reduce the risk of major preventable health problems such as obesity, diabetes, high blood pressure, heart attack, and stroke. Employment and higher income are associated with longer lifespan.

POTENTIAL HEALTH IMPACTS

Manufacturing, wholesale trade, transportation and warehousing businesses in the Lower Duwamish area face a variety of pressures that could influence their productivity and economic viability, and that could stimulate changes in land use analogous to ongoing residential gentrification in local neighborhoods.

It is plausible that the proposed cleanup of the Lower Duwamish River and related decisions could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employment. Alternatively, it is plausible that existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river, and if this stimulated industry revitalization and economic robustness.

This assessment considered four major categories of possible cleanup-related effects: cleanup job creation, cleanup costs and business liability, business uncertainty, and industry revitalization. Any potential effects of the proposed cleanup plan on workers and employment in the Lower Duwamish area industries would not occur in a vacuum. Therefore, the assessment also considered the context in which any cleanup-related effects would occur. Assessment findings will be summarized in a later version of this chapter, in our Final HIA Report. Meanwhile, we refer readers to the detailed addendum in this report.

RECOMMENDATIONS

We conducted this assessment of local workers and employment as a desk-based HIA, without guidance by a population-specific advisory committee or individual advisors. We will offer recommendations; however, we welcome opportunities to discuss our findings with stakeholders, explore recommendations and options, and consider whether modifications or enhancements are warranted.

Directed to EPA, City of Seattle, King County, and Port of Seattle

1. ***Selection of firms for cleanup construction and related activities should, as much as possible, give priority to firms that are based in Seattle or King County.***

   Placing a priority on hiring local firms and local workers will maximize the likelihood that healthful benefits of employment will go to local workers, and that indirect and induced economic impacts of the cleanup will further support local employment.

2. ***Selection of the final cleanup plan and the process for allocating liability should attempt to reduce or eliminate uncertainty for affected businesses, whenever possible.***

   We offer these options to consider:

   - *Allocation of liability:* It is hopeful that the first four identified Potentially Responsible Parties (PRPs)—the Lower Duwamish Waterway Group (LDWG)—are promoting a non-judicial process to allocate liability and that they plan to invite other PRPs to participate. Ideally, this will engage all willing PRPs, so that exclusion will not feed into uncertainties or adversarial relations between LDWG members and excluded parties.
   - *Scope of cleanup:* We purposely focused this HIA on the proposed cleanup plan ("5C+"), and we did not assess alternative cleanup scenarios or source controls. We encourage EPA and the PRPs to consider that uncertainty about finality of the chosen remedy will probably be higher with a heavy reliance on more uncertain and impermanent methods, such as natural recovery and, to a lesser extent, capping. In contrast, uncertainty will probably be lower with increased reliance on permanently removing contaminated sediments and taking measures to prevent recontamination.

Directed to City of Seattle, King County, and Port of Seattle

3. ***Convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.***

   We believe there will be opportunities to turn river cleanup and restoration into a model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own. It would be a devastating loss for Seattle and Washington state to suffer any substantial erosion of industry, port capacity, or employment in the Lower Duwamish area.

   Experiences in other places suggest that industry does not necessarily fare well with urban revitalization efforts, but a broad-based, collaborative endeavor might be more likely to achieve success than if industry pursues its own path.

   In our detailed report (see later chapter in this Public Comment Report) we describe experiences in other places that could provide models upon which to build a collaborative Duwamish Valley revitalization effort. There are undoubtedly others to consider too. Portland has proposed a river renaissance, and Seattle can probably draw lessons from industry dissatisfaction with that proposal. Chicago offers the example of a city with longstanding efforts to preserve manufacturing in the urban center and plans to renew those efforts. Efforts such as these will undoubtedly give cities the advantage in trying to become one of the proposed national hubs of manufacturing innovation. Finally, the Great Lakes restoration efforts, particularly the vision of the Council of Great Lakes Industries, offers inspiration to find new and better modes of public-private collaboration.

Photo: Paul Joseph Brown

Other considerations

INFORMATION GAPS AND UNCERTAINTIES

Identifying information gaps is an important goal for any HIA, almost as important as identifying health impacts. If the evidence base about possible health effects is incomplete, then decision-makers could make unfounded choices that adversely affect health or create inequities, and that might have been avoidable. Conversely, opportunities to benefit health or to restore equity could be lost if they are recognized too late.

Decision-makers need to know about information gaps in order to consider whether they should gather more information, amend the decision process or timeline, or alter a decision they might otherwise make. It is also challenging for members of the public and other stakeholders to participate meaningfully during a limited time period for public comment, if they do not have a complete picture that allows truly informed consent or comment.

Uncertainties in the proposed cleanup plan

One important gap is the limited planning for **institutional controls**, as discussed in this report. The health consequences of residual chemical contamination and institutional controls are potentially substantial, and these could pose disproportionate harm for the Tribes and lower-income subsistence fishing households. It is not possible to adequately assess these potential health impacts, given the gaps in information.

Another important gap in the Plan is the lack of formal connection to a **source control** plan. The cleanup goals for contaminant reduction, and the certainty of achieving those goals, depend critically on the timing and extent of source controls. It is not possible to fully assess the potential health impacts of residual contamination without knowing the timing and extent of source controls. Adding clear source control goals and objectives to the Plan, and defining required source control programs and actions, could reduce uncertainty and contribute to improved health outcomes by defining requirements to reduce pollutant loading to the site.

Information gaps for affected populations

As we describe in this report, there is little available information about health of the specific affected Tribes, particularly from a holistic perspective that would capture Tribal views of health and well-being. Population monitoring in Washington State and King County, however, reveals that regional Tribes suffer profound disparities in biomedical measures of disease and risk factors. There is also little information about urban subsistence fishing populations.

These gaps in information make it impossible to fully assess the potential health impacts of the proposed cleanup, and particularly institutional controls. It is feasible to collect information that would fill these gaps, and doing so would provide a greater understanding of and ability to address health impacts to these populations.

OPPORTUNITIES

Seattle is at the cusp of a new era. Beginning with the cleanup, and accompanied by source control and natural restoration efforts, the Lower Duwamish River and surrounding area have a chance to become a regional asset and symbol of pride, rather than an environmental stigma. There will be opportunities to turn river cleanup and restoration into a national model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own. In our detailed reports (see later chapters in this Public Comment Report) we describe local resources as well as experiences in other cities that could provide a foundation upon which to build a collaborative Duwamish Valley revitalization effort. We propose that the City of Seattle, King County, and the Port of Seattle convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.

EQUITY

We stress that some of our recommendations are cross-cutting and apply to all of the populations that we assessed. Some of our recommendations are directed towards the EPA, but some are directed to or indirectly applicable to local decision-makers.

It is noteworthy that the City of Seattle and King County are Potentially Responsible Parties for the cleanup, and as civic entities they are also responsible for protecting and improving the health and well-being of all people in their jurisdictions. At face value, cleaning up the Duwamish River will address both responsibilities. However, as we describe in this report, without targeted interventions, the proposed cleanup could result in unanticipated harms to vulnerable populations.

One of our key cross-cutting recommendations is to "ensure equity in all policies, programs, and tools regarding environment and community development, in accordance with Seattle's Race and Social Justice Initiative and King County's Equity and Social Justice Ordinance." It is critical that there be meaningful and collaborative participation with the affected communities in all efforts to prevent harm from the cleanup and to promote health and equity.

Photo: Paul Joseph Brown

SCHOOL OF PUBLIC HEALTH
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JustHealthAction

DUWAMISH RIVER CLEANUP COALITION
Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

June 2013

ADDENDA FOR PUBLIC COMMENT REPORT

Please note, these addenda are an integral part of this report and should be considered part of our "public comment"

APPENDICES

The following "technical reports" are <u>separately</u> provided to support our Public Comment Report

If these appendices become separated from our Public Comment Report, they are available at: http://deohs.washington.edu/hia-duwamish

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Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Addendum for Public Comment Report June 13, 2013

Assessment and Recommendations

Effects of the proposed cleanup plan on local residents

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Technical report

This technical report supports our *HIA Public Comment Report*, to be submitted to EPA on June 13, 2013.

Acknowledgment and disclaimer

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Duwamish Cleanup Health Impact Assessment: Resident Community Profile

The Duwamish Valley community includes some of the most ethnically diverse and lowest income neighborhoods in Seattle. The residential community is centered in the neighborhoods of South Park and Georgetown, in the 98018 ZIP code (98108 also includes Beacon Hill, the west slope of which is in the Duwamish River watershed, but is not generally considered part of the "Duwamish Valley," as it lies across and above the I-5 Highway).

South Park is the Valley's largest residential center, has a higher than average percent of elderly residents and children, and is ~40% Latino. The 2010 census reports that more than 70% of residents of the 98108 ZIP code are non-white minorities, including Asian, Pacific Islander, Hispanic, African-American, and Native American. King County data for 2006–2010 show that 42% of 98108 residents were foreign born. Thirty-two percent of 98108 residents live below 200% of the poverty level, 78% of children enrolled at South Park's Concord Elementary School qualify for reduced price lunch[1], and over 70% do not have a college degree. In 2000, median household incomes in South Park were ~40% below the Seattle average. Table 1 below compares demographic and socio-economic data from the 98108 ZIP code with the Seattle or King County average.

Table 1: Select demographic data: 98108, Seattle, King County

	ZIP code 98108 (Beacon Hill/Georgetown/South Park	Seattle[1]/King County[2] Average
Non-white minority	71.2	30.5 [1]
Foreign born	41.5	19.8 [2]
Below 200% poverty	32.4	22.2 [2]
College degree	71.7	54.8 [2]
% Elderly (>65)	12.0	10.8 [1]
% Children (<5)	6.8	5.3 [1]

Source: US Census Bureau, Census 2010.

Numerous social and environmental health indicators were compiled as part of a Cumulative Health Impacts Analysis (CHIA) funded by an EPA Environmental Justice Research Grant and published by the Duwamish River Cleanup Coalition/Technical Advisory Group (DRCC/TAG) and Just Health Action in 2013.[2] Findings of the study include:
– the childhood asthma hospitalization rate in 98108 is 299 per 100,000 residents, as compared with a Seattle and King County average of 216 and130, respectively;
– the rate of deaths from stroke in 98108 is 49%, compared to a Seattle average of 36%;
– 98108 had an assault hospitalization rate of 65%, compared with a citywide average of 43%.

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[1] Seattle Public Schools, Data Profile: District Summary, December 2011
[2] DRCC/TAG, Just Health Action. Duwamish Valley Cumulative Health Impacts Analysis.
[2] DRCC/TAG, Just Health Action. Duwamish Valley Cumulative Health Impacts Analysis. March 2013.

– 98108 residents have the lowest rates of leisure time citywide: a full 30% of residents reported having no leisure time, compared with a citywide average of 12%.

Other disparities found by the study include higher rates of lung cancer, obesity and diabetes among 98108 residents. Table 2 provides a summary of selected health indicators included in the report.

Table 2: Select health indicators: 98108, Seattle, King County

Indicator	98108	Seattle	King County
Adults without health insurance (%)	13.6	10.8	12.5
Adults with no leisure time physical activity (%)	30.0	11.6	15.2
Adults overweight or obese (%)	55	48	56
Adults with doctor diagnosed diabetes (%)	6	4	6
Adult current cigarette smokers (%)	10	10	11
Lung cancer death rates (per 100,000)	41.4	38.1	39.8
Stroke death rate (per 100,000)	48.7	36.0	36.6
Heart disease death rate (per 100,000)	123.3	138.4	137.8
Childhood asthma hospitalization (per 100,000)	299.1	215.9	129.7
Assault hospitalization rate (per 100,000)	65.4	43.3	29.0

Source: DRCC/TAG & JHA, 2013.

While limited data is available and statistically stable at the smaller South Park and Georgetown neighborhood (census tract) level, the disparities evident in the data that is available at this local scale further emphasize the findings at the ZIP code level. Heart disease rates from 2006–2010 in South Park and Georgetown were 168 per 100,000 residents, compared with 138 (18% lower) citywide. Most strikingly, overall life expectancy in South Park/Georgetown is 73.3 years – significantly lower than the Seattle average of 81.5 years, and a full thirteen years less than in Laurelhurst, a relatively wealthy and "white" North Seattle neighborhood, where average life expectancy is 86.4 years. These findings are summarized in Table 3.

Table 3: Georgetown and South Park health disparities

Indicator	South Park/ Georgetown	Laurelhurst	Seattle	King County
Life expectancy at birth (years)	73.3	86.4	81.5	81.5
Heart disease rate (per 100,000)	202.9	89.6	138.4	137.8

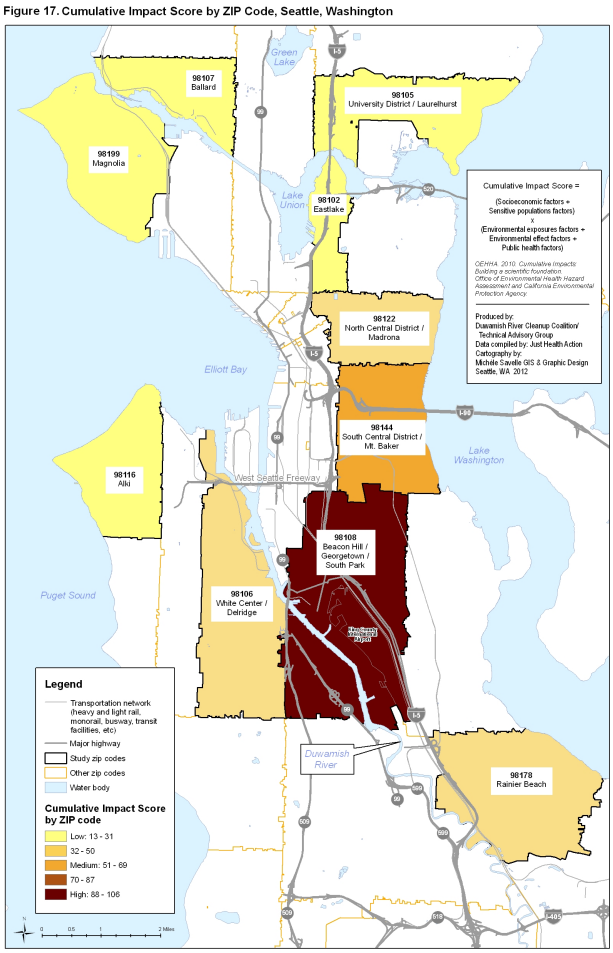
Source: Public Health Seattle & King County.

Finally, the Duwamish Valley is burdened with multiple sources of pollution exposures and correspondingly few environmental assets. In addition to the Duwamish River Superfund Site, which exceeds pollution limits for 42 toxic chemicals in the river's sediments – including PCBs, dioxins, arsenic, cPAHs, and phthalates – the 98108 ZIP code hosts the city's highest concentration of facilities releasing high levels of toxic chemicals, as listed by

EPA's Toxics Release Inventory (TRI). 98108 has 38 such facilities – more than twice as many as the next highest ZIP code; all other Seattle neighborhoods host from 0–13 TRI listed facilities. Similarly, the state's "ISIS" ranking of contaminated sites (number of sites x toxicity ranking) totals 142 in 98108 – more than three times greater than the next highest neighborhood; the rankings of sites in the rest of Seattle's ZIP codes total from 3–47. Disproportionate impacts in air pollution are also evident in the data on diesel and benzene concentrations. Annual average diesel particulate matter in outdoor air in 98108 is 2.3 ug/m3, compared to a King County average of 1.03, while benzene levels average 2.7 ug/m3, compared to King County's 1.7 ug/m3 annual average. As an indicator of environmental assets, while 98108 falls in the mid-range of park land per resident, it has among the city's lowest tree canopy per acre: 6% in 98108, in a range of 4–27% citywide.

Figure 1 shows the results of the Duwamish Valley Cumulative Health Impacts Analysis, which takes into account social, environmental, and public health indicators and serves as a summary environmental health "profile" of the 98108 (South Park/Georgetown/Beacon Hill) neighborhoods, as compared with nine other ZIP codes citywide.

Figure 1: Cumulative Impact Scores by ZIP Code, Seattle, WA (DRCC/TAG & JHA, 2013).



Resident Health Impact Assessment
Duwamish River Proposed Cleanup Plan

Construction Impacts

Introduction

Background. The current EPA Proposed Cleanup Plan for the Duwamish River Superfund Site anticipates a seven-year active construction phase, and a total of 17 years until site conditions meet objectives and recovery is complete.[1] During scoping for this assessment, potential impacts identified and prioritized by the project team and Resident Community Advisory Committee included health concerns related to short-term construction, as well as potential opportunities that could benefit the health of the community during the construction phase. Priority areas related to short-term construction included:

1. increased water pollution and fish contamination resulting from disruption of contaminated sediments during cleanup activities such as dredging;
2. increased congestion, road wear and safety hazards resulting from construction-related traffic such as truck and rail transport of waste materials;
3. increased air pollution and noise resulting from construction-related activities such as dredging equipment and barges;
4. increased opportunities for local "green" jobs created by cleanup activities, including remediation, pollution source control, and restoration.

Chapter Layout. This section of the Resident Health Impact Assessment will evaluate these construction phase impacts and provide an overview of:

A. current conditions in the adjacent residential communities, within which project impacts are anticipated to occur;
B. the likelihood and magnitude of anticipated impacts, as well as any evidence of disproportionate impacts on sub-groups within the community;
C. potential strategies to minimize harmful impacts, optimize benefits, and promote health equity.

Methods and Resources. Data for assessment of construction-related health impacts for the residential community were compiled from quantitative and qualitative data derived from several sources using a variety of methodologies. Public environmental and demographic databases, formal and informal literature (e.g., peer reviewed scientific papers, internal government reports, newspaper stories), community based participatory research (CBPR) results from related

[1] Complete recovery in this instance means reaching the lowest achievable chemical concentrations and satisfying the regulatory requirements of the EPA cleanup order, not a return to historical natural conditions.

studies, guidance from community advisory groups, and personal communication with topical experts all provided lines of evidence and data that are utilized in this assessment. A full list of citations and sources is provided at the end of this report.

The Resident Community Advisory Group that informed and helped to guide this assessment was comprised of seven residents and two advisors on specific technical issues. The advisory group was selected from established community leaders and representatives recommended by them, and included four South Park residents, including English-, Spanish- and Vietnamese-speaking community members; two Georgetown residents; one representative of the homeless encampment of Nickelsville; and two technical advisors to provide assistance in assessing air-related construction-phase impacts and gentrification – a representative of the non-profit organization Puget Sound Sage and a former WA State legislator representing the Duwamish neighborhoods, respectively. The Advisory Group met four times during the course of the project, and participated in two open community meetings to present and solicit feedback on the draft recommendations. The community meetings, held in South Park and Georgetown, provided opportunities to vet and refine the recommendations with a larger group of neighborhood residents.

Current Conditions

The Resident Community Profile provides an overview of current demographic and environmental baseline conditions in the riverfront neighborhoods of South Park and Georgetown. Additional baseline conditions relevant to the assessment of construction impacts are described below and include current water quality, beach safety, and fish contamination data and related advisories; recent dredging performance data; current road- and rail-related traffic and safety data; and air and noise pollution measures for the surrounding area and existing evidence of associated health risks.

Water quality, beach safety and fish contamination

The lower Duwamish River is listed by EPA and the Washington State Department of Ecology as an impaired waterway for exceeding several state water quality standards, including pH, fecal coliform, and dissolved oxygen, as well as numerous sediment quality standards, including polychlorinated biphenyls (PCBs), carcinogenic polyaromatic hydrocarbons (cPAHs), heavy metals (e.g., mercury and arsenic), and phthalates, among others.[2] In addition, the Remedial Investigation (RI) for the Lower Duwamish Waterway site notes

[2] 2012 303(d) list of impaired waterbodies for the state of Washington: http://www.ecy.wa.gov/programs/wq/303d/currentassessmt.html

that surface sediment within the Superfund site is regularly resuspended in the water column, causing toxic contaminants to become suspended in the river.[3]

Beaches throughout the lower Duwamish River have been extensively sampled and evaluated for human health risks as part of the RI for the Superfund site. Several publicly accessible beach areas exceed state health standards for direct (dermal) contact. The beaches that are most accessible to and utilized by South Park and Georgetown residents are at Duwamish Waterway Park in South Park and Gateway Park North in Georgetown. The contaminants with exceedances at these beaches include arsenic and cPAHs.[4] Human health risks at Duwamish Waterway Park include excess cancer risks associated with frequent beach play and exposure to the elevated pollutants.[5].

Resident (non-anadromous[6]) fish in the lower Duwamish River are highly contaminated with PCBs and other contaminants, and a Department of Health Fish Consumption Advisory recommending *no consumption* of resident seafood is currently in effect.[7] The degree of cancer risks and other health risks from eating resident seafood depend on the age of the consumer and the amount and species of seafood they eat. Washington State standards for cancer and non-cancer risks are 1 in 1,000,000 and a hazard index of 1, respectively.
The Human Health Risk Assessment for the site calculated the following risk levels for various groups of resident seafood consumers:[8]

- Suquamish Tribal adult excess cancer risk = 3 in 100
- Asian/Pacific Islander adult excess cancer risk = 1 in 1,000
- Suquamish Tribal adult non-cancer (developmental, immunological, and neurological) hazard index = 275
- Asian/Pacific Islander adult non-cancer cancer (developmental, immunological, and neurological) hazard index = 29–30.

In addition, a less stringent Puget Sound-wide *limited consumption* advisory has been issued by the Department of Health for certain salmon species, including Duwamish River runs, as follows:[9]

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[3] Lower Duwamish Waterway Remedial Investigation. Lower Duwamish Waterway Group: July 9, 2010.
[4] Lower Duwamish Waterway Remedial Investigation, Appendix B: Baseline Human Health Risk Assessment. Lower Duwamish Waterway Group: November 12, 2007
[5] Cancer risk rate = 8x10–6 – 9x10–6: Tables B5.31 and B5.32, Baseline Human Health Risk Assessment.
[6] Most salmon species are anadromous, spending a relatively short time in the river before migrating out to sea; resident seafood species that live in the river throughout their life cycle include perch, rockfish, herring, and crab.
[7] Lower Duwamish Waterway Superfund Site Fact Sheet. Washington State Department of Health; November 2007.
[8] Lower Duwamish Waterway Remedial Investigation, Appendix B: Baseline Human Health Risk Assessment. Lower Duwamish Waterway Group: November 12, 2007

- Limit consumption of Chum, Coho, Pink and Sockeye salmon to 2–3 times/week
- Limit consumption of Chinook salmon to once a week.
- Limit consumption of Blackmouth (resident Chinook) to once a month.

Dredging performance at Early Action Sites

Contaminated site dredging technology has advanced markedly in recent years. As a result, much of the available data on past dredging performance at contaminated sites is quickly supplanted by newer, and sometimes unpublished, results achieved with the most current environmental dredging equipment and techniques. In addition, every site has unique characteristics that make comparison among performance data from different contaminated sites difficult. Several recent dredging experiences on the lower Duwamish River provide the most relevant, recent and site-specific data on dredging performance.

- *Duwamish/Diagonal Combined Sewer Overflow and Storm Drain (CSO/SD) (2003–04)*
  An Early Action cleanup conducted at the mouth of the Duwamish Diagonal Combined Sewer Overflow (CSO) at River Mile 0.5 was conducted over the winter of 2003–04. A conventional clamshell dredge was used for the project, which typically releases sediment throughout the water column and at the water's surface , which can cause high turbidity and residuals.[10] During dredging, frequent turbidity violations (22 of 119; 20% of recorded measurements) were documented, indicating that plumes of contaminated sediment were being transported outside of the cleanup area. In addition, pre- and post-sediment characterizations found that relatively clean areas outside of the targeted cleanup zone had been contaminated by spilled material transported by the river currents and tides.[11] While important for lessons learned regarding selection of dredging technology, best management practices (BMPs), and operator skill, this data has little relevance to more recent cleanup projects using environmental dredging technologies.

- *Boeing South Storm Drain (2005)*
  A small area near the Norfolk CSO/SD was cleaned up in 2005 to remove a plume of sediment contamination that was attributed to releases from Boeing's South Storm Drain in the recent preceding years. The cleanup

[9] Puget Sound Fish Consumption Advice. Washington State Department of Health; October 2006.
[10] Technical Guidelines for Environmental Dredging of Contaminated Sediments. U.S. Army Corps of Engineers; September 2008.
[11] Duwamish/Diagonal CSO/SD Sediment Remediation Project Closeout Report. Elliott Bay/Duwamish Restoration Program Panel; July 2005.

area was intertidal, and the majority of work was conducted during low tide, when the area to be cleaned up was above the water line ("in the dry"). Cleanup was conducted using handheld vacuum excavator connected to a vac truck, which pumped contaminated sediments to an adjacent dewatering system on land.[12] However, this project is not comparable to sediment cleanups in underwater conditions, where handheld vaccuum removal is not feasible, or is limited to small areas inaccessible to large bucket dredges.

- *Slip 4 (2011–12)*
  To date, the most comparable cleanup that has been completed on the Duwamish River is the Early Action cleanup in Slip 4, at River Mile 2.8. The Slip 4 Early Action Areas was remediated in 2011–12. The primary removal technology planned for the project was an environmental dredge bucket with GPS navigation system and slurry wastewater collection and treatment system. Three other buckets were used during the project as necessary, depending on conditions encountered. During the 43-day dredging project, no violations of water quality standards were recorded, and only one instance of a turbidity violation was recorded during subsequent capping, where the material was clean sand being applied to the cap, not contaminated sediment being removed.[13] While this is the most recently completed dredging project on the river, it was located on a spur of the river off the main channel, so may have been less subject to the river's currents, which can increase the potential for plumes of contaminated sediment to escape during dredging. However, the data is promising in terms of effectively preventing contaminated sediment releases during dredging.

- *Boeing Plant 2 (2013)*
  Dredging of the river's largest Early Action Area at Boeing Plant 2 began in January 2013.[14] The Plant 2 cleanup area is on the main channel of the river, stretching roughly from river mile 3.0–4.0, and directly across the river from the residential South Park waterfront. The project spanned several weeks of dredging with a CableArm environmental dredge with GPS navigation. Monitoring included continuous turbidity sampling, which was posted in real time online, as well as daily turbidity compliance sampling, water chemistry, dredge residuals, and pre- and post construction characterization of nearby sediment areas. Results reported to date show only two exceedances of applicable turbidity

[12] Lower Duwamish Waterway Source Control Action Plan for Early Action Area 7. Washington State Department of Ecology; September 2007.
[13] Lower Duwamish Waterway Slip 4 Early Action Area: Removal Action Completion Report. City of Seattle; July 2012.
[14] EPA Region 10: http://yosemite.epa.gov/R10/cleanup.nsf/sites/BP2

standards, no violations of chemical water quality standards, no detectable dredge residuals, and no significant trends when comparing pre- and post- sediment characterization data.[15] This is the most recent and comparable dredging project to the work that will be required by the pending riverwide cleanup action. Dredging performance at additional Early Action Areas should be monitored and evaluated to predict the performance that can be expected for removal actions during the proposed riverwide cleanup.

Road and rail traffic and safety

There is extensive truck traffic on a daily basis in Georgetown and South Park. Over 3,000 shipping containers are moved by heavy trucks from the Port to local rail yards and warehouses each day.[16] More than 8,000 port-related truck trips occur on an average weekday, the Port of Seattle estimates, based on Washington Department of Transportation traffic counts.[17] A majority (56%) of respondents in a community survey conducted in Georgetown and South Park in 2009 thought that there were too many port trucks driving in their neighborhood. Fifty-six percent also said that port truck traffic made it hard to walk in their neighborhoods. Nearly one in five respondents reported an incident of someone from their home feeling endangered by port truck traffic within the prior year.[18]

The Duwamish Valley is also home to major rail lines with trains frequently passing through. Currently, approximately 65 to 85 train movements per day occur at the SODO main line crossings.[19] These include long-haul trains of about 150 cars as well as shorter trains. These figures do not include passenger trains.

Air and noise pollution

Air pollution. Air quality in the Duwamish Valley is poor for several parameters. The Washington State Department of Health (DOH) conducted a Health Assessment of air quality in the Duwamish Valley that concluded that the largest contribution to cancer and other health risks are mobile sources, and that risks are especially elevated within 200 meters of the Interstate 5, State Highway 99 and State Highway 509 corridors, all of which traverse the neighborhoods of

[15] AECOM: Boeing Plant 2 Completion Report. June 2013.
[16] Puget Sound Sage, Community Health Impact Survey Results: Port of Seattle Operations Hazardous to Health in Georgetown and South Park, 2009
[17] McClure, Robert and Cunningham, Jenny, Investigation: Air pollution crisis in South Seattle, mynorthwest.com, June 14, 2011
[18] Supra.
[19] Coal Train Traffic Impact Study. City of Seattle; October 2012.

South Park and/or Georgetown.[20] The DOH report also found that particularly vulnerable populations within these neighborhoods are exposed, specifically children at over a dozen child care centers or schools within the 200-meter high impact zone.

A recent Seattle Cumulative Health Impacts Analysis, conducted by HIA project partners DRCC/TAG and JHA, compiled air quality data for the Duwamish Valley's 98108 (South Park/Georgetown/Beacon Hill) ZIP code and compared the data to other Seattle neighborhoods and to the King County averages.[21] Diesel and benzene concentrations in the Duwamish Valley are significantly higher than the King County average: the annual average benzene concentration in King County is 1.7 ug/m3, vs. 2.7 ug/m3 in the 98108 ZIP code; the annual average diesel concentration in King County is 1.1 ug/m3 vs. 2.3 ug/m3 in the 98108 ZIP code. Among the ten ZIP codes included in the study, the 98108 concentrations were the highest in the city for diesel and second highest in the city for benzene.

The University of Washington School of Public Health and Puget Sound Sage, a non-profit organization, are currently conducting diesel monitoring in South Park and Georgetown in locations identified by residents as areas of high concern.[22] As results become available, they will be incorporated into the known existing conditions summarized in this report. In the 2009 community survey mentioned above, three out of five (60%) respondents believed that port truck pollution affected their health and the health of their family.[23]

Noise Pollution. Noise pollution is a significant issue in the South Park and Georgetown neighborhoods. Both neighborhoods are bordered by highways that contribute to noise experienced in the adjacent residential corridors, and both are under the SeaTac and King County Airport flight paths, which residents identify as sources of disruptive and harmful noise levels. Georgetown is also impacted by noise from the United Pacific and Burlington Northern rail lines, and is more directly impacted by noise from low-flying aircraft using the King County Airport, creating some disproportionality in the severity of noise impacts from these sources.

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[20] Health Consultation: Summary of Results of the Duwamish Valley Regional Modeling and Health Risk Assessment, Seattle, WA. Washington State Department of Health/ATSDR; July 2008.
[21] Duwamish Valley Cumulative Health Impacts Analysis. Just Health Action, Duwamish River Clean Up Coalition/Technical Advisory Group; March 2013.
[22] "Grant supports resident-led study of air pollution in the Duwamish." Environmental Health News: University of Washington Department of Environmental and Occupational Health Sciences; Autumn 2011.
[23] Community Health Impact Survey Results: Port of Seattle Operations Hazardous to Health in Georgetown and South Park. Puget Sound Sage; 2009.

Truck traffic through the area also creates noise that can interfere with quality of life. Nearly one-third (30%) of those responding to the survey in Georgetown and South Park in 2009 mentioned above reported sleep disruption from port trucks in their neighborhoods.[24]

Impacts Assessment

The assessment of potential harmful and beneficial health effects to residents from cleanup construction activities, as well as potential significant differences or disproportionalities in some parts of the neighborhoods, include four areas selected for assessment by the Resident Advisory Group as priorities. The priority areas are:

A. Construction disruption/pollution:

1. increased water pollution and fish contamination resulting from disruption of contaminated sediments during cleanup activities
2. increased congestion, road wear and safety hazards resulting from construction-related road and rail traffic
3. increased air pollution, noise and related emissions resulting from construction-related activities

B. Construction opportunities:

4. opportunities for local "green" jobs created by cleanup activities, including remediation, pollution source control, and restoration

C. Residual contamination:

5. potential for exposure to residual contamination on local shorelines/beaches

A. Construction disruption/pollution

Increased water pollution and fish contamination

Dredging performance at other Duwamish River cleanup sites has been mixed, but the most recent and comparable dredging projects are promising in terms of minimizing releases of contaminated sediment during cleanup operations and associated construction-related water pollution. While some suspension of contaminated sediments into the water column can be expected within the immediate vicinity of any dredging operation, the magnitude of the impacts from any contaminated material that may escape outside the construction zone is expected to be limited, assuming that environmental dredging technologies, best management practices, and skilled operators are employed for the cleanup. Based on evidence from similar recent dredging operations on the river, any

[24] Puget Sound Sage, Community Health Impact Survey Results: Port of Seattle Operations Hazardous to Health in Georgetown and South Park, 2009

water pollution plumes are expected to be infrequent and to disperse at low levels within a limited impact zone.

Impact on local beaches from the recent Boeing Plant 2 dredging provides the best comparative case study. EPA's initial assessment is that the data indicate only "white noise," i.e., expected variaiblity in a dynamic estuarine system, with no significant trends in the data attributable to the recent dredging.[25] Dredge residuals following removal at Boeing Plant 2 were all non-detect. Sampling in Slip 4 indicated a relatively small residual footprint adjacent to the area subject to dredging, which was treated with a thin layer of clean material (ENR).

Little information is available about the effect of previous Duwamish River dredging activities on levels of contamination in resident fish. Some past reports indicate higher fish tissue concentrations of PCBs following the Duwamish/Diagonal CSO dredging.[26] However, that project was not comparable to the environmental dredging anticipated for the riverwide cleanup. Recent fish tissue monitoring during and after dredging on the Hudson River in New York indicate that fish tissue increases sometimes occur with dredging, but are short-lived and transitory, with fish tissue recovering within a matter of weeks or months.[27] The Lower Duwamish Waterway Feasibility Study assumes that there will be a short-term increase in fish tissue chemical concentrations; a monitoring program planned for the cleanup will help to verify these assumptions.[28]

Increased traffic congestion, road wear and safety hazards

The Duwamish River Superfund Site cleanup is focused on riverbed sediments, rather than upland soils. While not explicitly prohibited by the EPA proposed Cleanup Plan, the Lower Duwamish Waterway Group does not plan to rely on trucks as the primary transportation mode for transferring contaminated sediments from the river to disposal sites.[29] Rather, the parties intend to rely on barging contaminated sediments from dredging operations to a transloading facility at one or two locations on the river, which will either have a direct rail connection and/or may require short distance truck transport of material from the transloading facility to an available intermodal rail spur. Trains will

[25] Personal communication: Holly Arragoni, EPA Remedial Project Manager.
[26] Final Data Report: 2006 Fish Tissue Sampling and Chemical Analysis in the Lower Duwamish Waterway. Anchor Environmental, King County; July 2007.
[27] PCBs in Fish Tissues at the Hudson River PCBs Superfund Site: Update on Results of Baseline and Remedial Action Monitoring (2004–2012). Marc Greenberg, U.S. Environmental Protection Agency Environmental Response Team; April 2013.
[28] Final Feasibility Study: Lower Duwamish Waterway, Seattle, WA. Lower Duwamish Waterway Group; October 2012.
[29] Lower Duwamish Waterway Group Liaison Committee representatives. Personal communications, 20012–13.

transport the sediments to a landfills in Roosevelt, Washington and/or Arlington, Oregon.

Any short distance truck transport to rail cars is not likely to impact the South Park neighborhood, where no rail lines exist, but may impact Georgetown, depending on the intermodal facility used. This may cause an impact on Georgetown residents, if trucks are used for short-distance transport.

Approximately 790,000 cubic yards of sediments will be dredged and transferred to rail cars for delivery to the landfill. A typical rail car can carry 66 cubic yards of waste, for a total of 11,800 rail cars. Assuming that trains consist of 50–150 cars, this translates to 80–240 train trips. If these are spread evenly over 7 years, this means an extra 11–34 train trips per year.[30] If sediment is only transported during months when removal is occurring, this could be consolidated into a limited number of months, balanced by no sediment transport during non-dredging months. If sediment removal proceeds more quickly overall, there would be a greater number of additional train trips over a shorter number of years.

The increase in train traffic itself is unlikely to have a meaningful effect on population health or wellbeing. Compared to the number of trains already moving through the area, the magnitude of these additional freight trips is small (1–3 additional trains per month, on average). Moreover, potential rail increases from other activities dwarf the increases associated with remediation. Proposed coal transport trains could add 10 extra train trips per day in the region in 2015, and 18 extra trips per day by 2026,[31] and the Port of Seattle's overall expansion goals could significantly increase rail freight traffic.[32]

In terms of any truck traffic required to transfer sediments from barge offloading facilities, the effects could to be more substantial. Georgetown is a small residential neighborhood surrounded by industrially zoned-land and bordered by the Duwamish River to the west, I-5 to the east, and the King County Airport (Boeing Field) to the south. The United Pacific rail line bisects the neighborhood, and the Burlington Northern rail facility lies on the opposite side of the residential community from the river, making a route through the neighborhood the shortest distance between the river and the rail facility. If any truck transport of contaminated sediments from the transloading facilities to the intermodal rail station is required, trucks may pass through the neighborhood in order to load the trains.

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[30] Email communication: Alison Hiltner, Remedial Project Manager, Environmental Protection Agency. Feb. 28, 2013

[31] Coal Train Traffic Impact Study. City of Seattle; October 2012.

[32] Century Agenda. Port of Seattle: http://www.portseattle.org/about/commission/pages/century-agenda.aspx

Impacts may include increased truck traffic volume that can increase risk of injury from pedestrian or vehicle collisions, or increase wear and tear on local roads. Additional traffic congestion can disrupt community cohesion and quality of life. Increased traffic volume, vehicle idling, and rail freight transport could contribute to local air and noise pollution. The likelihood of these impacts on Georgetown are possible, but the Lower Duwamish Waterway Group has stated its intent to avoid truck transport, relying instead on a direct barge-to-rail transfer, so the magnitude of any truck impacts is anticipated to be low. Regardless, to the extent that trucks may be used, the impacts will disproportionately fall on Georgetown residents.

Increased air and noise pollution

Cleanup of the Duwamish River will require an estimated seven years of active construction, including dredging, capping and transport of contaminated materials out of the site, as well as of clean capping material into the site. Dredging and capping operations will require the use of barges and construction machinery (e.g., dredgers). Contaminated and clean material will be transported by a combination of barge, truck, and rail. The Lower Duwamish Waterway Group has predicted that these activities will result in additional air and noise pollution.[33] However, the data for these predicted impacts used do not reflect current EPA fuel regulations or "green remediation" policies, which are expected to substantially reduce air emissions and noise impacts.

Additional air and noise emissions should be placed in the context of current conditions in the adjacent residential communities. Currently, air and noise pollution are long-standing and severe problems and have been identified as issues of concern by local residents. Any additional air and noise pollution resulting from the cleanup construction activities is likely to be minor in comparison to air and noise pollution from current non-cleanup activities, and residents may not perceive any change from current levels. However, since these neighborhoods are already disproportionately impacted by air pollution and noise and experience higher rates of diseases associated with these exposures including asthma, lung and heart disease, stress, and fatigue,[34] any additional impact may further exacerbate these impacts.

Air pollution: The Lower Duwamish Waterway Group conducted an evaluation of air pollution impacts from construction and predicted that impacts would be substantial. However, this analysis is outdated, because it assumed that all

[33] Final Feasibility Study, Appendix L: Lower Duwamish Waterway, Seattle, WA. Lower Duwamish Waterway Group; October 2012..
[34] Duwamish Valley Cumulative Health Impacts Analysis. Just Health Action, Duwamish River Clean Up Coalition/Technical Advisory Group; March 2013.

cleanup activities will rely on only conventional hydrocarbon fuels.[35], New federal rules now require the use of ultra low sulfur fuel in all highway, locomotive (rail), and marine diesel engines, so the conventional hydrocarbon fuels used in the Waterway Group's analysis are no longer legally permissible.[36] EPA's has also adopted a "green remediation" policy, which typically requires the use of low emission fuels, no-idling, and other measures which significantly reduce the impact of diesel emissions.[37] Since the Feasibility Study was conducted, a survey of diesel particulate emissions in the region has shown that since 2005, emissions from shipping have declined 16%, rail traffic emissions have declined 25%, and heavy truck emissions have declined 50%,[38] The Port of Seattle, as part of the Northwest Ports Clean Air Strategy, plans to reduce particulate emissions per ton of cargo by 75% of 2005 levels from by 2015, and by 80% by 2020.[39] Given the baseline conditions in the area, EPA's new fuel regulations, the agency's use of "green remediation" policies, and the Port's own Clean Air Strategy, while some air pollution impacts from cleanup construction are likely, the magnitude of these impacts is expected to be limited.

Noise pollution: Each stage of remediation entails noise that could impact quality of life for nearby residents or workers at other facilities. As with all construction-type work, there are also hearing safety issues and comfort concerns for those who conduct the remediation work.

Noise minimization and monitoring at other Superfund sites provide useful models and data for developing the Duwamish cleanup plan. Materials produced for the Hudson River PCB Superfund Site, for example, include modeling results and proposed mitigation measures for activities that could exceed noise standards.[40] They also include actual measurement data from other sites, including data showing exceedances of noise standards. Many variables affect whether noise will be a problem and must be considered in planning a remediation that minimizes noise problems for neighbors and workers. These include, but are not limited to proximity of residences and businesses to remediation activities, wind and air conditions, time of year, time of day, type of equipment used, etc.

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[35] Final Feasibility Study, Appendix L: Lower Duwamish Waterway, Seattle, WA. Lower Duwamish Waterway Group; October 2012.
[36] Emissions Standards Reference Guide. Environmental Protection Agency: http://www.epa.gov/otaq/standards/basicinfo.htm
[37] Superfund Green Remediation Strategy. Environmental Protection Agency; September 2010.
[38] "Air pollution from Puget Sound ports is declining, survey finds." The Seattle Times; October 30, 2012.
[39] Draft Northwest Ports Clean Air Strategy, 2013 Update. Port of Seattle; June 2013.
[40] See for example: Hudson River PCBs Superfund Site, Phase 1 Final Design Report, Attachment J – Noise Abatement Assessment. Epsilon Associates; March 21, 2006.

As discussed above, noise pollution is also already a significant issue in the South Park and Georgetown neighborhoods. While additional noise from cleanup construction may not make a big difference, it could exacerbate an already acute problem. Lying directly on the river, South Park is more likely to be affected than Georgetown, since the closest Georgetown residences are half a mile from the river. However, most cleanup construction in proximity to the residential areas will be completed during the Early Action Area remediation, so only a small portion of the riverwide cleanup plan will be conducted close to residences.

Recent river-based construction activities have provided a reference point for evaluating noise impacts that can be expected from cleanup-related construction. The South Park Bridge is undergoing reconstruction, requiring round-the-clock construction activities in close proximity to both waterfront residences and "live-aboards" in the South Park Marina. The King County Department of Transportation (DOT), which is constructing the bridge, conferred with the community and instituted a noise and light abatement program to minimize impacts. Despite 24-hour construction activity, complaints have been minimal, and residents praise the performance of the bridge construction crews.[41] Earlier this year, Boeing began cleanup construction activities at Plant 2, directly across the river from waterfront residences in South Park. Following King County DOT's example, Boeing negotiated a 24-hour construction schedule and noise abatement strategy with South Park residents, and to date, there have been few complaints.[42]

Minimal complaints from this early action remediation work and other construction activities on the Duwamish bode well. Careful planning is still essential, however, to make sure that the good noise record continues. While the likelihood of noise impacts during cleanup construction exists, if similarly successful noise mitigation measures are employed for cleanup activities within the residential reaches of the river, the magnitude of these impacts is anticipated to be limited.

B. Construction Opportunities: Local "green" cleanup jobs

Employment is one of the strongest favorable determinants of health.[43] Employment, job training, and skill development generate personal income and increase the likelihood of future employment and income stability. These can contribute to personal and family adaptive capacity, improved healthful practices, better access to and ability to pay for health care, reduced risk for cardiovascular and other major diseases, and extended lifespan.

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[41] Dagmar Cronn, South Park Neighborhood Association President. Personal communications; 2012–13.
[42] Ibid.
[43] Robert Wood Johnson Foundation. "How Does Employment–or Unemployment–Affect Health?" Healthy Policy Snapshot: Public Health and Prevention; March 2013.

The Hudson River cleanup example provides useful information regarding job creation at Superfund sites. Jobs are an important benefit that can accrue to local Superfund communities. The Hudson cleanup created 350 jobs, 210 of which were local, during cleanup in 2012. In addition, 285 regional businesses won contracts to provide supplies and services to the dredging operation there.

King County commissioned a study of the number of jobs expected to be created by the various Duwamish cleanup alternatives evaluated in the Feasibility Study. The alternative closest to the Proposed Plan (5C) was projected to create 270 full-time full-year jobs annually, and an additional 680 full-time part-year jobs annually, during the construction window.[44] The study notes: "About half the jobs can be classified as 'green jobs' because they are associated with cleaning up and restoring the natural environment, such as construction, dredging. and environmental consulting jobs." EPA's Superfund Jobs Training Initiative has recently begun a program to train and help place local residents in cleanup-related jobs related to the Duwamish Early Action Area cleanup projects.

Similar potential exists for creating jobs for Georgetown and South Park residents during the riverwide cleanup on the Duwamish River. It is likely that EPA's Superfund Jobs Training Initiative or Region 10's Environmental Workforce Development and Job Training Grants program will be part of a long-term strategy to facilitate local hiring for the Duwamish cleanup, with beneficial effects ranging limited to moderate, depending on the scale of the local jobs program and the cleanup itself.

C. Residual Contamination:

All four of the chemicals of concern for human health (PCBs, arsenic, cPAHs, and dioxins/furans) found in the Duwamish River can cause cancer and other health effects in humans, via skin contact, inhalation or ingestion. Beaches throughout the lower Duwamish River have been evaluated and several publicly accessible beach areas exceed State health standards for direct contact for one or more of the chemicals of concern. The EPA predicts that its cleanup plan will approach but not meet direct contact goals for arsenic on some publicly accessible shorelines. There are uncertainties in the predictive model, particularly the potential influence of pollution source controls, so while some impact is likely, the magnitude is difficult to predict, as actual residual contamination could prove to be either higher or lower. Washington State is also considering evidence that the arsenic standard is not sufficiently health-protective and should be updated, so current standards may not fully reflect harmful health effects from predicted residual levels of contamination. However, predicted residual levels are fairly close to Puget Sound background, so it may not be feasible for the cleanup to provide greater levels of protection.

[44] Estimates of Economic Impacts of Cleanup Activities Associated with the Lower Duwamish Superfund. ECONorthwest; November 29, 2010.

Table 1: POTENTIAL HEALTH EFFECTS

	Direction	Likelihood	Magnitude	Distribution
Construction disruption/ pollution	ADVERSE	POSSIBLE – LIKELY	LIMITED – MODERATE	Neighborhood differences; Disproportionate harm to fishers, beach users
Construction opportunities (jobs)	BENEFICIAL	LIKELY	LIMITED – MODERATE	Restorative equity effect
Residual contamination on beaches	ADVERSE	POSSIBLE	LIMITED	Disproportionate harm to beach users

C) Strategies/Recommendations

Minimize health impacts from construction:

To address water pollution and fish contamination from disruption of sediments:

- Employ environmental dredging technology and equipment, using experienced contractors and operators, based on site-specific conditions.

To address congestion, road wear and safety hazards resulting from construction:

- Work with affected communities to reach agreements on vehicle traffic routes and develop safety and/or mitigation measures for local impacts.

To address air pollution, noise and related emissions resulting from cleanup:

- Use ultra low sulfur fuels and biofuel blends in all construction equipment, machinery, and transport vehicles/vessels (e.g., trucks and barges; new federal rules already require ULSF for rail transport).
- Adopt noise and light minimization plans. Measures included in these plans may include placement requirements for equipment, specifications regarding types of equipment, limiting hours of operation, creating buffers and other measures.

Maximize health opportunities from construction:

To address opportunities for local "green" jobs created by cleanup activities:

- Develop and implement local cleanup (remediation, pollution source control, restoration) jobs training and placement program to benefit affected residents (Superfund Jobs Training Program, or other local initiative).

- Develop a program to solicit and encourage local contractors and service providers to bid on cleanup-related contracting opportunities.

Mitigate health impacts from contamination on beaches:

To address current and residual chemical contamination at local beaches:

- Provide educational signage and hand-washing stations at public local beaches until cleanup goals are met.

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Addendum for Public Comment Report June 13, 2013

Effects of the proposed cleanup plan on local residents (continued)

Revitalization and gentrification

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HOW WILL THE DUWAMISH SUPERFUND CLEANUP AFFECT HEALTH IN ADJACENT RESIDENTIAL COMMUNITIES (GEORGETOWN & SOUTH PARK)?

The substantial and enduring effects of the Lower Duwamish Superfund Cleanup project may reasonably be expected to affect the health of resident populations in Georgetown and South Park, the communities adjacent to the Superfund site. In scoping efforts for the Duwamish HIA, a Residential Community Advisory Committee composed of Georgetown and South Park residents identified two general categories of potential health effects of the Cleanup that are primary concerns for these communities: effects associated with construction activities, and effects connected to community revitalization and gentrification. Accordingly, for each of these two broad classes of potential health effects, the following reports document:

- Existing conditions of the affected environment in which the project effects would be imposed;
- Assessment of the character and likelihood of particular project-related health effects; and
- Recommendations to prevent adverse health effects, and to promote beneficial health outcomes, that may result from the Cleanup.

HOW WILL COMMUNITY REINVESTMENT SPURRED BY THE CLEANUP AFFECT HEALTH?

As described in the community profile of the Duwamish Superfund Cleanup HIA, the Georgetown and South Park neighborhoods of Seattle currently have lower median household incomes than many other Seattle neighborhoods, the City as a whole, or King County. In the future, the evident environmental improvements implemented under the Duwamish Superfund Cleanup would be expected to increase the general esteem of areas surrounding the Superfund site and spur economic reinvestment in Georgetown and South Park. Such flow of resources into these neighborhoods would likely contribute to the evolution of their character. For example, past Superfund Cleanup projects have been found to increase housing values in areas near Superfund sites (Gamper-Rabindran, 2011). The U.S. Environmental Protection Agency (EPA) recognizes the potential problematic implications of such community changes in their draft Environmental Justice Analysis for the Lower Duwamish Waterway (LDW) Cleanup:

> "Community groups have raised concerns over gentrification as a negative outcome for a successful Superfund cleanup within the LDW. The community groups envision equitable revitalization rather than gentrification of the neighborhoods surrounding the LDW to preserve the benefits of their diverse and vibrant communities" (EPA, 2013a)."

Framed by such concerns, as voiced by the Residential Community Advisory Committee for the Duwamish HIA, this report investigates how potential Cleanup-related changes in the prevailing economic, physical, and social character of Georgetown and South Park could be expected to yield attendant positive or negative effects on the health of the resident populations. Then, recommendations are made for limiting potential adverse health effects of Cleanup-spurred reinvestment and promoting equitable revitalization and associated health benefits.

1.0 BACKGROUND

Accurately predicting the comprehensive health results from reinvestment-related community changes would be extremely complex and involve controlling for innumerable interacting factors. Yet, there are a number of relatively well-documented associations that are useful in discerning the likely relationships between general trends in urban neighborhood characteristics and population health. In particular, increasing evidence has characterized the intricate interweaving of aspects of "place"- including local economic, physical, and social factors- that substantively influence local population health.

1.1 HOW ARE "PLACE" & HEALTH RELATED?

The Social Ecological Model (SEM) offers one useful theoretical approach for conceiving of the complex relationships between individuals and groups in neighborhoods, their local economic, physical, and social conditions, and their health. Building upon systems theory, the SEM is an "overarching framework… for understanding the interrelations among diverse personal and environmental factors in human health and illness" (Jamner & Stokols, 2000).

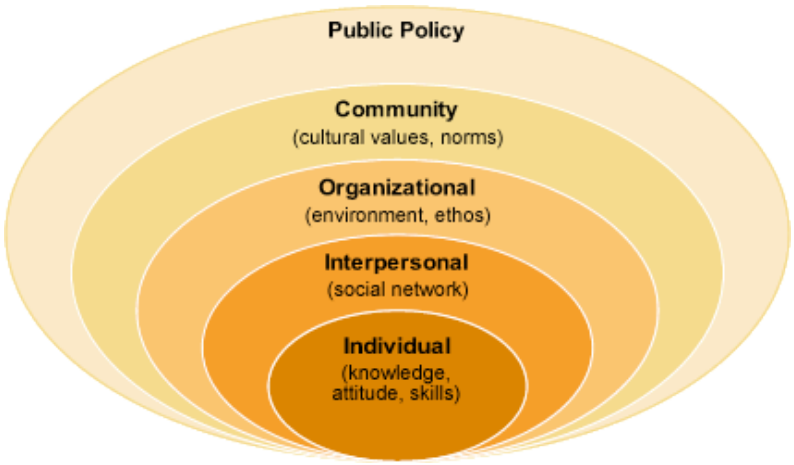

FIGURE 1. The Social Ecological Model

Source: U.S. Department of Health and Human Services, National Institutes of Health, Office of Behavioral and Social Science Research. 2012. Retrieved from http://www.esourceresearch.org/Default.aspx?TabId=736. Adapted from Bronfenbrenner, U. 1977. Toward an experimental ecology of human development. American Psychologist, 32*(7), 513-531.*

In accordance with the SEM, one may conceive of health as the effective product of interactions between numerous health determinants at multiple levels of organization. By attending to individual, interpersonal, organizational, community, and policy factors as nested influences on health, an SEM-based perspective facilitates interpretation of the complicated engagement of such factors in yielding health outcomes. Accordingly, modern researchers often aggregate findings from varied areas of specialized study to accumulate broader understanding of the seemingly disparate factors that can combine to affect health in a given realm of interest. Such an approach is valuable in assessing the complex relationships between "place" and community health that will be of crucial importance to future effects of the Duwamish Superfund Cleanup.

In a previous study addressing the connections between place and health, PolicyLink followed an SEM-based approach to catalog the characteristics of local economic, social, physical, and service environments that have been shown to influence residential health. The researchers concluded that, when a variety of particular aspects of a community are robust, residents' health improves, while residents' health declines when such factors are absent (PolicyLink, 2007). Table 1 highlights the PolicyLink findings, as summarized by graduate students studying Health Impact Assessment at the University of Washington.

Because local community characteristics are so influential on health, it is significant that neighborhoods in the Unites States are often informally but effectively segregated according race, ethnicity, and income. Such *de facto* segregation limits access to healthy foods, safe and walkable streets, and clean environments. In addition, low-income and minority populations endure disproportionately high crime rates, under-funded schools, insufficient services, and poor transportation and housing options. Communities of color also bear disproportionate rates of diabetes, high blood pressure, obesity, and asthma (PolicyLink, 2007). Considering these health effects of neighborhood stratification, and given that the neighborhoods adjacent to the Duwamish Superfund Cleanup site are lower-income and higher-minority neighborhoods than many Seattle neighborhoods, disparity must be a key consideration in assessing the Cleanup's effects on place and health.

TABLE 1. Characteristics of Local Environments that Favorably Influence Health
Source: PolicyLink, 2007. As compiled by 2012 University of Washington HIA Class.

Economic Environment	**Social Environment**
A strong economy is protective for neighborhood health. Aspects of a robust economic environment include: • Commercial investment • Living-wage jobs with health benefits • Safe workplaces • Businesses that provide healthy food option for all residents • Diverse and quality businesses (including banks, restaurants) • Homeownership • Less residents with low-wage jobs, no benefits, and unsafe working conditions • Racial and economic desegregation	Creating and experiencing strong community empowers individuals to advocate for themselves and for others. Positive social environments allow for: • Knowledge, skill, and information sharing • Leadership development to increase the community's capacity for mobilization, civic engagement, and political power • Communities able to make decisions on the physical spaces of their neighborhoods, including investment in parks, schools, etc.
Physical Environment	**Service Environment**
A well-designed and well-built physical environment protects the health of residents. Built features that support health include: • Parks and other green spaces • Full-service grocery stores and farmers' markets • Safe, walkable streets with sidewalks and less motor vehicle traffic • Convenience to transportation, including public transit and safe and active transportation options • Good accessibility to daily services (shops, schools, jobs) • Houses removed from polluting businesses and highways • Healthy, affordable housing • Urban design that supports physical activity	Equitable distribution of and access to community services is protective for health. The following factors support effective services: • Healthcare facilities staffed by culturally competent staff • Police and fire protection • Minimal crime • Active streets and sidewalks • Schools, parks, and recreational facilities available to residents • Water and sewer systems • Facilities for neighborhood meetings • Safe, reliable, and clean mass transit • Culturally competent public health providers • Churches, social clubs, and block groups • Leadership development

Many residents of Georgetown and South Park have voiced the belief that the overall character of the Duwamish Cleanup's health outcomes, the determination of whether the Cleanup will positively or negatively affect their health, could hinge on how resulting reinvestment plays out in their communities. The residential populations may enjoy widespread health benefits if

Cleanup-spurred reinvestment advances revitalization that equitably benefits a full spectrum of residents. But population health could suffer if reinvestment spurs gentrification that profits primarily newer, wealthier residents. The known potential for such harm is well characterized by the National Environmental Justice Advisory Council (NEJAC), in a 2006 report on unintended impacts of some of EPA's cleanup, redevelopment and revitalization efforts:

> "Displacement, gentrification, public health, and land use concerns are all connected, directly or indirectly, to the EPA's mission of protecting public health and the environment… When outcomes from cleanup and revitalization projects are assessed, EPA may have unintentionally exacerbated historical gentrification and displacement" (NEJAC, 2006).

1.2 HOW DOES COMMUNITY REINVESTMENT AFFECT "PLACE"?: REVITALIZATION AND GENTRIFICATION

While residents of economically challenged neighborhoods often passionately respond to their impressions of reinvestment in their communities, it is often a matter of debate whether development truly represents equitable revitalization or disparity-promoting gentrification. In practical terms, revitalization efforts may occur at small or large scales; be driven by public or private interests; and be implemented by individuals, groups, or institutions. Accordingly, with respect to given projects, from cleaning and renewal of local sites, to broadcloth land development, various residents may perceive the resulting neighborhood changes as either improvements or problems. Even when community changes lead to shifts in local populations comprising replacement of some lower-income residents by higher-income residents (change commonly labeled "gentrification"), long-term residents may see benefits if the transitions strengthen the local tax base and propel development of new local services and amenities. But if such dynamics extend further, the overall character of neighborhoods may change and the bulk of original residents may be displaced and unable to enjoy the community improvements.

The degree, rate, and character of community development are, thus, critical to residential

opinions of desirable versus undesirable change. Yet, such residential perceptions are also inherently perspectival, and objective identification of phenomena as equitable revitalization or gentrification can be problematic. As such, in a widely cited 2001 Brookings Institution paper dealing with neighborhood change and addressing gentrification, Maureen Kennedy and Paul Leonard usefully take up the challenge of clarifying definitions. Noting that the "term 'gentrification' is both imprecise and quite politically charged," the authors highlight professional perceptions of distinctions between gentrification and more equitable revitalization, methodically describing the respective phenomena (Kennedy & Leonard, 2001). These distinctions are summarized in Table 2.

Kennedy and Leonard describe revitalization as "the process of enhancing the physical, commercial and social components of neighborhoods and the future prospects of residents through private sector and/or public sector efforts." They further flesh out that "physical components of revitalization may include upgrading of housing stock and streetscapes, commercial components may include the creation of viable businesses and services in the community, and social components include increasing employment and reductions in crime." Such revitalization may be considered equitable, the authors contend, when it advances "the creation and maintenance of economically and socially diverse communities that are stable over the long term, through means that generate a minimum of transition costs that fall unfairly on lower income residents."

The authors also realistically attend to the complexity of community development, noting that, "gentrification sometimes occurs in the midst of the revitalization process." In contrast to more equitable revitalization, Kennedy and Leonard express that gentrification is a "process by which higher income households displace lower income residents of a neighborhood, changing the essential character and flavor of that neighborhood." They further specify that the gentrification process typically involves three critical conditions: "displacement of original residents; physical upgrading of the neighborhood (particularly of housing stock); and change in neighborhood character."

TABLE 2: Typical Effects of Equitable Revitalization and Gentrification

Source: Kennedy & Leonard, 2001.

Result of Reinvestment and Development	Economic Effects	Physical Effects	Social Effects
Equitable Revitalization	• Expansion of local businesses and services • Increased employment • Increased economic security • Gradually increasing property values	• Improvement of local housing stock • Maintenance and improvement of infrastructure • Improvement and activation of public spaces	• Decreased social polarity • Increased social cohesion • Decreased crime • Strengthened fabric of community
Gentrification	• Influx of higher income residents • Increased demand for upscale services and amenities • Greater regional esteem • Rising costs of living • Rapidly increasing property values • Increased tax base	• Upgrade or replacement of local housing stock and neighborhood infrastructure • Development of upscale commercial establishments and amenities • Displacement of previous businesses	• Shifting societal structure • Increased social polarity • Increased class tension • Decreased community cohesion • Displacement of lower income residents • Decreased diversity

2.0 WHAT DO EXISTING CONDITIONS IN GEORGETOWN & SOUTH PARK INDICATE ABOUT FUTURE REINVESTMENT & DEVELOPMENT SCENARIOS?

As described above, community revitalization efforts and related gentrification may lead to changes in the prevailing economic, physical, and social character of communities, and may consequently affect the health of local residents. Thus, the current conditions in Georgetown and South Park that influence future development scenarios, in which reinvestment will lead to either more equitable- or more gentrifying- revitalization, may strongly influence the community health effects of the Duwamish Cleanup.

Analysis Method

In seeking to understand local characteristics that determine the outcomes of reinvestment in neighborhoods, researchers have developed indicators for gauging gentrification in progress in communities and for estimating the likelihood of future gentrification. The next two sections (2.1 and 2.2) utilize data from the U.S. Census Bureau's 2000 and 2010 Census, as well as interim data from the Bureau's American Community Surveys, to assess conditions in Georgetown and South Park (as well as neighboring areas, the City of Seattle, and King County) in relation to these indicators and to convey findings regarding gentrification dynamics in the communities. The following section (2.3) then addresses institutional and grass roots measures that present prospects for more equitable community revitalization, as compiled via literature review with guidance from the Duwamish HIA Residential Community Advisory Committee and Liaison Committee.

2.1 IS GENTRIFICATION IN PROGRESS IN GEORGETOWN AND SOUTH PARK?

Through analysis of neighborhood changes associated with various modes of investment, the Brookings Institution (Kennedy & Leonard, 2001) and the Dukakis Center (Billingham, Bluestone, & Pollack, 2010) have identified multiple measurable neighborhood characteristics that are nationally recognized as indicators of gentrification in progress in

communities. Table 3 assesses existing conditions in Georgetown and South Park with respect to these indicators, and presents findings regarding trends that would demonstrate gentrification in progress. Table 4 at the end of Section 2.1 summarizes the conclusions from this analysis.

Table 3. Indicators of Gentrification in Progress in Georgetown and South Park
Source: U.S. Census Bureau. 2012. American FactFinder. Retrieved from http://factfinder2.census.gov
*Historical dollar figures have been converted to 2010 dollars using the Consumer Price Index (U.S. Bureau of Labor Statistics, 2012)

Indicators of Gentrification	Existing Conditions in Georgetown	Existing Conditions in South Park	Findings
Increased proportion of higher income residents	Records reflect a recent trend of decreasing poverty in Georgetown. As reflected in Census 2000 data (U.S. Census Bureau, 2000) and the Census Bureau's American Community Survey (ACS) 2006-2010 combined estimates (U.S. Census Bureau, 2010a), the proportion of residents with household incomes below the poverty level decreased from about 19.3% to 14% in Georgetown between 2000 and 2010, compared to a drop from 9.8% to 6.4% in Beacon Hill. This contrasts with increases from 11.8% to 12.7% in the City of Seattle, and from 8.4% to 10.2% in King County. Georgetown also has a decreasing proportion of residents with household incomes over $100,000. In	Records reflect a recent trend of increasing poverty in South Park. As reflected in Census 2000 data and ACS 2006-2010 estimates, the proportion of residents with household incomes below the poverty level increased from about 12.5% to 16.1% in South Park between 2000 and 2010, contrasting with a drop from 14.7% to 7.4% in adjacent Highland Park. In the same period, there were increases from 11.8% to 12.7% in the City of Seattle, and from 8.4% to 10.2% in King County. South Park also has an increasing proportion of residents with household incomes over $100,000. In the period between Census 2000 reporting and ACS 2006-2010 estimates, data shows	Distribution of income in Georgetown seems to be trending toward the middle, and slightly downward, with decreasing proportions of impoverished and high-income residents, and a declining median income (when factoring in inflation). In contrast, the distribution of income in South Park seems to be trending toward bipolarity, with increasing proportions of impoverished and high-income residents, and growth in the median income.

Indicators of Gentrification	Existing Conditions in Georgetown	Existing Conditions in South Park	Findings
	the period between Census 2000 reporting and ACS 2006-2010 combined estimates, data shows that the fraction of Georgetown residents with household incomes over $100,000 dropped from 8.1% to 7.1%, while the share of residents with incomes in this range increased from 13.1% to 27.6% in Beacon Hill, from 15.8% to 28.1% in Seattle, and from 18.7% to 31.7% in King County. During the past decade, median household income (*in 2010 dollars) in Georgetown decreased 15.8% from $44,048*, as reported in Census 2000 data, to $37,097, as reflected in ACS 2006-2010 combined estimates. In the same period: the median income in Beacon Hill rose from $63,738* to $68,525 (7.5%); Seattle's median income rose slightly from $59,862* to $60,665 (1.3%); and median income in King County decreased slightly from $69.575* to $68,065 (-2.2%).	that the fraction of South Park residents with household incomes over $100,000 rose from 9.2% to 12.2%, while the share of residents with incomes in this range increased from 13.2% to 21.5% in Highland Park, 15.8% to 28.1% in Seattle, and from 18.7% to 31.7% in King County. During the past decade, median household income (*in 2010 dollars) in South Park increased 6.0% from $40,466*, as reported in Census 2000 data, to $42,907, as reflected in ACS 2006-2010 combined estimates. In the same period: the median income in Highland Park rose from $61,304* to $63,333 (3.3%); Seattle's median income rose slightly from $59,862* to $60,665 (1.3%); and median income in King County decreased slightly from $69.575* to $68,065 (-2.2%).	
Increased educational attainment of residents	Data from the Census Bureau indicates the proportion of Georgetown residents, age 25 or older,	Data from the U.S. Census Bureau indicates the share of South Park residents, age 25 or	Data do not indicate a growth trend in educational

Indicators of Gentrification	Existing Conditions in Georgetown	Existing Conditions in South Park	Findings
	with bachelor's degrees decreased from 20.6% in 2000 to 14.9% (+/- 7.7) in the ACS 2006-2010 combined estimates. The reported proportions in Beacon Hill also lightly decreased from 20.9% to 19.6% for the same period. This contrasts with increases reported in Seattle from 47.2% to 55.1%, and in King County from 40% to 45.2%.	older, with bachelor's degrees increased from 6.1% in 2000 to 13.7% (+/- 5.1) in the ACS 2006-2010 combined estimates. This compares with reported increases in Highland Park from 22.6% to 32.9%, in Seattle from 47.2% to 55.1%, and in King County from 40% to 45.2%.	attainment in Georgetown. However, educational attainment among South Park residents has increased during the past decade.
Decreased racial/ethnic diversity	According to data from the 2000 and 2010 Census (U.S. Census Bureau, 2010b), the proportion of persons of color in Georgetown decreased from 43.5% to 34.6%, compared to a decrease in adjacent Beacon Hill from 81.8% to 79.6%, and contrasting with increases in the City of Seattle from 32.1% to 33.7%, and in King County from 26.6% to 35.2%.	South Park has a substantially higher representation of person of color than the City of Seattle of King County as wholes. According to data from the 2000 to 2010 Census, the proportion of persons of color in South Park increased from 66.2% to 68.1%, compared to increases in adjacent Highland Park from 48.7% to 50.5%, in the City of Seattle from 32.1% to 33.7%, and in King County from 26.6% to 35.2%.	In the past decade there was a decrease in the proportion of persons of color residing in Georgetown. South Park residents include a large and growing proportion of persons of color, in comparison to the surrounding area.
Increased rents and home values	Rents have risen more quickly in Georgetown than in neighboring area or in broader Seattle or King County. Data from the	Rents have risen more quickly in South Park than in neighboring area or in broader Seattle or King County. Data from	Rents and home values have been increasing in Georgetown at faster rates than

Indicators of Gentrification	Existing Conditions in Georgetown	Existing Conditions in South Park	Findings
	2000 Census (*converted to 2010 dollars) and ACS 2006-2010 combined estimates indicate that median rent in Georgetown increased 17.1% during the past decade, from $714* to $836. During the same period, median rents in adjacent Beacon Hill decreased 20.4% from $1,250* to $995, median Seattle rents rose 4.9% from $913* to $958, and median rents in King County grew 4.1% from $960* to $999. Similarly, home values have increased at a faster rate in Georgetown than in neighboring area or the City of Seattle or King County as wholes. Data from the 2000 Census (*converted to 2010 dollars) and ACS 2006-2010 combined estimates indicate that median home values in Georgetown increased around 87.8% during the past decade, from $170,064* to $319,300. During the same period, median home values in neighboring Beacon Hill rose 65.5% from $228,187* to $377,542, median Seattle home values rose	the 2000 Census (*converted to 2010 dollars) and ACS 2006-2010 combined estimates indicate median rent in South Park increased 36.7% during the past decade, from $677* to $926. During the same period, median rents in Highland Park decreased 24.5% from $1,406* to $1,061, median Seattle rents rose 4.9% from $913* to $958, and median rents in King County grew 4.1% from $960* to $999. Home values have also increased in South Park at a faster rate than in the City of Seattle or King County as wholes, similar to home values in neighboring area. Data from the 2000 Census (*converted to 2010 dollars) and ACS 2006-2010 combined estimates indicate that median home values in south Park increased around 70.1% during the past decade, from $151,576* to $257,800. During the same period, median home values in neighboring Highland Park rose 71.6% from $197,416* to $338,700, median Seattle home	those of neighboring Beacon Hill, or broader City of Seattle or King County. Rents have been increasing in South Park at faster rates than those in neighboring Highland Park, the broader City of Seattle, or King County. Home values have also been increasing in South Park at faster rates than in the City of Seattle or King County. This local increase in home values is similar to that in neighboring Highland Park.

Indicators of Gentrification	Existing Conditions in Georgetown	Existing Conditions in South Park	Findings
	42.9%, from $319,234* to $456,200, and median home values in King County grew 42.2% from $286,690* to $407,700.	values rose 42.9%, from $319,234* to $456,200, and median home values in King County grew 42.2% from $286,690* to $407,700.	
Increased proportion of home ownership	Data from Census 2000 and Census 2010 indicate the proportion of occupied housing in Georgetown that was occupied by homeowners modestly increased from 36.2% to 37.5% during the past decade, while remaining lower than in other neighboring area and the broader City and County. In contrast, the same period saw modest declines in homeowner occupancy from 76.3% to 71.7% in adjacent Beacon hill, from 48.4% to 48.1% in the City of Seattle, and from 59.8% to 59.1% in King County.	Data from Census 2000 and Census 2010 indicate the proportion of occupied housing in South Park that was occupied by homeowners increased from 44.9% to 46.7% during the past decade, while remaining lower than in some neighboring area. The same period saw a minimal increase in homeowner occupancy from 64.5% to 64.6% in adjacent Highland Park, and modest declines from 48.4% to 48.1% in the City of Seattle, and from 59.8% to 59.1% in King County.	Both Georgetown and South Park experienced increases in the proportion of homeownership from 2000 to 2010, while other neighboring area and the surrounding City and County saw decreases in levels of owner-occupied housing. Georgetown recently had a lower proportion of owner-occupied housing than Beacon Hill, the City of Seattle, or the County, while South Park recently had a level of owner-occupied housing similar to the City, somewhat less than the County, and less than nearby Highland Park.

Conclusions Regarding Gentrification in Progress in Georgetown & South Park

As described in Table 3, above, when considering a range of factors recognized to indicate gentrification in progress:

- **In Georgetown**, local trends in racial composition, rents and home values, and home ownership suggest that gentrification is beginning; and
- **In South Park**, local trends in income, educational attainment, rents and homes values, and home ownership suggest that gentrification is well underway and ongoing.

These conclusions are summarized in Table 4.

TABLE 4. SUMMARY: Indicators of Gentrification in Progress in Georgetown & South Park

Indicator of Gentrification	Data Analysis	Data Quality	Occurring in Georgetown?	Magnitude in Georgetown	Occurring in South Park?	Magnitude in South Park
Increased proportion of higher income residents	Analysis of income data (2000 Census & ACS 2006-2010)	Acceptable	No	(Income decreasing)	**Yes**	**Moderate**
Increased residential educational attainment	Analysis of education data (2000 Census & ACS 2006-2010)	High margin of error in ACS 2006-2010	No	(Educational attainment potentially decreasing)	**Yes**	**Substantial**
Decreased racial/ethnic diversity	Analysis of diversity data (2000 & 2010 Census)	Acceptable	**Yes**	**Substantial**	No	(Diversity increasing)
Increased rents and home values	Analysis of rent and housing data (2000 Census & ACS 2006-2010)	Acceptable	**Yes**	**Moderate**	**Yes**	**Substantial**
Increased proportion of home ownership	Analysis of home ownership data (2000 & 2010 Census)	Acceptable	**Yes**	**Moderate**	**Yes**	**Moderate**
Overall interpretation of above indicators	Combined analysis of above factors	Acceptable	**Indicators suggest gentrification is beginning in Georgetown.**		**Indicators suggest gentrification is well underway in South Park.**	

2.2 IS FUTURE GENTRIFICATION LIKELY IN GEORGETOWN AND SOUTH PARK?

To comprehend potential effects of future reinvestment and development scenarios in communities, it is necessary to understand not only gentrification in progress in the neighborhoods, but also the likelihood of future gentrification. Toward these ends, the Brookings Institution has described multiple local characteristics that can promote gentrification, including rapid job growth, tight housing markets, preference for city amenities, increased traffic and lengthening commutes, and public sector policies (Kennedy & Leonard, 2001). In a recent study, the Center for Community Innovation at the University of California further specifies indicators that can be assessed to identify neighborhoods likely to experience future gentrification (Chapple, 2009). Table 5 provides analysis and findings regarding some of these recognized indicators of likely future gentrification, as they exist in Georgetown and South Park. Table 6 at the end of Section 2.2 summarizes the conclusions from this analysis.

TABLE 5. Indicators of Likely Future Gentrification in Georgetown and South Park
Source: U.S. Census Bureau. 2012. American FactFinder. Retrieved from http://factfinder2.census.gov

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
Increasing commute time	Records reflect a recent trend of increasing commute times in Georgetown. As reflected in Census 2000 data and ACS 2006-2010 combined estimates, median commute times for Georgetown commuters increased from between 15 and 19 minutes in 2000 to between 30 and 34 minutes in 2010. In the same period, median commute times remained between 20 and 24 minutes in adjacent Beacon Hill, the City of	Records reflect a recent trend of increasing commute times in South Park. As reflected in Census 2000 data and ACS 2006-2010 combined estimates, median commute times for South Park commuters increased from between 20 and 24 minutes in 2000 to between 25 and 29 minutes in 2010. In the same period, median commute times dropped from between 25 and 29 minutes to between 20 and 24 minutes in	In contrast to surrounding areas, median commute times have been increasing in South Park and increasingly substantially in Georgetown.

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
	Seattle and broader King County.	adjacent Highland Park, and remained between 20 and 24 minutes in the City of Seattle and broader King County.	
High percentage of workers taking public transit	Records reflect faster-growing rates of transit use in Georgetown than in adjacent area or the broader surroundings. Data from the Census Bureau indicates the proportion of Georgetown commuters, age 16 or older, that utilized public transit (excluding taxi cabs) to get to work almost doubled in the past decade, from 13.2% in 2000, to 26.0% as estimated for 2006-2010 combined. The same Census 2000 data and ACS 2006-2010 combined estimates show transit use among commuters in adjacent Beacon Hill dropped from 20.3% to 15.2%, the proportion of transit users in Seattle increased from 18.3% to 19.9%, and the rate of transit use in King County increased from 9.9% to 11.7%. In Beacon Hill, new light-rail in Rainier Valley will likely increase transit use.	Records reflect faster-growing rates of transit use in South Park than in adjacent area or the broader surroundings. Data from the Census Bureau indicates the proportion of South Park commuters, age 16 or older, that utilized public transit (excluding taxi cabs) to get to work increased more than 50% in the past decade, from 16.2% of commuters in 2000, to 27.9% as estimated for 2006-2010 combined. The same Census 2000 data and ACS 2006-2010 combined estimates show transit use among commuters in adjacent Highland Park increased from 14.8% to 15.4%, the proportion of transit users in Seattle increased from 18.3% to 19.9%, and the rate of transit use in King County increased from 9.9% to 11.7%.	The proportions of Georgetown and South Park commuters that use transit to travel to work are higher, and increasing faster, than in adjacent area, or in the broader City or County.

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
High percentage of non-family households	Census 2000 and 2010 data show the proportion of non-family households in Georgetown is higher than in adjacent area and the broader surroundings, having increased from 65.1% of all households in 2000 to 69.1% of all households in 2010. During the same period, the proportion of non-family households increased from 26.6% to 30.4% in adjacent Beacon Hill, from 56.1% to 57.1% in the City of Seattle, and from 40.9% to 41.5% in King County.	Census 2000 and 2010 data show the proportion of non-family households in South Park increased from 39.3% of all households in 2000 to 41.5% of all households in 2010. During the same period, the proportion of non-family households comparably increased from 37.1% to 40.6% in adjacent Highland Park, from 56.1% to 57.1% in the City of Seattle, and from 40.9% to 41.5% in King County.	Georgetown has a higher proportion of non-family households than adjacent area and the broader City of Seattle and King County. The rate of such households is increasing at moderate rates in Georgetown and the surrounding areas. South Park has a proportion of non-family households comparable to adjacent Highland Park and King County, and less than that in the City of Seattle. The rate of such households is increasing at moderate rates in South Park and the surrounding areas.

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
High proportion of buildings with three or more units	At the neighborhood level, Georgetown has a moderate proportion of buildings with 3 or more units. According to Census 2000 data and ACS 2006–2010 combined estimates, structures with 3 or more units made up 36.4% of Georgetown's housing in 2000, dropping to 23.6% in 2010. In contrast, buildings with three or more units composed only 2.8% of Beacon Hill's housing in 2000 and 6.1% in 2010. In the City of Seattle, 44.6% of housing was in structures with 3 or more units in 2000, increasing to 46.7% in 2010; in King County, the proportion of housing in buildings with 3 or more unites increased from 34.9% in 2000 to 36.1% in 2010.	At the neighborhood level, South Park has a moderate proportion of buildings with 3 or more units. According to Census 2000 data and ACS 2006–2010 combined estimates, structures with 3 or more units made up 23.8% of Georgetown's housing in 2000, increasing to 25.6% in 2010. In comparison, buildings with three or more units composed 16.1% of Beacon Hill's housing in 2000 and 23.5% in 2010. In the City of Seattle, 44.6% of housing was in structures with 3 or more units in 2000, increasing to 46.7% in 2010; in King County, the proportion of housing in buildings with 3 or more unites increased from 34.9% in 2000 to 36.1% in 2010.	Georgetown has a moderate proportion of higher-density residences, distinctly higher than adjacent area, and comparable to the broader City and County. South Park has a moderate proportion of such residences, comparable to adjacent area and lower than the broader City and County.
Lower median gross rent and home values compared to region	As presented in Table 3 above, median gross rents increased faster during the past decade in Georgetown than in some adjacent area or the broader City of Seattle or King County. However, Georgetown's estimated median rent of $836 in 2010 was still lower than the estimated median	Median gross rents also increased faster over the past decade in South Park than in some adjacent area or the broader City of Seattle or King County. However, South Park's estimated median rent of $926 in 2010 was still lower than the estimated median rents of $1,061 in	Although rents and home values increased comparatively quickly in Georgetown and South Park over the past decade, estimated median gross rents and median home values in the two

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
	rents of $995 in adjacent Beacon Hill, $958 in Seattle, and $999 in King County. Similarly, home values increased faster during the past decade in Georgetown than in neighboring area or the City of Seattle or King County as wholes. Yet, Georgetown's estimated median home value of $319,300 in 2010 was lower than the estimated median home values of $377,542 in Beacon Hill, $456,200 in Seattle, or $407,700 in King County.	adjacent Highland Park, $958 in Seattle, and $999 in King County. Home values similarly increased more quickly over the past decade in South Park than in the City of Seattle or King County as wholes (in keeping with home value changes in neighboring area). Yet, South Park's estimated median home value of $257,800 in 2010 was lower than the estimated median home values of $338,700 in Highland Park, $456,200 in Seattle, or $407,700 in King County.	neighborhoods are still lower than those in neighboring area, the city, or the county.
High proportion of renters compared to homeowners	As the inverse of data above regarding homeownership, data from Census 2000 and Census 2010 indicate the proportion of occupied housing in Georgetown that was occupied by renters modestly decreased from 63.8% to 62.5% during the past decade while remaining higher than in other nearby area and the broader City and County. In contrast, the same period saw modest increases in renter occupancy from 23.7% to	Data from Census 2000 and Census 2010 indicate the proportion of occupied housing in South Park that was renter occupied was higher than in some nearby areas, while also decreasing from 55.1% to 53.3% during the past decade. The same period saw a minimal decrease in renter occupancy from 35.5% to 35.4% in adjacent Highland Park, and modest increases from 51.6% to 51.9% in the City of Seattle, and from 40.8% to 40.9% in	Despite growth in homeownership in Georgetown and South Park, as reflected in Table 3, there is still a relatively high proportion of renter occupancy in these two neighborhoods. The levels of renter occupancy in the communities contrast with lower levels in adjacent areas, are comparable to

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
	28.3% in adjacent Beacon hill, from 51.6% to 51.9% in the City of Seattle, and from 40.8% to 40.9% in King County.	King County.	levels for the City, and are higher than levels in King County.
High proportion of households spending a large share of household income on housing	**Renters**: Census 2000 and ACS 2006-2010 combined estimates report the percentage of renter households in Georgetown that spent at least 30% of their household income on rent increased from 38.8% in 2000 to 47.5% in 2010, while those spending at least 50% of income on rent dropped from 28.2% to 15.7%. In adjacent Beacon Hill, the proportion of renter households that spent at least 30% of income on rent increased from 41.1% in 2000 to 50.8% in 2010, and those spending at least 50% of income on rent increased from 21.5% to 24.2%. In the City of Seattle, the percentage of renter households that spent at least 30% of income on rent increased from 41.1% in 2000 to 46.4% in 2010, while those spending at least 50% of income on rent increased from 18.0%	**Renters**: Census 2000 and ACS 2006-2010 combined estimates report the percentage of renter households in South Park that spent at least 30% of their household income on rent increased from 44.1% in 2000 to 54.8% in 2010, while those spending at least 50% of income on rent rose from 13.0% to 25.2%. In adjacent Highland Park, the proportion of renter households that spent at least 30% of income on rent increased from 40.2% in 2000 to 64.5% in 2010, and those spending at least 50% of income on rent increased from 19.5% to 30.2%. In the City of Seattle, the percentage of renter households that spent at least 30% of income on rent increased from 41.1% in 2000 to 46.4% in 2010, while those spending at least 50% of income on rent increased	The proportion of households spending a large share of income on home rental costs increased between 2000 and 2010 in both the City of Seattle and King County. In the Georgetown and South Park neighborhoods, changes were in keeping with those seen in the broader area. With regard to homeowners, the proportion of households spending a large fraction of their income on ownership costs also rose from 2000 to 2010 across broader City of Seattle and King County. However, the increase was much more

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
	to 22.4%. In King County, the share of renter households that spent at least 30% of income on rent increased from 40.0% in 2000 to 46.6% in 2010, while those spending at least 50% of income on rent increased from 17.5% to 22.5%. **Homeowners**: Census 2000 and ACS 2006-2010 combined estimates show the percentage of Georgetown homeowners with mortgages that spent at least 30% of their household income on home ownership costs increased from 23.2% in 2000 to 59.4% in 2010, while those spending at least 50% of income on ownership costs rose from 13.1% to 35.0%. In adjacent Beacon Hill, the proportion of mortgage-holding households that spent at least 30% of income on ownership costs dropped from 48.5% in 2000 to 36.0% in 2010, while those spending at least 50% of income on ownership costs increased from 16.8% to 19.4%.	from 18.0% to 22.4%. In King County, the share of renter households that spent at least 30% of income on rent increased from 40.0% in 2000 to 46.6% in 2010, while those spending at least 50% of income on rent increased from 17.5% to 22.5%. **Homeowners**: Census 2000 and ACS 2006-2010 combined estimates show the percentage of South Park homeowners with mortgages that spent at least 30% of their household income on home ownership costs increased from 28.0% in 2000 to 56.4% in 2010, while those spending at least 50% of income on ownership costs rose from 13.0% to 46.8%. In adjacent Highland Park, the proportion of mortgage-holding households that spent at least 30% of income on ownership costs rose from 37.4% in 2000 to 53.7% in 2010, while those spending at least 50% of income on ownership costs increased from 9.9% to	dramatic in Georgetown and South Park than in the broader areas. The proportion of households paying at least 30% of income on ownership costs, and those paying at least 50% of income on ownership costs, more than doubled during the decade in each neighborhood.

Indicators of Likely Future Gentrification	Conditions in Georgetown	Conditions in South Park	Findings
	In the City of Seattle, the percentage of mortgage-holding households that spent at least 30% of income on costs of ownership increased from 33.6% in 2000 to 41.0% in 2010, while those spending at least 50% of income on ownership costs increased from 11.4% to 15.0%. In King County, the proportion of mortgage-holding households that spent at least 30% of income on ownership costs increased from 32.1% in 2000 to 41.4% in 2010, while those spending at least 50% of income on ownership increased from 9.9% to 14.7%.	18.0%. In the City of Seattle, the percentage of mortgage-holding households that spent at least 30% of income on costs of ownership increased from 33.6% in 2000 to 41.0% in 2010, while those spending at least 50% of income on ownership costs increased from 11.4% to 15.0%. In King County, the proportion of mortgage-holding households that spent at least 30% of income on ownership costs increased from 32.1% in 2000 to 41.4% in 2010, while those spending at least 50% of income on ownership increased from 9.9% to 14.7%.	

Conclusions Regarding Future Gentrification in Georgetown and South Park

As outlined in Table 5, above, when considering a variety of recognized indicators of likely future gentrification:

- **In Georgetown**, community trends in commute times, share of commuters using transit, prevalence of non-family households, median gross rents and home values, proportion of renters to homeowners, and share of household income spent on home ownership costs indicate future gentrification is likely. Since indicators (discussed in Section 2.1) suggest gentrification is currently beginning in Georgetown, future acceleration of neighborhood gentrification would be expected.
- **In South Park**, community trends in commute times, share of commuters using transit, median gross rents and home values, proportion of renters to homeowners, and share of household income spent on home ownership costs indicate that future gentrification is moderately likely. Since indicators (discussed in Section 2.1) suggest gentrification is already well underway in South Park, ongoing neighborhood gentrification would be expected.

These conclusions are summarized in Table 6. While the conditions assessed in this section are recognized indicators of likely future gentrification, it should be noted that there are also many other economic, environmental, and social factors that will affect local investment and development. Importantly, several known environmental conditions may bear upon development dynamics in Georgetown and South Park. As described elsewhere in this HIA, air, soil, and water pollution are considered problematic in both neighborhoods. These issues are the focus of current health research and may realistically modify future residential behavior and development patterns. In addition, noise due to proximity to freight and air transport is of concern in Georgetown (and to some degree in South Park) and may affect investment and development prospects. Finally, current access to and from South Park has been complicated by the closure of the South Park Bridge. When a new bridge, now under construction, opens to traffic (predicted in fall 2013) the access changes may transform development in South Park.

TABLE 6. SUMMARY: Indicators of Likely Future Gentrification in Georgetown & South Park

Indicator of Likely Future Gentrification	Data Analysis	Data Quality	Occurring in Georgetown?	Magnitude in Georgetown	Occurring in South Park?	Magnitude in South Park
Increasing commute time	Analysis of commute data (2000 Census & ACS 2006-2010)	High margin of error in ACS 2006-2010	**Yes**	**Moderate**	**Yes**	**Moderate**
High percentage of workers taking public transit	Analysis of transport data (2000 Census & ACS 2006-2010)	High margin of error in ACS 2006-2010	**Yes**	**Substantial**	**Yes**	**Substantial**
High percentage of non-family households	Analysis of household data (2000 & 2010 Census)	Acceptable	**Yes**	**Substantial**	No	N/A
High proportion of buildings with three or more units	Analysis of housing data (2000 Census and ACS 2006-2010)	High margin of error in ACS 2006-2010	No	N/A	No	N/A
Lower median gross rent and home values compared to region	Analysis of rent and housing data (2000 Census & ACS 2006-2010)	Acceptable	**Yes**	**Substantial**	**Yes**	**Moderate**

Indicator of Likely Future Gentrification	Data Analysis	Data Quality	Occurring in Georgetown?	Magnitude in Georgetown	Occurring in South Park?	Magnitude in South Park
High proportion of renters compared to homeowners	Analysis of home ownership data (2000 Census & 2010 Census)	Acceptable	**Yes**	**Substantial**	**Yes**	**Moderate**
High proportion of households spending a large share of income on housing	Analysis of rent and ownership cost data (2000 Census and ACS 2006-2010)	High margin of error in ACS 2006-2010	**Yes**	**Substantial**	**Yes**	**Substantial**
Overall interpretation of above indicators	Combined evaluation of above factors	Acceptable	**Indicators suggest accelerating gentrification is likely in Georgetown.**		**Indicators suggest ongoing gentrification is likely in South Park.**	

2.3 ARE THERE PROSPECTS FOR MORE EQUITABLE COMMUNITY REVITALIZATION IN GEORGETOWN AND SOUTH PARK?

The above discussion describes indicators, in Georgetown and South Park, of gentrification in progress and likely future gentrification that could displace existing residents or dramatically change the communities to the detriment of existing residents. Alongside these conditions, there is also evidence that institutional and grass roots responses could potentially provide for more equitable revitalization of the neighborhoods. Several potential options for such response are described in the following pages and summarized at the end of Section 2.3, in Table 8.

Institutionally Driven Revitalization: Partnering to Strengthen Communities

Indeed, well-coordinated institutional revitalization measures, implemented by governmental and non-governmental organizations (NGOs), can effectively transform local development dynamics. The EPA's recently forged Urban Waters program provides one example of the potency of such cooperative intervention. The EPA developed their Urban Waters strategy to protect and restore water resources and to reconnect underserved and economically distressed communities to urban water environments (EPA, 2012). Under the program, the EPA and diverse governmental and non-governmental partners coordinate to protect public health and the environment, promote environmental justice in community growth, expand economic opportunities, enhance neighborhoods, and support healthy sustainable development.

The Urban Waters program demonstrates how the EPA's technical environmental management expertise can be leveraged, in partnership, to yield broad and equitable community revitalization with benefits extending well beyond remediation of contamination. Many Urban Waters projects have results that are potentially germane to the situation around the Lower Duwamish. Table 7 outlines program elements in two watersheds that share challenges with the Duwamish Valley.

TABLE 7. EPA Urban Waters Community Programs

Source: EPA. 2012. Retrieved from http://www.epa.gov/urbanwaters/communities.html

Watershed Location	Partial list of EPA's Partners	Program Background and Achievements
Anacostia River Washington, D.C. and Maryland	Anacostia Watershed Restoration Partnership: • Executives from local jurisdictions • Maryland Department of Environment • Metropolitan Washington Council of Governments • Washington, D.C. Department of Environment • Washington, D.C. Water and Sewer Authority • Washington Sanitary Sewer Commission	The Anacostia receives high volumes of polluted runoff from tributaries and Combined Sewer Overflow discharge, resulting in flooding, erosion, infrastructure damage, health concerns, and heavy trash and sediment deposition. The Partnership recently released a comprehensive Watershed Restoration Plan, facilitating community revitalization via coordination of specific projects that provide environmental, economic, and social benefits and enhance the vitality of local jurisdictions. The EPA is monitoring and enforcing Combined Sewer Overflow reduction commitments under a Long Term Control Plan.
South Platte River in Denver, Colorado	• City and County parks, planning, public works, and finance departments • Colorado Water Conservation Board • Denver Urban Gardens • Denver Water • Great Outdoors Colorado • The Greenway Foundation • Trust for Public Land • Trout Unlimited • U.S. Army Corps of Engineers • Urban Drainage and Control District	Urban families, paddlers, fishers, walkers, runners, and cyclists enjoy the river and connected parks. The river corridor is also highly industrialized, containing multiple railroad lines and Interstate 25. The river has been polluted by source and non-point source pollution. Significant community input has gone into River North and River South Greenway Master Plans and a River Vision Implementation Plan. Superfund and Brownfields cleanups are ongoing. An EPA Brownfields Area Wide Planning grant will help the City of Denver and the Greenway Foundation coordinate further cleanups toward achieving a swimmably clean river.

A multitude of organizational efforts are coordinated to transform local situations through EPA's Urban Waters program. Similarly, whether in formal centralized partnership, or simply in intensive ongoing collaboration regarding organizational efforts, a wide array of programs should be incorporated to address the complexities of future reinvestment and development in Georgetown and South Park. Nearby in the Pacific Northwest, the history of Ruston, Washington provides an example of the power of such cooperative engagement.

Ruston, WA: An Example of Powerful Partnership

The town of Ruston was first established in 1890 as "Smelter," a company town for the Tacoma Smelting and Refining Company. The site was then known for decades as the location of the ASARCO copper smelting plant on the shoreline of Commencement Bay. After the smelter closed in 1985, due to a weak copper market and pollution restrictions, a Superfund cleanup of the area was undertaken in the early 1990s. Today, the once toxic area is known as Point Ruston, a site of massive community reinvestment and coordinated land development comprising residences; retail, dining, entertainment, and lodging establishments; and open space (Point Ruston LLC, 2012).

FIGURE 2. Point Ruston Plan

Source: Point Ruston, LLC, 2012

Based on the experience in Ruston, there is clearly local precedent for effective coordinated intervention to foster energetic community development in the wake of extensive environmental harm. Yet, even in recognition of this substantial achievement, aspects of the new development in Ruston do provide room for critique. Marketing for Point Ruston targets higher-income residents and the development seems disconnected from the previous character of the small town. Indeed, the 2000 Census (Census Bureau, 2000) and 2006-2010 ACS (Census Bureau, 2010a) reflect that Ruston's median household income increased about 23% during the past decade, while decreasing by around 3.5% in the surrounding City of Tacoma. In the midst of great efforts of numerous parties working to brighten the future of Ruston, an influx of higher income residents may be harming or displacing previous residents of the town.

The dynamics that have developed in Ruston accentuate that pursuing transformational progress in Georgetown and South Park, while successfully providing equitable benefits to all residents, will likely require extraordinary effort and concern. A very broad palette of institutional and organizational responses must be simultaneously integrated to promote neighborhood revitalization while forestalling adverse effects of gentrification. In a recent publication on Creating Equitable, Healthy, and Sustainable Communities, the EPA supports such a coordinated approach.

Reporting that, "too often, revitalization efforts in low-income or overburdened neighborhoods end up displacing long-time residents," the EPA suggests that local municipalities and organizations may avoid or mitigate such unintended impacts via "strategies that draw needed resources and amenities into established neighborhoods while helping existing residents and the commercial, service, and cultural establishments they value remain there." Specifying that "a proactive and comprehensive approach to minimizing displacement encompasses affordable housing, commercial stabilization, economic and workforce development, supportive land use policies, and community engagement" the EPA further notes that "To increase the likelihood of success, local governments and community-based organizations should initiate efforts to

mitigate displacement as soon as revitalization planning begins rather than waiting until projects are underway" (EPA, 2013b).

While the notion may seem dauntingly complex, there is precedent for successful implementation of such proactive and comprehensive response to environmental and economic challenges. For example, the California Environmental Justice Alliance (CEJA) has recently formalized an initiative called "Green Zones" that utilizes just such a thoroughgoing approach to transform communities facing environmental hazards and lacking economic opportunities into healthy neighborhoods. There are now several communities following Green Zones' principles in implementing comprehensive revitalization measures to achieve community-based visions of sustainable economy, environment, and equity (CEJA, 2012).

Closer to the Duwamish Valley, recent developments in the Cully neighborhood of Portland, Oregon provide another example of agencies and organizations partnering to effectively achieve community revitalization via an explicitly anti-displacement model. In Cully, the EPA (via an Urban Waters Small Grant) has aligned with the State of Oregon, the City of Portland, and "Let Us Build Cully Park," a coalition of community-based organizations, to facilitate improvement of neighborhood environmental assets by employing local residents in community projects. Via this partnership, Cully residents recently designed, built, and opened Cully Park and Community Garden, reclaiming area atop buried landfill as community green space that now supports active, healthy living (Let Us Build Cully Park, 2013).

Drawing on successes like these, it seems feasible that the Duwamish Cleanup, if appropriately planned, may catalyze such coalescence of agency and organizational revitalization measures (potentially including a variety of existing local programs described in the following section) to achieve beneficial community transformation in Georgetown and South Park.

Local Program Options for Facilitating Revitalization in Georgetown and South Park

Coordinating the effective use of revitalization measures among the diverse communities along the Duwamish, during and after the complex Duwamish Cleanup, would be a considerable undertaking. Yet, such synchronized implementation would be in line with the missions of programs that already exist in the area, and would support established plans to address revitalization in these needy Seattle communities. For example, the South Park Action Agenda notes that participation of multiple parties including the "city, county, state, and federal government, and most importantly, the community itself" will be necessary to address critical community issues such as public health and the environment, and community and economic development (South Park Community, 2006).

Toward such ends, the following partial listing of potentially relevant programs in the Seattle area offers a vision of some measures that could be marshaled to strengthen the fabric of community while economically invigorating Georgetown and South Park.

Assisting Tenants

While rent control is illegal in Washington State (Revised Code of Washington 35.21.830), the Seattle Housing Authority provides assistance to help tenants afford housing by:

- Providing tenant-based rental assistance via the Housing Choice Voucher Program (under Section 8 of the Housing Act 1937);
- Managing and operating low income public housing units in apartments are multi-family structures;
- Owning and managing Seattle Senior Housing units; and
- Managing affordable housing in Seattle's Hope VI mixed-income residential communities at High Point, NewHolly, and Rainier Vista.

  (Seattle Housing Authority, 2012)

Developing Affordable Housing

The City of Seattle's Office of Housing encourages development of new affordable housing opportunities via land use code incentives and programs such as the Multifamily Property Tax Exemption (MFTE) Program and the Rental Housing Production and Preservation Program.

Land use code incentives encourage residential and non-residential developers in Seattle to build or financially support affordable housing. Developers may be permitted bonus residential floor area above base height limits in exchange for building or funding affordable housing, and certified Transferable Development Potential can be sold to developers needing residential floor area beyond base height or floor area ratio limits. Developers may also be permitted bonus non-residential floor area above floor area ratio limits for building or funding affordable housing, and certified Transferable Development Rights may be sold to developers needing non-residential floor area beyond base height or floor area ratio limits. (Seattle Office of Housing, 2012a)

The City's MFTE program aims to revitalize communities and encourage mixed income residence by stimulating the construction of new multifamily structures, or the rehabilitation of existing structures, in order to increase the supply of housing for moderate-wage workers. The MFTE provides a 12-year property tax exemption for residential improvements of multifamily projects, located in targeted residential areas, in exchange for 20% of units being set aside for moderate-wage workers (Seattle Office of Housing, 2012b).

Finally, Seattle's Rental Housing Production and Preservation Program supports development of affordable rental housing using funds from the 2009 Housing Levy's Rental Preservation and Production Program, federal funds, and other funding sources. In the seven years from 2003 through 2009, the program completed production of 1,882 units of affordable rental housing in Seattle (Seattle Office of Housing, 2010).

Fostering Home Ownership

The following downpayment assistance programs utilize a variety of funding, including levy-based funds from the Seattle Office of Housing (Seattle Office of Housing, 2012c), to enable lower-income households to buy their own homes (Seattle Office of Housing, 2012d):

- *Habitat for Humanity* – a nonprofit that builds homes for needy families that invest their own labor to build their home in par a no-interest mortgage (http://www.seattle-habitat.org/);
- *Homesight* - a nonprofit Community Development Corporation that promotes affordable homeownership through homebuyer education and financial planning and utilizes private and public partnerships to provide purchase assistance via low interest loans for qualifying first time homebuyers (www.homesightwa.org).
- *Homestead Community Land Trust* - a membership-based nonprofit community housing development organization that facilitates affordable homeownership. Homestead removes the cost of land from the cost of buying a home by acquiring and managing the land, providing a long-term lease for the homeowner's use of the land, and permanently protecting the affordability of the home for future generations (www.homesteadclt.org).
- *HomeTown Home Loans from HomeStreet Bank* - a partnership between the City of Seattle and HomeStreet Bank, the HomeTown Home Loan program offers employees of participating employers, including the City of Seattle, University of Washington, Fred Hutchinson, Seattle Cancer Care Alliance, and other organization, access to free homeownership education, savings on purchases & refinances, and downpayment assistance (https://www.homestreet.com/programs/index.aspx).
- *House Key Plus Seattle* - a downpayment assistance program for first-time homebuyers in Seattle, offers low-interest second loans combined with House Key State Bond below-market interest rate first mortgages for first-time homebuyers (http://www.wshfc.org/buyers/keyplusSeattle.htm).

- *Parkview Services Homebuyer Program* - a King County based non-profit organization that offers home buying assistance to individuals with developmental disabilities and family members who live with them (parkviewservices.org).
- *Seattle Teacher Homebuyer Program* - a City of Seattle program, in partnership with Evergreen Home Loans, that provides additional financing, waived lender fees, and discounted closing costs for eligible teachers' first home purchases (http://www.seattle.gov/housing/buying/teachers.htm).

Nurturing Home Ownership via Tax Relief

To promote continued homeownership by decreasing ownership cost burden, King County facilitates property tax deferral or exemption for senior citizens and disabled taxpayers, tax deferral for limited income households, and tax relief for households with increased tax liability due to home improvements (King County Assessor, 2012).

Preventing Foreclosure

In the event that Georgetown or South Park residents are struggling with the costs of home ownership, the Seattle Foreclosure Prevention Program may help them avoid default and work out viable repayment plans or acceptable terms for home sales. The program, administered by the nonprofits Urban League of Metropolitan Seattle and Solid Ground, provides financial and mortgage counseling, assistance in negotiating with lenders, and stabilization loans of up to $5000 for homeowners with household income less than 80% of the area median income. Since the program began in 2008, it has helped more than 30 homeowners avoid foreclose and stay in their homes (Seattle Office of Housing, 2012e).

Promoting Economic Vitality

Local economic conditions in Georgetown and South Park are a key factor in the viability of the residential communities. In general, development of sound local business environments, including strong commercial and service cores, may provide living-wage jobs for neighborhood residents and allow residents, businesses, and organizations to support their communities through local purchasing (PolicyLink, 2012). Accordingly, Seattle's Office of Economic Development (OED) has secured federal grant funding to sustain ongoing work in Georgetown and South Park, along with affiliated non-governmental organizations such as the Environmental Coalition of South Seattle (ECOSS), in pursuit of measures to preserve and enhance local businesses and support local incomes (ECOSS, 2012).

Additional business development opportunities are offered through the Only in Seattle Initiative, a partnership between OED and financers that strengthens business districts with technical assistance, marketing, and facilitation of Business Improvement Area (BIA) formation (Seattle OED, 2012a). To further develop local business opportunities in South Park and Georgetown, the business districts may consider forming BIAs in contract with the City of Seattle. In essence, business and property owners within BIAs pool their money to fund business district revitalization and management. Each BIA has a Ratepayers Advisory Board, which prepares an annual work program submitted to the City. The City then invoices the ratepayers, collects assessed funds and holds them in a dedicated account, and reimburses the BIA expenses according to the work program (Seattle OED, 2012b).

With regard to local work during the coming years of change in the Duwamish Valley, the EPA's Superfund Job Training Initiative (Super JTI) provides one promising avenue for supporting higher-wage local employment, as workers will be needed for new jobs implementing the Duwamish Cleanup (EPA, 2012). Seattle's OED also continues to support South Seattle Community College's (SSCC) Apprenticeship and Education Center and Puget Sound Industrial Excellence Center, as SSCC builds partnerships and identifies opportunities to train workers for

living wage jobs in communities including South Park and Georgetown (SSCC, 2012a and 2012b). Finally, development of forward-thinking larger enterprise in the industrial areas of the Duwamish Valley, such as sustainable industry encouraged by Green Enterprise Zones (City of Wilmington, 2009), could eventually yield a diverse range of new jobs boosting local employment.

Providing Food Security

As future reinvestment drives changes in Georgetown and South Park, the costs of living in these neighborhoods are likely to increase. To ensure households can continue to meet their basic needs under such conditions, Seattle's Department of Neighborhoods and partner organizations have taken on many projects to address urban food security.

In South Park, Seattle's P-Patch and Cultivating Communities programs, Solid Ground's Lettuce Link, Seattle Youth Garden Works, and the South Park Neighborhood Association have formed the South Park Marra Farm Coalition that manages Marra Farm in Marra-Desimone Park. Many local residents come to the farm to learn, hands-on, about sustainable growth of organic produce and other food issues. The farm cultivates the "innate values of community: gardening, friendships, community building, self-reliance, neighborhood open-space, environmental awareness, hunger relief, improved nutrition, recreation, gardening education, and therapeutic opportunities" (Seattle Department Neighborhoods P-Patch Community Gardens, 2012). During the growing season, fresh produce is harvested from Marra Farm on Fridays and distributed at food banks including the Providence Regina House in South Park. Saturdays are then full of weeding, planting, composting and other jobs that keep the farm working (Solid Ground, 2012).

As another example of innovative response to food needs in Seattle, a community-based group of advocates and planners has received funding from the Department of Neighborhoods to design and develop the nation's largest public food forest in the Beacon Hill neighborhood. Following permaculture principles, hundreds of species of edible trees, bushes, and flowers will

be planted on public land along the western slope of Seattle's Jefferson Park. The organic foods sustainably produced by the forest will be free for public harvest (Seattle P-Patch Community Gardens, 2012).

Supporting Vibrant Human Habitat

With reinvestment in Georgetown and South Park, an influx of residents could emphasize opportunities to enhance neighborhood conditions through public improvements. In particular the public management of transportation, open space, and natural resource issues could noticeably improve the neighborhoods.

The Seattle Department of Transportation (SDOT) will plan, develop, and maintain circulation systems in Georgetown and South Park under the framework of the City's Complete Streets ordinance (Ordinance 122386), passed by the Seattle City Council in 2007. The policy, intended to create and maintain safe Seattle streets for everyone, directs SDOT to design streets for pedestrians, bicyclists, transit riders, and persons of all abilities, while promoting safe operation for all users. SDOT follows a data intensive process to evaluate projects to prioritize safety and mobility, while balancing the existing and projected future needs of all users. Such efforts may be key to equitable revitalization in Georgetown and South Park, as Complete Streets can provide amenities that benefit all residents, including: improved crossings, lighting, and sidewalks for pedestrians; bicycle lanes, sharrows, or wide outside lanes for bicyclists; adequate lane width for freight and transit operation; convenient transit stops for transit riders; and street trees, landscaping, lighting and other features to "make streets good for community life" (SDOT, 2012).

SDOT is also investigating options for the future management of shoreline at the ends of 149 public streets in Seattle that terminate on waterfronts (including several in South Park). These "Shoreline Street Ends" constitute valuable community assets, and are officially considered rights-of-way that should be preserved and developed for public access as their highest and

best use (City Resolution 29370, adopted in September 1996). However, most of these sites are not currently well maintained, or are subject to private encroachment. SDOT intends to improve the sites, in partnership with local residents and community groups, to improve public access and enjoyment of the waterfront. SDOT's Shoreline Street Ends Program guides the process of improving a shoreline street end and permitting uses of the land (SDOT, 2000).

In another example of site-scale land improvement that can benefit communities, the City of Seattle's reLeaf program is focused on increasing beneficial tree canopy in the City. Establishing more healthy trees will enhance ecological functions and urban livability by creating cleaner environments, reducing stormwater runoff and erosion, and promoting enjoyment of nature in the city. The Trees for Neighborhoods program helps Seattle residents plant trees around their homes by providing participants with free trees (up to 4 per household) and watering bags, discounted compost, and ongoing training on planting and care (Seattle Trees for Neighborhoods, 2012). In a separate but related program, Seattle and the Cascade Land Conservancy forged the Green Seattle Partnership in 2004, pursuing of a 20-year plan to combat invasive species and restore health to Seattle's forested areas. By 2025, the Partnership plans to re-establish and maintain 2,500 acres of healthy, invasive-free, forested parklands throughout the city (Green Seattle Partnership, 2012).

Installation of Low Impact Development stormwater systems could further add to the enhancement of local ecological services. By using swales, rain gardens, and similar green infrastructure to control stormwater, discharge could be reduced while water quality could be improved. Such development could enhance local neighborhoods while contributing pollutant source control to protect the Duwamish River.

Finally, King County's Combined Sewer Overflow (CSO) Control Program and Seattle Public Utilities will continue critical environmental work addressing CSOs, the discharge of untreated sewage and stormwater directly into lakes, rivers, and marine waters when sewers reach their capacity during heavy rainfall. While the sewage in CSOs is diluted by stormwater, CSOs and

stormwater carry chemicals and pathogens that may be harmful to public health and aquatic life (King County CSO Control Program, 2012). CSOs have been noted as a major source of contamination in the Lower Duwamish (Duwamish River Cleanup Coalition, 2008). Thus, prioritizing CSO control and achieving safe and enjoyable waters in the Duwamish would coordinate well with other environmental enhancements, such as street end improvements, urban forestry, and stormwater management via Low Impact Development, that could revitalize Georgetown and South Park via attractive open spaces and expanded recreation opportunities.

Transferring Benefits to All

A concluding set of institutional measures critical for enabling equitable revitalization in Georgetown and South Park are those that expressly address challenges inherent in serving diverse communities through institutional programs. Toward these ends, Seattle's Race and Social Justice Initiative (Seattle Race and Social Justice Initiative, 2012) and King County's Equity and Social Justice Ordinance (King County Equity and Social Justice Ordinance, 2012) are intended to transform systems that create disparities in communities, toward promoting equity for all. Under these relatively recent initiatives, administrators of the various City and County programs previously discussed should strive to ensure that all residents of Georgetown and South Park are appropriately served by revitalization efforts, despite barriers presented by age, income, language, race, or other factors.

Community-Based Revitalization: Grass Roots Endeavors

Alongside formal institutional approaches listed above, there are also a variety of grass roots initiatives that are achieving community revitalization in Georgetown and South Park. In general, the execution of hands-on local service in parallel with broader institutional programs may help strength community ties and avoid situations in which vulnerable residents, such as the elderly or those facing language barriers, fail to receive attention to their needs. For

example, high school students conducting local service projects in which they assist completion of agency forms for neighbors may help secure crucial public assistance for residents who face difficulty negotiating application processes alone. Furthermore, beyond basic needs, creative efforts in Georgetown and South Park are also transcending individual, institutional, and corporate interests to extend the richness of community to all local residents.

As the South Park neighborhood has dealt with loss of access options during the replacement of the South Park Bridge, a variety of community-based responses have provided moral support for the challenged neighborhood. The thriving arts community in South Park has been one source of vitality, organizing activities such a South Park Putts Out, a temporary mini-golf course designed by local artists and installed in the parking strip of a tree-lined residential street. South Park neighbors recently enjoyed the third annual round of this original mini-golf, along with food and live music, in August 2012 (South Park Arts, 2012).

Another locally driven activity that bonds South Park residents and builds community energy is a bonfire social held weekly on the "Sliver on the River." A resident that used to have solitary bonfires on his property along the Duwamish has opened up the event to his South Park neighbors. Many residents, especially artists and musicians, meet regularly at the fire. Participants are encouraged to walk or bike to the event (Shultz, 2011).

Georgetown also has a strong local arts community that drives community engagement, as illustrated by the annual Georgetown Super 8 Film Festival. The Festival started in 2006 when local artists offered to teach their neighbors how to make super 8 films, with the intent of sharing a created film with the community. The community response was overwhelming and 33 films were made the first year and screened for an audience of 200 at the Georgetown Ballroom. Each of following years, the number of created films, audience attendance, and community support for the Festival has increased. The festivals have now led to the creation of over 200 total films. (Georgetown Super 8 Film Festival, 2012)

TABLE 8. Sample of Potential Programs/Initiatives to Promote Equitable Revitalization in Georgetown & South Park

Program Structure	Program Participants	Focal Issues	Exemplary Initiatives
Coalition of Multiple Governmental & Non-Governmental Organizations (NGOs)	Public/private partners in EPA's *Urban Waters* program	Restoring water resources and enhancing communities	• Anacostia River contamination control • South Platte River shoreline cleanup and conversion for community use
Government/ NGO Alliance	Seattle's Housing Authority and partners	Assisting tenants	• Housing Choice Voucher Program • Management of Senior Housing units • Management of affordable housing
Government/ NGO Alliance	Seattle's Office of Housing and partners	Developing affordable housing	• Land use incentives for affordable housing development • Multifamily Property Tax Exemption (MFTE) Program • Rental Housing Production and Preservation Program
Government/ NGO Alliance	Seattle's Office of Housing and partners	Fostering home ownership	Expansion of home ownership via: • Habitat for Humanity • Homesight • Homestead Community Land Trust • HomeTown Home Loans from HomeStreet Bank • House Key Plus Seattle • Parkview Services Homebuyer Program • Seattle Teacher Homebuyer Program
Government/ NGO Alliance	Seattle Foreclosure Prevention Program	Preventing foreclosure	• Since inception in 2008, helping more than 30 homeowners avoid foreclosure and stay in their homes.

Program Structure	Program Participants	Focal Issues	Exemplary Initiatives
Government/ NGO Alliance	Seattle's Office of Economic Development and partners	Promoting economic vitality	• Preserve and enhance local business opportunities • EPA's Superfund Job Training Initiative • Green Enterprise Zone
Government/ NGO Alliance	Seattle's Department of Neighborhoods and partners	Providing food security	• South Park Marra Farm Coalition (P-Patch and Cultivating Communities programs; Solid Ground's Lettuce Link; Seattle Youth Garden Works, and South Park Neighborhood Association • Beacon Hill Food Forest
Government/ NGO Alliance	Seattle's reLeaf Program and Partners	Supporting vibrant human habitat	• Trees for Neighborhoods • Green Seattle Partnership
Governmental Alliance	King County Combined Sewer Overflow Control Program and Seattle Public Utilities	Supporting vibrant human habitat	• Reduction of Combined Sewer Overflow Discharge
Governmental Program	King County Assessor	Relieving property tax burden	• Tax deferral or exemption for senior citizens and disabled taxpayers • Tax deferral for limited income households • Tax relief supporting home improvements
Governmental Program	City of Seattle and King County	Social Equity	• Seattle Race and Social Justice Initiative • King County Equity and Social Justice Initiative
Governmental Program	Seattle's Department of Transportation and partners	Supporting vibrant human habitat	• Complete Streets Program • Shoreline Street Ends Program

Program Structure	Program Participants	Focal Issues	Exemplary Initiatives
Grass Roots Endeavor	Local community groups	Strengthening community ties	• Youth service projects • South Park Arts – South Park Putts Out • Weekly South Park bonfire on the Sliver by the River • Georgetown Super 8 Film Festival

3.0 HOW WILL REINVESTMENT & DEVELOPMENT AFFECT RESIDENTS' HEALTH IN GEORGETOWN AND SOUTH PARK?

Considering the indicators of existing and future gentrification discussed in sections 2.1 and 2.2, there seems to be some likelihood that the Duwamish Cleanup may contribute to gentrification in Georgetown and South Park. Specifically, indicators suggest that gentrification is currently beginning in Georgetown, and future acceleration of gentrification is likely in that community. In South Park, indicators reveal that gentrification is already well underway and ongoing future gentrification is likely. In light of these conditions, along with the fact that other cleanup projects have been found to boost real-estate prices in areas near Superfund sites (Gamper-Rambindran, 2011), the Duwamish Cleanup may reasonably be expected to stimulate reinvestment and development in Georgetown and South Park that could exacerbate gentrification.

Where community development does spur gentrification, the noticeable consequences (as cataloged by Kennedy and Leonard in 2001) may likely include "changing community leadership, power structures and institutions; conflicts between old and new residents; changing street flavor and new commercial activity; displacement of renters, homeowners and local businesses; greater mixing of incomes and deconcentration of poverty; increasing real estate values and equity for owners, and increasing rents for renters and business owners; increasing tax revenue; and increasing value placed on the neighborhood by outsiders."

However, as highlighted in section 2.3, propulsion of gentrification and disparity by community reinvestment may also be augmented by institutionally based revitalization efforts and local projects that extend benefits to both existing and new residents. Thus, a varied range of community changes could simultaneously result from Cleanup-spurred reinvestment in Georgetown and South Park. Such changes, from revitalization fostering equity and stability, to disparity-promoting gentrification, could all potentially affect the health of residents.

In meetings with the Residential Community Advisory Committee and Liaison Committee for the Duwamish HIA, several general types of physical, social, and economic changes were noted as the primary concerns regarding the Cleanup's potential reinvestment-spurred community health effects. Fortunately, recent research has aimed to increase understanding of the health effects of such changes. In general, studies have found that resident health may be substantively affected by local neighborhood characteristics such as physical factors, including housing and transportation, as well as economic capital and social capital

Analysis Method

The discussion below, comprising a review of pertinent community health literature and analysis of its implications in the Duwamish neighborhood, is organized by neighborhood characteristics associated with population health. Each section highlights alternate potential health outcomes that might be associated with gentrifying or revitalizing community development in Georgetown and South Park. Conclusions regarding potential health effects of Cleanup-spurred reinvestment are summarized at the end of Section 3.5, in Table 9.

3.1 HOW WILL REINVESTMENT AND DEVELOPMENT AFFECT HOUSING & HEALTH?

Among the more evident changes that can occur due to reinvestment in communities, changes in housing markets and residential conditions may have pronounced effects on resident health. Srinivasan, O'Fallon, and Dearry (2003) review the findings of multiple studies linking physical and mental health problems to poor urban planning, well-intentioned but damaging urban renewal (Fullilove, 2003) and inadequate housing (Bashir, 2002). Particular associations have been found between housing quality and health problems including infectious diseases, chronic illnesses, injuries, poor nutrition, and mental disorders (Krieger & Higgins, 2002).

If gentrification were to substantially increase housing costs in Georgetown or South Park, the resulting displacement of households into cheaper, lower quality, or more crowded housing

could adversely affect residents' health. Potential relocation to lower-income areas with lower cost housing could also reduce access to healthy foods, transportation choices, non-motorized circulation options, quality schools, and supportive social networks (PolicyLink, 2007).

However, if measures such as tenant assistance, home ownership promotion, and property tax relief allowed existing residents to maintain their presence in areas of rising home values, improvements in housing quality benefit health. The increasing value of properties would provide substantial equity growth for owners, and increased financing options could allow for more maintenance and improvement of existing housing stock. Such enhancement of local housing conditions could yield health benefits for both existing tenants and owners.

3.2 HOW WILL REINVESTMENT AND DEVELOPMENT AFFECT SOCIOECONOMIC CONDITIONS & HEALTH?

As the Georgetown and South Park neighborhoods transition under economic reinvestment, varying influences may well lead to shifts in the demographic composition of the local residential populations. Such changes may likely be accompanied by attendant shifts in the prevailing socioeconomic characteristics of the population and such shifts may results in changes in population health.

Among ample evidence supporting conclusions that socioeconomic conditions affect health status, the Centers for Disease Control and Prevention have compiled the straightforward graph below from survey data collected between 2007 and 2009 (Figure 3). The graph shows the percentage of adults over the age of 25 reporting fair or poor health in the United States, stratified by income level. In all age ranges, those with lower incomes had worse health.

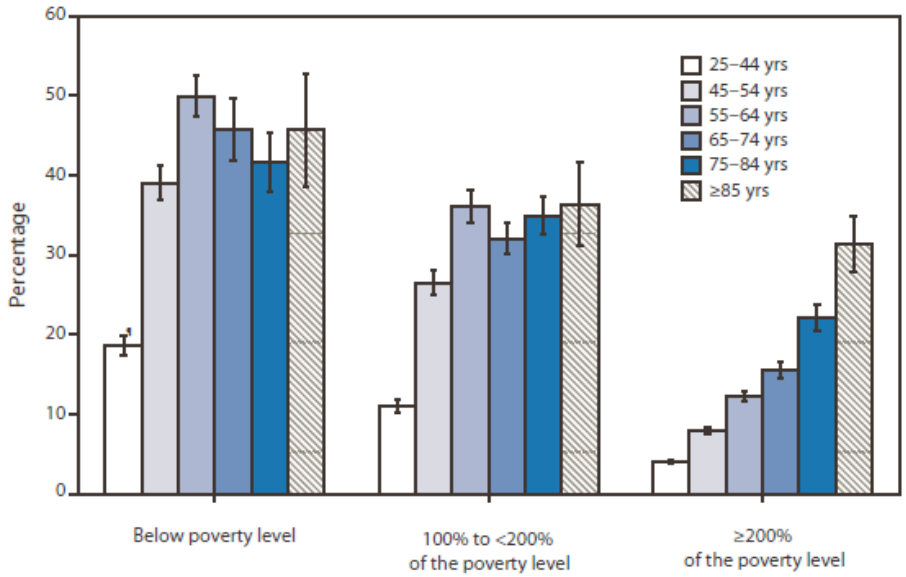

FIGURE 3. Percentage of Adults over 25 Reporting Fair or Poor Health, by Age Group and Income Level

Source: Center for Disease Control and Prevention, 2011

There are many other examples of documented associations between local socioeconomic status and health conditions. For example, research has found that, in general, communities with lower average socioeconomic status have lower quality housing, lack opportunities for outdoor activities, and lack access to fresh fruits and vegetables (Srinivasan et al., 2003). Such conditions may reasonably be expected to play out in health consequences. Rates of illness for lower income and less educated U.S adults in their 30s and 40s have been found to be comparable to those of affluent adults in their 60s and 70s (Adelman, 2008). In addition, individuals of lower socioeconomic levels have been documented to have higher incidence rates of arthritis, cancer, cardiovascular disease, diabetes, hypertension, low birth weight, and respiratory illness (Adler & Newman, 2002).

Thus, if reinvestment in Georgetown or South Park leads to an influx of higher income residents, those residents may have better health on average than existing residents with lower incomes. Such demographic shifts could lead to less local exposures to disease, and could potentially result in overall improvements in local rates of mortality and morbidity.

Furthermore, if economic development measures were to increase job security and income levels among existing residents, those residents could also personally enjoy the health benefits of their improved socioeconomic status.

However, lower-income residents that were to remain in place among new higher-income residents in gentrifying Georgetown or South Park could be subject to additional stress and associated health risks through exposure to increased costs of living and localized income inequality (Wang & Arnold, 2008). In addition, with the influx of new wealthier residents, previous residents might be displaced by rising costs of living to lower income, lower cost areas. In such areas, residents could be exposed to more adverse health conditions though diminished access to quality housing and healthy foods, decreased transportation and non-motorized circulation options, and lack of quality schools or supportive social networks (PolicyLink, 2007).

3.3 HOW WILL REINVESTMENT AND DEVELOPMENT AFFECT SOCIAL CAPITAL & HEALTH?

As future reinvestment modifies the Georgetown and South Park communities, the social and physical aspects of these urban environments may effectively promote either cohesion or isolation among the residents. Obviously, the displacement of existing households due to increased costs of living could disrupt existing neighborhood cohesion as residents relocate to new areas. In addition, evidence indicates that changes in existing neighborhoods, such as increased geographic barriers, sensed disparities between residents, concerns about crime and safety, higher rates of television and computer usage, and decreased contact among neighbors, may foster isolation and poor interconnection in communities (Srinivasan et al., 2003).

Such isolation has been documented to result in a lack of social networks and diminished social capital – that is, decreased benefits and obligations as conferred my membership in a social group (Hawe & Shiell, 2000). Accordingly, those living in urban isolation may find themselves

less empowered to utilize communal adaptive capacity to respond to crises or health challenges. Research regarding the complex interaction of social determinants has found that, at the individual level, low social capital and low economic capital are both independently associated with poor health outcomes" and, when combined, these factors "seem to contribute to an increased burden of poor health" (Ahnquist, Wamala, and Lindstrom, 2012). In particular, decreased social capital may be associated with increased obesity, cardiovascular disease, and mental health problems, as well as higher mortality rates (Srinivasan et al., 2003).

In contrast to the health threat posed by neighborhood gentrification eroding social capital, community health could potentially be buoyed by changes under more balanced revitalization of Georgetown and South Park. As the esteem of these areas rises with the cleanup of contamination, an influx of higher income households could coincide with business development (such as the Superfund Job Training Initiative) supporting job security and increased income for existing residents. Such economic development could increase consumer spending and property taxes to fiscally fortify the neighborhoods and their encompassing jurisdictions. If assistance and incentive programs, implemented as part of community revitalization programs, were also able to prevent undesired displacement of existing residents, the populations on whole could be empowered by the stronger political voice that comes from stronger local economic contribution. This empowerment could increase the adaptive capacity of the communities, potentially increasing residential interest in community engagement, interconnection, and responsiveness. Such interconnection may be facilitated if public improvements of streetscapes and open space enhance possibilities for active interaction among neighbors in the communities. Ultimately, such changes could benefit health via strengthened social capital.

3.4 HOW WILL REINVESTMENT AND DEVELOPMENT AFFECT OPEN SPACE, RECREATION, & HEALTH?

Potential health benefits may also be gained through prioritization of open space and recreational needs as part of future reinvestment in Georgetown and South Park. Current conditions along the Lower Duwamish River do not provide much pleasant open recreational area for use by community residents. Industrial expansion has created shorelines largely dominated by fences, storage yards, machinery, and waste. In addition, those recreating in the few areas of green space existing along the Duwamish may harbor reasonable apprehension about exposing themselves, their children, or their pets to contaminated soils, water and air.

While health concerns regarding environmental contamination will be attenuated by the Superfund cleanup activities in the coming years, Georgetown and South Park residents are likely to be subject to additional life stresses during the lengthy and complex cleanup activities. Such stress may contribute to the onset of illness, affect physical and psychological wellbeing, and predispose residents to greater vulnerability to other life stresses (Miller, 2007). Thus, the ability to cope with stress may play a major role in the addressing physical, mental, and behavioral health problems (Taylor & Stanton, 2007), as well as facilitating healthy family and social relationships (Sachser, Dürschlag, & Hirzel, 1998). Providing green and recreation space in the affected neighborhoods could facilitate such coping.

A multitude of studies confirm that stress reduction is major benefit of spending time in green space (Kahn, 1999). More specifically, the opportunity to increase outdoor activity in open recreational space may encourage exercise and its health benefits (Sallis, Millstein, & Carlson, 2011); reduce stress, increase mental wellbeing, assist recovery from mental fatigue (Kuo & Sullivan, 2001b), and improve ability to cope with adversity (Kuo, 2001).

Furthermore, residents' shared experience of well designed and safe open spaces may strengthen social ties in neighborhoods (Coley, Kuo, & Sullivan, 1997), increase a sense of

community (Sullivan, Kuo, & DePooter, 2004), and decrease crime and fear (Kuo & Sullivan, 2001a). Research has even found that time in green space promotes healthy child development, and may reduce symptoms of Attention Deficit Hyperactivity Disorder (Kuo & Taylor, 2004). Thus, pursuit of programs to develop attractive and active streets and green space as part of revitalization in Georgetown and South Park could be key to health improvement in the coming years.

3.5 SUMMARY: POTENTIAL HEALTH EFFECTS OF CLEANUP-SPURRED REINVESTMENT & DEVELOPMENT IN GEORGETOWN & SOUTH PARK

Overall, based on indicators discussed in sections 2.1 and 2.2, it is reasonable to expect that gentrification currently occurring in Georgetown and South Park will continue, to some degree, irrespective of the outcome of the Duwamish Superfund Cleanup. However, the Cleanup does constitute a pivotal factor in the development of these neighborhoods. As the project addresses local contamination issues, reinvestment in the communities is likely to increase, catalyzing either further gentrification or more equitable revitalization. By approaching the Cleanup project as a focal point for institutional and grass roots revitalization efforts, measures such as those described in Section 2.3 may be pursued to improved the health effects of consequent reinvestment and development. Table 9, below, highlights some key health benefits and harms that Georgetown and South Park residents could foreseeably experience due to reinvestment spurred by the Cleanup.

TABLE 9. Summary of Cleanup-Spurred Reinvestment's Potential Effects on Existing Residents' Health

Factor in Local Health	Foreseeable Outcome of Reinvestment	Potential Effect on Health Determinants	Potential Effect on Existing Residents' Health	Likelihood of Health Effect	Potential Magnitude of Health Effect	Potential Distribution of Health Effect	Rationale
Housing	Improvement of housing stock and associated infrastructure	- Decreased exposure to harmful environmental agents in homes - Improved local infrastructure for active community life	Increased emotional and physical fitness, decreased illness Importance: Low	Likely	Moderate	Disproportionate benefit to higher income residents	Development of new housing and infrastructure is likely, given indicators of gentrification in progress and likely future gentrification. Health benefit depends on ability to inhabit improved housing/areas.
	Increased housing costs	- Reduced funds available for discretionary spending - Reduced adaptive capacity for crisis situations	Increased stress and illness Importance: Low to Medium	Very likely	Substantial	Disproportionate harm to lower income residents	Continued increases in housing costs are very likely, given indicators of gentrification in progress and likely future gentrification.
	Displacement of residents to lower cost housing	Increased exposure to harmful environmental agents and crowding	Increased stress and illness Importance: Medium	Very likely	Substantial	Disproportionate harm to lower income residents	Residential displacement is very likely given indicators of gentrification in progress and likely future gentrification.
	Increased home values and home equity	- Increased financial ability to maintain and improve housing - Decreased exposure to harmful environmental agents and crowding	Decreased stress and illness Importance: Low	Possible	Limited	Disproportionate benefit to higher income residents	Continued increases in home values are very likely, given indicators of gentrification in progress and likely future gentrification. Health benefit depends on ability to inhabit housing with increasing home values and secure financing to make home improvements.

Factor in Local Health	Foreseeable Outcome of Reinvestment	Potential Effect on Health Determinants	Potential Effect on Existing Residents' Health	Likelihood of Health Effect	Potential Magnitude of Health Effect	Potential Distribution of Health Effect	Rationale
Socio-economic Conditions	Increased proportion of higher income residents	Increased local median income, associated with decreased local exposure to disease (CDC, 2011)	Decreased illness Importance: Low	Likely	Limited	Disproportionate benefit to higher income residents	Influx of higher income residents is very likely, given indicators of gentrification in progress and likely future gentrification. Health benefit from decreased local disease burden depends on ability to remain in place as local incomes rise.
	Development of new local services and amenities and associated infrastructure	- Improved public services and private amenities available to residents - Improved local infrastructure for active community life	Improved physical and emotional fitness Importance: Low	Likely	Limited	Disproportionate benefit to higher income residents	Increased demand for new services and amenities is likely, given indicators of gentrification in progress and likely future gentrification. Health benefit depends on ability to use new services and amenities.
	Increased cost of living	- Reduced funds available for discretionary spending - Decreased food security	Increased stress and illness Importance: Low to Medium	Very likely	Substantial	Disproportionate harm to lower income residents	Increased cost of living, including the cost of food, is very likely, given indicators of gentrification in progress and likely future gentrification.

Factor in Local Health	Foreseeable Outcome of Reinvestment	Potential Effect on Health Determinants	Potential Effect on Existing Residents' Health	Likelihood of Health Effect	Potential Magnitude of Health Effect	Potential Distribution of Health Effect	Rationale
Social Capital	Expanded local employment	- Increased funds for discretionary spending - Increased adaptive capacity for crisis situations	Decreased stress and illness Importance: Medium	Likely	Moderate to Substantial	Equitable benefit to all residents	Duwamish Cleanup will require labor. EPA Superfund Jobs Training Initiative may provide vehicle for training local residents to work in the Cleanup. In addition, increased demand for new local services and amenities is likely, given indicators of gentrification in progress and likely future gentrification.
	Increased social polarity	- Decreased social cohesion (Miller, 2007) - Decreased adaptive capacity for crisis situations	Increased stress, decreased physical and emotional fitness Importance: Low	Very likely	Moderate to Substantial	Disproportionate harm to lower income residents	Increased proportion of higher income residents is likely, given indicators of gentrification in progress and likely future gentrification. Reduced interconnection between residents reduces social network available in crisis situations.
	Increased tax base	- Increased political power - Improved public services and infrastructure	Decreased stress, increased physical and emotional fitness Importance: Low	Possible	Limited	Disproportionate benefit to higher income residents	Increasing median income is likely, given indicators of gentrification in progress and likely future gentrification. With increased tax base, political power could increase and drive improvements in local services and infrastructure. Health benefit of political power depends on ability to remain in more empowered local community.

Factor in Local Health	Foreseeable Outcome of Reinvestment	Potential Effect on Health Determinants	Potential Effect on Existing Residents' Health	Likelihood of Health Effect	Potential Magnitude of Health Effect	Potential Distribution of Health Effect	Rationale
Open Space and Recreation	Cleaner natural environment	- Decreased exposure to harmful environmental agents outdoors - Decreased worry about exposure/ decreased stress	Decreased stress, decreased illness Importance: Low	Likely	Moderate to Substantial	Disproportionate benefit to higher income residents	Implementation of the Duwamish Superfund Cleanup will significantly reduce contamination in the Duwamish River and along its shoreline. Open space along the river will be safer for recreational access by residents. Health benefit of cleaner local environment depends on ability to remain in the area.
	Expanded and enhanced open space	- Increased options for outdoor recreation - Increased social connection via attractive activated public space - Increased physical activity/ decreased stress (Miller, 2007)	Decreased stress and increased physical and emotional fitness Importance: Low	Likely	Moderate to Substantial	Disproportionate benefit to higher income residents	Expansion and enhancement of well-designed open space along the river is expected as a part of the Cleanup. Health benefit from active use of improved local open space depends on ability to remain in the area.
	Improved sidewalk and pathway connectivity	Increased recreation and active transportation	Decreased stress and increased physical and emotional fitness Importance: Low	Likely	Moderate to Substantial	Disproportionate benefit to higher income residents	Improvement of pathways along the river is expected under the Cleanup. Health benefit from active use of such infrastructure depends on ability to remain in local area.

4.0 POSSIBLE STRATEGIES TO MAXIMIZE HEALTH BENEFITS AND MINIMIZE HARM FROM CLEANUP-SPURRED REINVESTMENT AND DEVELOPMENT

In light of the potential associations between community revitalization, gentrification, and residential population health, changes in local conditions due to reinvestment in Georgetown and South Park could substantially affect the health of the residential populations. Given the previously discussed indicators of gentrification and prospects for revitalization in these neighborhoods, it is of particular interest how health will be affected by measures associated with the Duwamish Superfund Cleanup that either facilitate, or impair, community revitalization efforts and lead to, or inhibit, gentrification. In brief, it will be important for the diverse ranks of professionals planning and implementing the Duwamish Cleanup to consider how reinvestment spurred by the project can be managed to maximize health benefits from equitable revitalization in Georgetown and South Park, while minimizing adverse health effects from gentrification.

Toward these ends, Kennedy and Leonard (2001) propose the following strategies for public-private partnerships seeking to promote revitalization while reigning in gentrification:

- "Knowing the context, and the growth dynamics in the city and region to determine the extent to which gentrification is a reality, a near possibility, or an unlikely occurrence;
- Increasing regional, city and community understanding of the dynamics of gentrification, and conducting analyses that can anticipate pressures;
- Getting organized, again at the regional, city and community levels;
- Developing a unified vision and plan (e.g., for jobs/housing balance at the regional level, for economic and housing needs and opportunities for residents at the city level, and for neighborhood stability and viability at the local level);
- Implementing regulatory and policy fixes at the regional, city and community levels, as appropriate;
- Gaining control of public and private property assets that can be taken out of the market and used to provide affordable housing and office space for neighborhood

residents and service providers;

- Improving resident understanding of legal rights, and home-buying and selling strategies;
- Improving public education at the local and citywide levels;
- Preparing parties to negotiate for more equitable development in the midst of gentrification; and
- Creating forums to resolve conflicts and to re-knit the community."

These measures correspond well with approaches the Center for Disease Control and Prevention suggest for addressing the health effects of gentrification, entailing community involvement in strategies to:

- Create affordable housing for residents of all income levels;
- Ensure new housing development benefits existing residents;
- Utilize policy to promote affordable housing and preserve tenure; and
- Increase residents' assets to reduce public dependency.

  (Center for Disease Control, 2012)

Many of the previously discussed institutional and community-based approaches currently pursued to promote revitalization are in line with the tactics listed above. Drawing from those programs as examples, and creatively extrapolating to conceive of other related possibilities, the following strategies may be considered to manage reinvestment, revitalization, and gentrification spurred by the Duwamish Superfund Cleanup.

4.1 STRATEGIES

1. **Coordinate management of future community reinvestment.**
    - Formalize a coalition of agencies and organizations responsible for monitoring, reporting on, and managing neighborhood development in Georgetown and South Park in relation to the Superfund Cleanup. Investigate formal partnership under EPA's Urban Waters program. Pursue social equity through alignment of policies with Seattle's Race and Social Justice Initiative and King County's Equity and Social Initiative; ensuring revitalization measures appropriately serve all residents despite barriers presented by income, language, race or other factors.

2. **Produce affordable housing and preserve affordability.**
    - Publicize and facilitate tenant assistance by Seattle Housing Authority and partner NGOs.
    - Promote development of affordable housing in Georgetown and South Park via affordable housing development NGOs and Seattle Office of Housing's land use code incentives, tax incentives for developers, and public funding of affordable housing.

3. **Promote and protect home ownership.**
    - Expand homeownership by lower-income families in Georgetown and South Park by publicizing and facilitating local resident participation in downpayment assistance programs supported by the Seattle Office of Housing and NGOs.
    - Publicize and facilitate protection of qualifying local homeowners from increasing tax liability through NGO-based counseling and the King County Assessor's tax deferral, exemption, and relief programs.
    - Preserve local homeownership and reduce foreclosures by facilitating use of the NGO-administered Seattle Foreclosure Prevention Program.

4. Foster local economic strength and sustainable access to basic needs.

- Work with Seattle's Office of Economic Development and local NGOs to invest in and improve local business environments in Georgetown and South Park.
- Improve local job security and median income through employment programs, such as the EPA Superfund Job Training Initiative.
- Prioritize offsetting increasing costs of living in Georgetown and South Park by expanding secure local access to quality foods.
    - Promote and facilitate expanded resident participation in urban agriculture at Marra Farm.
    - Publicize and facilitate resident receipt of nutritious foods from local food banks as well as local schools.

5. Enhance Human and Natural Habitat

- Create vibrant neighborhoods through pursuit of active streetscapes under SDOT's Complete Streets program.
- Increase public access to the Duwamish River, safe open space (designed according to principles of Crime Prevention Through Environmental Design), and shared recreational area through SDOT's Shoreline Street Ends program and additional land use conversion programs. If possible, expand public open space along the shoreline at Boeing Plant 2.
- Improve local ecological services, pollutant source control, and aesthetics through Low Impact Development stormwater systems (swales, rain gardens, etc.), and tree planting and preservation programs.
- Increase local enjoyment of aquatic recreational opportunities by minimizing Combined Sewer Overflow discharge into the Duwamish.

6. Increase Community Engagement

- Publicize, facilitate, and grant funding to support local grass roots activities building social cohesion.

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SCHOOL OF PUBLIC HEALTH
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JustHealthAction

DUWAMISH RIVER CLEANUP COALITION
Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Addendum for Public Comment Report June 13, 2013

Assessment and Recommendations

Effects of the proposed cleanup plan on Tribes

Technical report

This technical report supports our *HIA Public Comment Report*, which will be submitted to EPA on June 13, 2013.

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Duwamish Superfund Health Impact Assessment
Tribal Impacts Technical Report
Final Report June 5, 2013

1. Introduction

Three Native American Tribes, the Duwamish, Muckleshoot, and Suquamish may potentially be affected by unintended health consequences of the Lower Duwamish Waterway (LDW). Although cleanup of the river will result in reduced sediment contamination levels and therefore decreased seafood tissue concentrations over time, residual[1] contamination and restrictions on river usage could affect the health of the Tribes in ways beyond those described in a traditional human health risk assessment.

In this technical report, we describe the current status of health in the Tribal populations, identify how contaminated sites have affected Tribal health in the past, assess how the proposed cleanup plan will affect Tribal health, and make recommendations for how the cleanup plan can be approached in a way that addresses health impacts and reduces inequities for these three Tribes.

2. Information Resources

Both qualitative and quantitative information was collected for this technical report, drawing on diverse resources including: available statistics; empirical research; a Tribal Advisory Committee formed specifically for the Health Impact Assessment (HIA); a Duwamish Tribe focus group; and technical advisors to the Tribal Advisory Committee and HIA team.

Statistical resources: Much of our statistical data came from the following locations: 2010 U.S. Census Bureau; Behavioral Risk Factor Surveillance System*;* National Vital Statistics System; and the Urban Indian Health Institute: Seattle Indian Health Board.

Literature resources: A literature review was conducted to examine how Tribes conceptualize health, and how Tribal health is affected by contamination.

Tribal Advisory Committee resource: The Tribal Advisory Committee (TAC) is assisting the HIA team in understanding the Tribal concept of health, identifying concerns about the cleanup, developing recommendations, and informing their respective Tribal councils about the HIA progress. This committee includes two members of the Duwamish Tribe and two professional staff employees of the Suquamish Tribe. The Muckleshoot Tribe has chosen not to participate. Four TAC meetings were held on May 29th, June 13th, and October 16th, 2012 and February 13th, 2013.

Duwamish Tribe resource: On January 8, 2013, the HIA team met with eight members of the Duwamish Tribe who volunteered to participate in a focus group with health related questions

[1] In the context of this report, residual contamination is defined as any contamination level above Puget Sound background and lasts as long as Institutional Controls are in place.

about the Duwamish River cleanup. Focus group procedures were approved in advance by the University of Washington Human Subjects Division (minimal risk).

Decision Research resource: Dr. Jamie Donatuto and Dr. Robin Gregory from Decision Research (Eugene, Oregon) acted as technical advisors to the HIA team and Tribal Advisory Committee. Dr. Donatuto, as an employee of the Swinomish Indian Tribal Community (La Conner, WA), and Dr. Robin Gregory, as an expert advisor from Decision Research, are in the process of developing an evaluation tool that explores how contamination of Coast Salish natural resources may affect Tribal health (Donatuto et al, 2011; manuscript in progress*).*

3. Tribal Baseline Community Profile

There are 37 American Indian Tribal communities in Washington State[2]. According to the 2010 Census, American Indians and Alaska Natives (AI/AN) currently account for about 1.5% of the WA State population and approximately 2% of the King County population (US Census Bureau, 2010). The three Tribal communities directly affected by the proposed cleanup plan are the Duwamish, Muckleshoot, and Suquamish. All three Tribes are a Lushootseed (Puget Salish) speaking people who have lived in the Central Puget Sound for approximately 10,000 years. Historically, they have depended on abundant natural resources including but not limited to salmon, cod and other bottom fish, clams and other shellfish, berries, roots, ducks and other waterfowl, deer and other land game for food for family use, ceremonial feasts, and for trade. Throughout history, the Duwamish River has provided both physical and spiritual sustenance to these three Tribal communities.

In 1855, the Treaty of Point Elliott reaffirmed that signatory Tribes occupying lands situated in Washington Territory had "the right of taking fish at usual and accustomed grounds and stations." In *United States v. Washington* (1974), otherwise known as the Boldt Decision, usual and accustomed were described to mean "every fishing location where members of a tribe customarily fished from time to time at and before treaty times, however distant from the usual habitat of the tribe, and whether or not other tribes then also fished in the same waters." The Boldt Decision also reaffirmed the right for the Tribes to have the opportunity to take up to 50% of the harvestable number of fish at usual and accustomed grounds and stations (*United States v. Washington, 1974*). Finally, O'Neill has clarified the meaning of "fishable waters" to mean that the Tribes have a right to take fish adequate in both quantity and quality (2013). In a United States vs Washington case referred to as the "Culverts case", the district court considered "whether the right of taking fish incorporates the right to have treaty fish protected from environmental degradation". It held that "implicitly incorporated in the treaties' fishing clause is the right to have the fishery habitat protected from man-made despoliation" (O'Neill, 2013).

[2]There are currently 29 federally recognized Tribes in Washington State. In addition, there are eight tribal communities classified by the government as "unrecognized"; although most signed treaties with the federal government, these were either not ratified in Congress or simply not recognized.

Duwamish Tribe

The Dkh^{w}'Duw'Absh are "The People of the Inside." The Duwamish Tribe's ancestral homelands are along the waters of Elliott Bay and the Duwamish River watershed. In 1851, the Duwamish people occupied 17 villages and 90 longhouses (www.duwamishtribe.org/index.html).

The Duwamish Tribe currently has nearly 600 enrolled Native American members. All are direct descendants of Seattle's First People. Many enrolled members still live in Duwamish territory, which includes Seattle, Burien, Tukwila, Renton, and Redmond. Duwamish members are actively involved in the Duwamish Tribal Council, Duwamish Tribal Services Board of Directors and General Council. The Tribe's Longhouse sits on the bank of the Duwamish River, at the site of the Tribe's historic winter fishing village, a National Historic Site.

Although Chief Seattle was the first signer of the 1855 Treaty of Point Elliott, city fathers fought a proposed Duwamish reservation. As a result the Duwamish Tribe has neither federal recognition nor fishing treaty rights that were granted to the other Tribes in the Treaty of Point Elliott and upheld in the Boldt Decision. The Duwamish Tribe continues to seek restoration of its status as a recognized Tribe and all rights and services that Tribal sovereignty guarantees. The Tribe submitted a petition under the Federal Acknowledgement Process and was acknowledged at the end of the Clinton Administration. This decision was reversed by the Bush administration. The Tribe is currently seeking to reverse this decision in Federal Court.

Muckleshoot Tribe

The Muckleshoot Indian Tribe is a federally recognized Indian Tribe whose membership is composed of descendants of the Duwamish and Upper Puyallup people. The Tribe's name is derived from the native name for the prairie on which the Muckleshoot Reservation was established. The Reservation lies along the White River and State Road 164 in Auburn, WA and was established in 1857. The Muckleshoot Tribe currently has approximately 1,660 enrolled members (http://www.muckleshoot.nsn.us/about-us/overview.aspx).

According to the Boldt Decision, the ancestors of the present day Muckleshoot Indians have usual and accustomed fishing places primarily at locations on the upper Puyallup, the Carbon, Stuck, White, Green, Cedar and Black Rivers, the tributaries to these rivers (including Soos Creek, Burns Creek and Newaukum Creek) and Lake Washington, and secondarily in the saltwater of Puget Sound (*United States v Washington, 1974*). The Tribe currently conducts seasonal, commercial, ceremonial, and subsistence netfishing operations in the Duwamish River (Lower Duwamish Waterway Group, 2012).

Suquamish Tribe

The federally recognized Suquamish are the "people of the clear salt water." They traditionally lived along the Kitsap Peninsula, including Bainbridge and Blake Islands, across Puget Sound from present Seattle (www.suquamish.nsn.us/HistoryCulture.aspx). The Suquamish Tribe has approximately 950 enrolled members, of which half live on the Port Madison Indian Reservation (www.suquamish.nsn.us/HistoryCulture.aspx).

The Suquamish Tribe's usual and accustomed fishing places include the marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada, including Haro and Rosario Straights and streams draining into the western side of central Puget Sound (The Suquamish Tribe, 2000). The Suquamish Tribe actively manages seafood resources just north (downstream) of the Duwamish Superfund Site (Lower Duwamish Waterway Group, 2012).

4. Health of the Affected Tribes

There are no health data publicly available that are specific to the Duwamish, Muckleshoot, or Suquamish Tribes. Most Tribes keep health data private because the data is either statistically unstable (difficult to interpret due to small population size) or because of distrust in how the information might be misused. Because Duwamish, Muckleshoot, and Suquamish Tribal health data is not available, information was compiled for the (American Indian/Alaska Native (AI/AN) population at the King County and Washington State levels and compared to the general population. Much of the health data described below comes from the Urban Indian Health Institute (2011) and a data request by the HIA team. Data was collected for 14 indicators representing important components of socioeconomic conditions, mortality, heart health, maternal and child health, mental health and wellness, and general health as shown in Table 1. The data shows that statistically significant ($p=0.05$) health disparities exist for both the King County and Washington AI/AN populations relative to the general population for close to 80% of the indicators. AI/ANs are more than 2.6 times as likely to be in poverty, 2.8 times less likely to have a college education, and 1.9 times as likely to be unemployed, compared to the general population. AI/ANs in King County are 1.9 times as likely to smoke, 2.1 times more likely to have diabetes and 1.75 times more likely to be obese. All three of these factors are associated with heart disease (2.3 times as likely in the AI/AN population), which is the leading cause of death in the United States for both Natives and the general population. Table 1 also shows statistically significant disparities in infant mortality rates, mental distress (stress, depression, and problems with emotions), cirrhosis deaths, and asthma.

Table 1: Comparison of American Indian/Alaska Native Indicators to General Population in Washington State and King County

Indicators/Source	WA AI/AN	WA Gen Pop	KC AI/AN	KC Gen Pop
Sociodemographics				
Poverty (percent)	26.3*	12.1	25.1*	9.7
Source	US Census, ACS 2006-2010; GCT1701		US Census, ACS 2005-2009:GTC1701	
College Education (percent)	13.2*	31.0	16*	44.8
Source	US Census, ACS 2006-2010; B15002		US Census, ACS 2005-2009; B15002	
Unemployment (percent)	16.4*	7.6	10.9*	5.7
Source	US Census, ACS 2006-2010: DP03		US Census, ACS 2005-2009: DP03	
Mortality				
Cancer mortality per 100,000	170.3	177.7	177.3	165.6
Source	US National Center for Health Statistics 2004-2008		U.S. National Center for Health Statistics 2003-2007	
Heart disease mortality per 100,000	185.5	168.5	176.5	152.6
Source	US National Center for Health Statistics 2004-2008		U.S. National Center for Health Statistics 2003-2007	
Heart health				
Heart disease (percent)	4.9*	3.5	6.3	2.8
Source	BRFSS 2006-2010		BRFSS 2005-2010	
Smoking (percent)	31.3*	15.9	23.7*	12.1
Source	BRFSS 2006-2010		BRFSS 2005-2010	
Diabetes (percent)	11.5*	7.3	12.2*	5.9
Source	BRFSS 2006-2010		BRFSS 2006-2010	
Obesity (percent)	39.0*	25.6	35.3*	20.1
Source	BRFSS 2006-2010		BRFSS 2006-2010	
Maternal and childhealth				
Infant mortality per 1,000 live births	9.7*	5.1	13.2*	4.5
Source	US National Center for Health Statistics 2003-2007		US National Center for Health Statistics 2002-2006	
Low birth weight (percent)	7.6*	6.3	6.9	6.5
Source	US National Center for Health Statistics 2004-2008		US National Center for Health Statistics 2003-2007	
Mental health				
Mental distress (percent)	19.1*	9.9	15.7*	8.3
Source	BRFSS 2006-2010		BRFSS 2005-2010	
Wellness				
Cirrhosis deaths per 100,000	31.6*	9.1	24.3*	7.8
Source	US National Center for Health Statistics 2004-2008		US National Center for Health Statistics 2003-2007	
Asthma (percent)	17.3*	9.2	17.3*	8.1
Source	BRFSS 2006-2010		BRFSS 2005-2010	

Health data produced by: Urban Indian Health Institute: Seattle Indian Health Board
U.S Census Data and Table 1 compiled by: Just Health Action
BRFSS- Behavioral Risk Factor Surveillance System
* Statistically significant at p= 0.05

5. Tribal concept of health – How do Tribes think of health compared to the general population?

In this section, we briefly describe the way that the general U.S. population has traditionally conceptualized health and compare it to the way Native Americans view health. The HIA team met with both the Tribal Advisory Committee (TAC) and 8 members of the Duwamish Tribe to explore how Tribal health is conceptualized from both an individual and community perspective. (The Muckleshoot Tribe chose not to participate in the TAC).

General population health models

Approaches to describing and understanding the factors that determine health in the U.S have been traditionally described through two models: 1) the biomedical model, and 2) the lifestyle approach. The biomedical model views physical, chemical, or biological agents as the primary causes of disease. The traditional human health risk assessment is an example of this model in that it evaluates how exposure to chemicals results in an increased or decreased risk of cancer or non-cancer disease development. The lifestyle model views individual behavior as a key determinant of health and focuses on how an individual can change his/her health outcome by making different choices. For example, if advisory signs are placed along the Duwamish to not harvest the seafood, an individual makes a “choice” of whether he/she wants to continue to

consume seafood. Recently, U.S. institutions (e.g., Institute of Medicine, Centers for Disease Control, etc) and this HIA have adopted an emerging "social determinants of health" (SDOH) model to conceptualize health defined as "the circumstances people are born with, grow, live, work, and age in, including the health care system" (WHO, 2008). As this SDOH model has gained traction, researchers are developing new methods to measure health in multiple dimensions, some of which are referred to as cumulative health impact analyses or in the case of this report, Health Impact Assessment.

Tribal health model

The Native American concept of health traditionally embodies a holistic perspective. One member of the Tribal Advisory Committee (TAC) described individual health as "*being at one with the universe, being in a state of non-conflict."* The Medicine Wheel, a symbol of wholeness, is often used to describe traditional concepts of health (Dapice, 2006). It is divided into 4 quadrants representing the physical, emotional, spiritual, and mental world and is still used by many AI/ANs around Puget Sound today to describe pathways to healing, supporting others, and reclaiming of culture (Urban Indian Health Institute, Seattle Indian Health Board, 2011; www.nwic.edu/news/true-community-garden). One member of the Duwamish Tribe described being healthy as "*diet, exercise, mental health, and spirituality. Measured by … a balance of all 4 elements."*

The well-being of the community is also important in tribal concepts of health. One TAC member described community health as "*support networks, resilience, ability to respond… and measured by whether community has resources needed to respond and adapt."* Additionally, health incorporates the well-being of the environment as described by a Duwamish Tribe member: "*Good air, water, food resources, self-sufficiency, involvement anywhere you can help."* The concept of health is not just individualistic, but also encompasses health in terms of collaboration, social cohesion, and empowerment.

Generally, our meetings with both the TAC and the Duwamish Tribe focus group reinforced our belief that the Tribes conceptualize health in a more holistic fashion. This issue is explored in more detail in sections below.

6. How do contaminated sites affect Tribal health?

A literature review conducted by Dr Jamie Donatuto and Dr Robin Gregory from Decision Research[3] identified a number of ways that previous contaminated site clean-ups have affected the health and wellbeing of Native peoples. As they describe below, these effects include biophysical chemical contamination, but also a constellation of mental, emotional, and spiritual effects related to temporary and permanent changes in the land, ecosystems, and their interactions with culture and community. In addition, even when areas are remediated and

[3] Decision Research is a non-profit research group dedicated to sound risk management and decision making and "helping individuals and organizations understand and cope with the complex and often risky decisions of modern life". More information about Decision Research can be found at: www.decisionresearch.org

made substantially cleaner, in terms of achieving equity, residual contamination may still disproportionately affect Tribes.

> *Tribes across the United States have suffered from chemical contamination during and after cleanup events (Arquette, 2002; Harris & Harper, 1997, 2004; USEPA, 2002). Impacts to Tribal health and well-being may stem not only from low levels of remaining contamination in areas where Tribal members have higher exposures than other people, but from sources including but not limited to the stress, sadness, uncertainty and trauma associated with the knowledge that their homelands have been involuntarily compromised by external forces, that the homelands are still not fully restored, and that they may never be. Externally imposed trauma is defined as 'events that overwhelm a community's capacities to function in stable and generative ways' (Korn, 2002). Community trauma can result from factors such as externally imposed habitat destruction, economic dislocation, food security interruption, social order disruption, and physical relocation (Korn & Dyser, 2008).*
>
> *It is well known that commonly employed institutional controls such as fish consumption advisories are not effective for many recreational and subsistence fishers (e.g., Burger, 2000). When Tribal fishers are engaging in cultural life ways that their ancestors have practiced since time immemorial, many will continue to harvest and consume fish and shellfish even when they know about the contamination. The Swinomish elder's quote at the beginning of Donatuto et al. (2011) succinctly illustrates this point: "Like we say, it's our spiritual food so it feeds our soul; so it might poison our body, but then we'd rather nourish our soul." In addition, other institutional controls such as providing substitution species for locally caught fish may negatively impact the health and well-being of Tribal members because they are not able to "feed the soul" with the proper spiritual foods, along with more widespread concerns for all fishers regarding the source and nutritional value of the substitution foods* (Decision Research, 2012).

Institutional controls can also be viewed as a direct violation of treaty rights. In the case of the Suquamish and Muckleshoot, the Boldt decision reaffirmed the Tribes' treaty-guaranteed rights to harvest seafood from usual and accustomed fishing grounds as well as the opportunity to take up to 50% of the harvestable number of fish at usual and accustomed grounds and stations (*United States v. Washington, 1974*). If pollution related fishing advisories restrict the Tribes from fully expressing their treaty rights, particularly with no meaningful options to restore those rights and make their situation whole, then they have been substantially disempowered. If a Tribe is denied a traditional and treaty-guaranteed resource, the Tribe cannot simply use a different river. No such alternative resource exists, and it would have less or no value to exercise Tribal rights nor the meaning necessary to carry forth cultural traditions. Furthermore, this disempowerment occurs in the context of a long history of lost or denied Tribal rights and resources, even when seemingly guaranteed in writing. Empowerment and disempowerment are fundamental determinants of health (WHO, 2006), and disempowerment in this setting has potentially broad repercussions for Tribal population health and well-being.

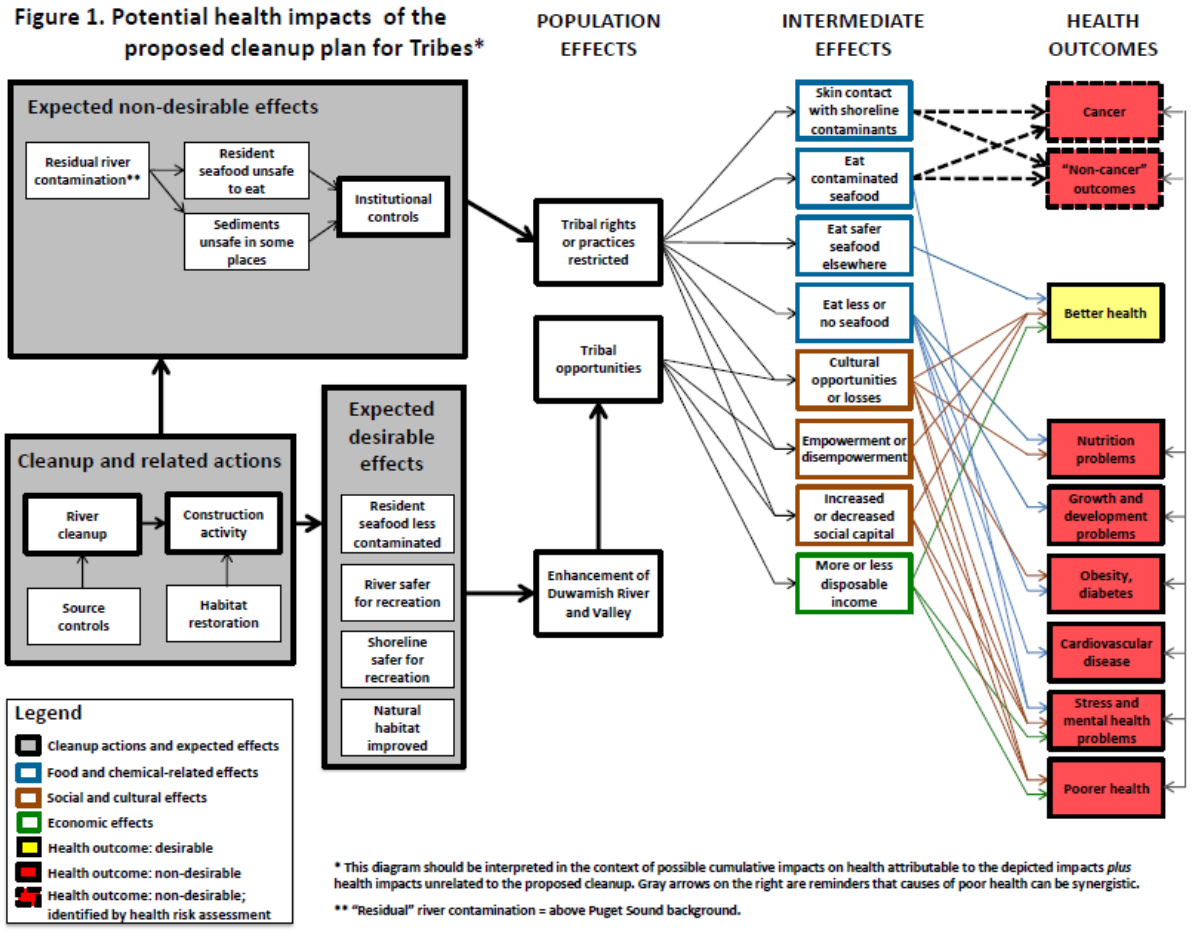
7. How will the Duwamish Superfund proposed plan affect health?

In this section, we discuss the ways in which Tribal health may be affected by the Duwamish River cleanup (Figure 1). We start with the health effect that has had the most public attention and most research done on it: the potential for human exposure to chemical contaminants through the use of a conventional EPA human health risk assessment. This is followed by a discussion of an alternative way of assessing contaminant effects on health as seen through a Tribal lens using Indigenous Health Indicators. Finally, we describe how the Tribal Advisory Committee and Duwamish Tribe conveyed their concerns about the cleanup and how it might affect their health.

Effects of contaminant exposure on health

The baseline human health risk assessment (HHRA) for the Lower Duwamish Waterway (LDW) Superfund Site was finalized in November, 2007 as part of the Remedial Investigation and refined in the Final Feasibility Study in October, 2012 (Lower Duwamish Waterway Group, 2012). The HHRA was conducted "to provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action." (Lower Duwamish Waterway Group, 2012). In turn, the HHRA would provide the basis for determining whether or not remedial action was necessary.

The HHRA presents risk estimates for several exposure scenarios wherein people could potentially be exposed to contaminants of concern by dermal contact with sediments and through seafood consumption. Contaminants of concern are identified as contaminants posing an excess lifetime cancer risk of greater than 1×10^{-6} (1 in 1,000,000) for chemicals causing carcinogenic effects and having a Hazard Quotient (HQ) greater than 1 for chemicals causing non-cancer health effects. To assess the potential for non-cancer effects posed by multiple chemicals, HQ's are summed and a hazard index (HI) is calculated. When either the HQ or HI exceed unity (1), there is concern for potential health effects and action is recommended.



Dermal contact with sediments near Duwamish Long House - Duwamish Tribe members have expressed concern about dermal contact (particularly children) with contaminated sediments when they are playing on the beach across from the Long House, performing ceremonies, and using the beach to launch canoes (e.g., Canoe Journey). As presented in the Remedial Investigation, total excess cancer risk estimates from exposure to contaminated sediments at all 8 beach areas ranged from 5 in 1,000,000 (5×10^{-6}) to 5 in 100,000 (5×10^{-5}) for the eight individual beach play areas evaluated as part of the beach play scenarios (Lower Duwamish Waterway Group, 2007). Non-cancer HQs were less than 1 for all of the eight beach play areas. For Beach 2, where the Duwamish Long House is located, total risks from beach play was 9 in 100,000 (9×10^{-5}) with carcinogenic polycyclic aromatic hydrocarbons (cPAHs) being the main risk driver 8 in 100,000 (8×10^{-5}) (Lower Duwamish Waterway Group, 2007).

Fish Consumption - Exposure to eating contaminated seafood is the main "risk driver" justifying remedial action of the LDW sediments. Mean fish and shellfish consumption rates for Washington State Tribes range from a low of 63.2 grams/day (four Columbia River Tribes) to 72.9 grams/day for the Tulalip and Squaxin Tribes, to a high of 213.9 grams/day for the Suquamish Tribe (CRITFC, 1994; Toy, 1996; The Suquamish Tribe, 2000). However, the

reasonable maximum exposure scenario in the HHRA for LDW seafood consumption is based on adult and child seafood consumption data for the Tulalip Tribe (who do not have Tribal fishing rights in the Duwamish). Suquamish seafood consumption rates were not used by EPA in the HHRA with the justification that there currently is not enough habitat in the Duwamish River to sustain these consumption rates (Lower Duwamish Waterway Group, 2007).

Baseline (before River cleanup) estimated excess lifetime cancer risks are highest for the seafood consumption scenario at 4×10^{-3} (4 in 1,000; Tulalip data) and 3×10^{-2} (3 in 100; Suquamish data) with polychlorinated biphenyls (PCBs), inorganic arsenic, carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans contributing to the majority of the risk (USEPA, 2013; Lower Duwamish Waterway Group, 2007; 2012). For non-cancer health effects, arsenic and PCBs are the main "risk drivers" for the Tulalip seafood consumption scenario, contributing to a non-cancer HI of 44. For the Tulalip child seafood consumption scenario, PCBs, arsenic, tributyl tin and vanadium contribute to a non-cancer HI of 100. For the Suquamish adult seafood consumption scenario, PCBs, arsenic, chromium, mercury, tributyl tin and vanadium contribute to a non-cancer Hazard Index of 340 (Lower Duwamish Waterway Group, 2007; 2012). Chemicals cause different non-cancer effects (endpoints) on different parts of the body. The most significant endpoints for PCBs are developmental, immunological, and neurological.

According to the proposed plan (2013), Remedial Action Objective (RAO) 1 is to "Reduce human health risks associated with the consumption of contaminated resident LDW fish and shellfish by adults and children with the highest potential exposure to protective levels. PCBs, arsenic, cPAHs, and dioxins/furans are the primary risk drivers that contribute to the estimated cancer and non-cancer risks from consumption of resident seafood." However, the Final Feasibility Study (2012) indicates that that even after "cleanup," residual contamination will result in Tribal adult excess cancer risks of 2×10^{-4} (2 in 10,000) and a non-cancer effects Hazard Index of 4 based, on the Tulalip Tribe exposure scenario. Tulalip child non-cancer risks are estimated to be at a HI of 8. Suquamish Tribe residual cancer and non-cancer effects have not been calculated.

Particularly considering that unrestricted Suquamish child mean fish consumption rate is approximately 9 times higher than Tulalip consumption rates (24.8 grams/day vs 2.7 grams/day; The Suquamish Tribe, 2000), it is highly likely that Suquamish children's health would be compromised, not just during 17 years of active cleanup and recovery, but continuing thereafter and potentially in perpetuity. As a result of the residual sediment contamination and resulting seafood contamination, "institutional controls designed to reduce exposure" are assumed to be required, also in perpetuity. Even utilizing a conventional HHRA, a range of negative health impacts (particularly to children) from unrestricted fish consumption from the LDW site are predicted for many years to come (EPA, 2013).

Limitations of the conventional risk assessment approach

The EPA has acknowledged that its current risk assessment approach is inadequate in that it focuses on a small range of chemicals and a small number of exposure pathways (USEPA, 1997).

The approach does not account for synergistic effects (increased risks of a disease from combined exposures) and cumulative health risks (Schwartz et al, 2011). Cumulative risk is defined as "the combined threats from exposures via all relevant routes to multiple environmental stressors, including biological, chemical, physical, and psychosocial entities" (USEPA, 2003). Recent cumulative risk assessments are incorporating both chemical and nonchemical stressors (e.g., low income, substandard nutrition, poor built environment) that can influence vulnerability (OEHHA, 2010; Sexton, 2012; Gould & Cummings, 2013). In cumulative risk assessment, vulnerability acknowledges that disadvantaged, underserved, and overburdened communities exhibit physical, social, and cultural burdens that make the effects of environmental pollution worse than for the general population (EPA, 2004)

Not surprisingly, the residual seafood contamination levels do not encompass the full range of potential health effects as seen through a Tribal lens. Arquette et al (2002) described why the risk assessment process is inadequate in the case of the Mohawk territory of Akwesasne on the Saint Lawrence River, where PCBs and other toxic chemicals have affected their health. Because of the direct adverse health effects associated with consuming PCB contaminated fish and wildlife, the Mohawk were forced to abandon cultural practices that were an inherent part of maintaining their health. Even if exposure to toxic chemicals is reduced, alternative non-traditional foods have resulted in diets that are higher in fat and calories and lower in nutrients, which in turn is linked to health problems such as obesity, diabetes, heart disease, and cancer (Arquette, 2002; USEPA, 2002).

Forced changes in traditional cultural practices have other health implications. Much evidence on the social determinants of health point to health impacts for people who lose a sense of control over their environment (Marmot, 2004). In the case of the Mohawk, the health of the natural world is directly linked to their own health (Arquette, 2002). The Medicine Wheel's four quadrants include all races, all life (e.g., eagle, salmon), and traditional medicines (e.g., sage, cedar), all of which are considered sacred and equal and reflected in the Lakota prayer, "We are all related" (Dapice, 2006).

The HIA team heard this sentiment expressed by one of its Tribal Advisors, who said, "the salmon and the eagles are our cousins and when they are sick, we are too."

Tribal concerns about the Duwamish Superfund cleanup plan

The HIA team met with both the Tribal Advisory Committee (consisting of two Duwamish Tribe members and two professional staff representatives for the Suquamish - The Muckleshoot chose not to participate in the HIA advisory process) and eight members of the Duwamish Tribe to discuss how the river cleanup could potentially impact the Suquamish and Duwamish Tribes. The information provided below combines the responses of the two groups. It should be noted that the individuals participating in the process spoke only from their own perspectives and on behalf of themselves, and their perspectives do not necessarily reflect those of the Suquamish or Duwamish Tribes.

Both the TAC and the Duwamish Tribe participated in a small-group exercise which asked how the cleanup both during River cleanup construction activities and post-cleanup could potentially impact or change their communities in "good" (beneficial) and "bad" (adverse) ways. Beneficial

themes that were discussed during cleanup construction activities were the *empowerment* gained because the Tribes were a part of the decision making process; a sense of *ownership*; *raising awareness;* and *river progress*. Beneficial themes from post-cleanup activities repeated a sense of *ownership*; *accomplishment* and *pride*; *access to land and resources* that were not available in the past; and a return of the *spiritual aspect of the place itself*. One Duwamish Tribe participant mentioned and many concurred that after cleanup activities there would be more *Duwamish Tribe ceremonies on the river.*

Both the TAC and the Duwamish Tribe expressed sentiment that adverse effects that could occur during cleanup activities include *community disruption* and *restricted access* to the River because of traffic, noise, and dredging causing more contamination, which may result in feelings of *cynicism* and *disempowerment.* Adverse themes that were discussed for post-cleanup included apprehension about unmet expectations because the River is *not 100% recovered* and that *apathy may set in* or there may be *reinforced cynicism*. In addition, both the TAC and Duwamish expressed concerns for both their Tribes and the residents of South Park and Georgetown that *displacement* and *gentrification* might occur (see appendix: Effects of Cleanup Plan on Local Residents Report).

The information gathered from both the TAC and Duwamish Tribe meetings suggests that the Tribes have identified likely health determinants stemming from the cleanup that have not been addressed in the conventional risk assessment.

Alternative way of evaluating risk: Indigenous Health Indicators

Dr. Jamie Donatuto and Dr. Robin Gregory from Decision Research (Eugene, Oregon) served as technical advisors to the HIA team and Tribal Advisory Committee. Drs. Donatuto and Gregory are in the process of developing an evaluation tool that explores how contamination of Coast Salish natural resources may affect Tribal health (Donatuto et al, 2011; *manuscript in progress*). Decision Research describes Indigenous Health Indicators below and recommends that their application could be applied to the Superfund Site cleanup if Tribal Council approval was granted (Decision Research, 2012).

> *In order to encompass the way that Tribes envision health, researchers have been working with several Coast Salish Tribes to create a set of health indicators that better describe the many and nuanced connections between the health of tribal communities and the health of their natural resources. These indicators, called Indigenous Health Indicators (IHIs), have been developed to be easy to use and to understand by both the community and decision-makers outside the community. The indicators combine science-based with community-based sources of information, a key requirement in developing culturally relevant measures of impact (Failing et al, 2007) and seek to combine the benefits and familiarity of narratives and stories about different levels of health impact with quantitative measures based on a combination of natural, proxy, and constructed scales (Keeney & Gregory, 2005).*
>
> *The six IHIs (Table 2) developed to date are straightforward and have the flexibility to be tailored to an individual community's characterization of health. They can be used in a number of ways: to obtain a snapshot of current health conditions, to establish a*

baseline of health that can be re-evaluated over time, and/ or to prioritize which indicators to focus on in specific scenarios (e.g., in a cleanup). Most importantly, the IHIs describe many health priorities that are often considered "intangible" and therefore omitted from conventional health assessment frameworks (Donatuto et al, manuscript in progress).

The IHIs have not yet been employed with the Tribes in this Lower Duwamish Waterway Health Impact Assessment. However, if applied in the future, the IHIs could provide one avenue that would allow impacted Tribal communities to more effectively demonstrate how and to what degree the Superfund cleanup plan could impact their communities. Because several Coast Salish Tribes have participated in the development of the IHIs, the indicators may be applicable in and resonate with each of the Tribal communities with little adjustment of the indicator descriptions. However, the degree of applicability is a question to be addressed by the Tribes themselves. In order to first refine and then potentially employ the IHIs, for example, the Council of each Tribal community would need to review the indicator set and decide whether the Tribe would like to employ the IHIs to assist them in gathering relevant health information. After use of the IHIs has been approved by a Council, the IHIs may be used in a number of ways within the community, beginning with aiding understanding and communication regarding aspects of how that community defines and prioritizes health (Decision Research, 2012).

Table 2: Indigenous Health Indicators
Community Connection: Community members are actively participating in community functions and helping each other, particularly in connection with the harvest, preparation, and storage of natural resources.
Natural Resources Security: Local natural resources (land and aquatic plants and animals) are abundant and accessible such that they can support a healthy ecosystem(s) and healthy human community. The community equitably shares these natural resources.
Cultural Traditions: The community is able to carry forth their cultural traditions in a respectful and fulfilling way using the local natural resources.
Education: Knowledge, values and beliefs are actively passed on from elders to youth.
Self-determination: Communities develop and enact their own healing, development and restoration programs.
Well-being: Community members maintain their connection to their homeland, confident that their health and the health of the next several generations are not at risk due to contaminated natural resources.

Source: Donatuto, Gregory & Campbell, M.S. in progress

8.0 Summary and Characterization of expected health effects for the three affected Tribes

This section summarizes what has been learned about potential unintended and unexamined health consequences of the Superfund Cleanup on the Duwamish, Suquamish, and Muckleshoot Tribes through the eyes of the HIA team and the Tribal Advisory Committee. Rather than characterizing the effects using parameters such as likelihood, severity, magnitude or frequency (see appendix: Effect Characterization), a narrative characterization approach is used.

- Residual contamination – The conventional EPA risk assessment has shown that the three affected Tribes are disproportionately impacted by the Duwamish Superfund Site baseline contamination relative to the general population. In addition, residual risks post active cleanup activities will continue to be substantial. Tribal health outcomes are likely to be worse than predicted by the conventional risk assessment because: 1. The risk assessment approach does not account for fundamental aspects of Tribal health and well-being, and considers health as only the absence of cancer and "non-cancer" effects; and 2. Any river-related risks are compounded by existing Tribal health disparities (Table 1) and cumulative risks from both chemical and nonchemical stressors such as poverty, stress, food security, and concerns about self-determination. Furthermore, although the cleanup will create a cleaner environment for all, disproportionality and inequity between the general population and the Tribes may be increased because seafood will be safe to eat at the general population seafood consumption rate but not for the Tribal seafood consumption rate.

- Institutional Controls – Institutional Controls (such as fish advisories) imposed because of residual contamination restrict the amount of seafood that can be harvested by the Tribes. It is likely to affect Tribal population health through three pathways: 1. It is a violation of Tribal fishing rights which may lead to disempowerment, an established determinant of health, that can then lead to increased stress, mental health problems, and decreased well-being (as shown in Table 1); 2. It can affect food security and may prompt Tribal members to switch to alternative food sources that are not as healthy, which may cause other health problems including but not limited to obesity, diabetes, heart disease, and cancer; 3. It may affect physical health in order to protect cultural and spiritual health, since Tribal members might harvest fish in spite of biomedical warnings. As expressed by a Swinomish elder "it's our spiritual food so it feeds our soul; so it might poison our body, but then we'd rather nourish our soul." The decision to place Institutional Controls in effect until recovery is complete disproportionately affects the Tribes relative to the general population.

- Habitat renewal – It is highly likely that a healthier river will improve Tribal health because sediment contact will be safer during beach play and seafood harvest. In addition, the Duwamish Tribe focus group reported that they will have more ceremonies on the river resulting in feelings of pride, ownership, and empowerment, all important determinants of health.

9. Recommendations:

On February 13, 2013, the Tribal Advisory Committee met to review this technical report and develop recommendations supported by the HIA findings. The following recommendations emerged from the discussion:

1. *Collaborate with Tribes to more fully address their health concerns about the river cleanup*

   Remedial Action Objective 1 is *to reduce to protective levels the human health risks associated with consumption of contaminated Lower Duwamish Waterway resident fish and shellfish by adults and children with the highest potential exposure* (USEPA, 2013). Despite the Human Health Risk Assessment's inadequacy in accounting for cumulative risks that may affect the Tribes, it shows that residual contamination will continue to negatively affect the Tribes' health (Lower Duwamish Waterway Group, 2012; USEPA, 2013). Collaboration with the Tribes should include a "Structured Decision Making" (Failing et al, 2012) approach during the years of monitored recovery to incorporate Tribal beliefs and values into the adaptive management process. One possible approach to account for indigenous health concerns beyond a traditional risk assessment would be to utilize the Indigenous Health Indicators (Donatuto et al, 2011; manuscript in progress). Indigenous health indicators may differ between Tribes. A formal partnership would have to be established with each affected Tribe in order to pursue this approach. Although the current cleanup plans are already considered inadequate to the TAC because of residual risks, a study like this could provide evidence that the cleanup levels should be more protective for Tribal health.

2. *Restore Tribes' traditional resource use in accordance with Treaty Rights: Institutional Controls need to be temporary, not permanent*

   A long-term goal of the Tribes is to fully express their Treaty rights determined-- in the 1855 Treaty of Point Elliott where the right of taking fish at usual and accustomed grounds and stations was firmly established. As long as Institutional Controls are in effect, these treaty rights cannot be fully expressed and may result in health effects including disempowerment, cynicism, and decreased access to harvest. The definition of temporary Institutional Controls needs to be defined and negotiated with the Tribes.

3. *Establish a "Revitalization Fund" to enhance Tribal empowerment and health until Institutional Controls are removed:*

   As illustrated in Table 1 of this report, the Tribal populations suffer significant disparities in health relative to the general population, before even considering ramifications of the proposed cleanup plan. As previously described, Institutional Controls are disempowering because they limit reserved fishing treaty rights granted to the Tribes. The TAC recommends that the Responsible Parties direct resources into the Tribal communities to redress some of the inequities that would be compounded by Institutional Controls. A Tribal "revitalization fund" for each affected Tribe could be established and funded by the Responsible Parties as long as Institutional Controls are in effect to assist in decreasing existing inequities and increase positive environmental benefits. Revitalization funds could improve community empowerment, ownership of the process as well as reduce cynicism

that the cleanup is not yet complete. While each affected Tribe should control its own fund and choose what it would do with those funds, one TAC member gave an example of the building of a new hatchery for salmon enhancement.

Based on historical and ongoing cumulative impacts, the revitalization funding could be used to remedy disparities in housing, transportation, jobs, etc. An example of a fund like this has been established for the Harbor Community Benefit Foundation (http://hcbf.org). The foundation was established through an agreement between the Port of Los Angeles, community, environmental, health, and labor organizations in a Memorandum of Understanding (MOA). The foundation is funded by the Port of Los Angeles to improve community health, access to open space, and economic opportunities until cumulative impacts are reduced.

10. Limitations

The information provided in this report has limitations. First, while the statistical data about Tribal disparities relative to King County and Washington State is clear and the literature review is sound, the information collected from Tribal Advisory Committee and the Duwamish Tribe focus group is preliminary. Because the Duwamish, Muckleshoot, and Suquamish Tribes were never engaged in a formal process that asked them how the Superfund Site cleanup may affect their health through the use of their own health model, it is not possible to fully characterize how the Tribes' health will change over the course of restoring the river to its natural state. This exclusion of Tribal health concerns in a process constrained by the conventional risk assessment approach is another contributor to Tribal disempowerment, with potential repercussions for Tribal health and well-being. In fact, as demonstrated by Donatuto et al; 2011; manuscript in progress) with other Salish Sea Tribes, it is feasible to collect meaningful information about a Tribe using its own health model, and the necessary effort would probably be only a small additional fraction beyond the considerable efforts that are committed to conventional risk assessment.

Second, the Tribal Advisory Committee is small. It contains two members from the Duwamish Tribe and two professional staff representatives for the Suquamish Tribe. The Muckleshoot chose not to participate in the HIA advisory process. Although the HIA team did conduct a focus group with the Duwamish Tribe to pose questions about health and concerns about the Superfund Site, under no circumstances can the health effects characterization provided in this report be considered representative of the Suquamish or Duwamish opinions.

Finally, because the Muckleshoot did not participate in this HIA, the limited information about them in this report makes their voice appear insignificant. The Muckleshoot have made a decision to voice their opinions about the Superfund cleanup through different pathways.

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UNITED STATES of America, Plaintiff, Quinault Tribe of Indians on its own behalf and on behalf of the Queets Band of Indians, et al., Intervenor-Plaintiffs, v. STATE OF WASHINGTON, Defendant, Thor C. Tollefson, Director, Washington State Department of Fisheries, et al., Intervenor-Defendants Civ. No. 9213 UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF WASHINGTON, TACOMA DIVISION 384 F. Supp. 312; 1974 U.S. Dist. LEXIS 12291 February 12, 1974

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JustHealthAction

DUWAMISH RIVER CLEANUP COALITION
Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Addendum for Public Comment Report

June 13, 2013

Assessment and Recommendations

Effects of the proposed cleanup plan on Subsistence Fishing Populations

Technical report

This technical report supports our HIA Public Comment Report, which will be submitted to EPA on June 13, 2013.

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Outline

Introduction

How will the Duwamish Superfund Cleanup Affect Health among Urban, Non-Tribal, Subsistence Fishers?

The Lower Duwamish Superfund Cleanup has the potential to affect local non-tribal, subsistence[1] fishing populations during the cleanup and for many years to follow. Ongoing cleanup activities may impact fishing activities in the region, even outside the Lower Duwamish Waterway by displacing fishers to other locations. Additionally, the cleanup plan is unlikely to achieve the objective of protecting the health of people who consume fish and shellfish from the Waterway. Following the cleanup, human cancer risk from consumption of resident fish and shellfish is not likely to fall below the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Washington State Model Toxics Control Act (MTCA) excess cancer risk threshold of 1 in 100,000 for people consuming fish at the rates reported for tribal[2] and Asian Pacific Islander populations. Additionally, the hazard quotient for non-cancer risk may remain above the CERCLA and MTCA threshold of 1 (United States Environmental Protection Agency, 2013). In an attempt to protect individuals from such residual health risks, the cleanup plan includes non-engineered institutional controls (described in a later section of this report). Seafood consumption advisories, outreach, and education programs are likely to decrease fishing and shellfishing activity and the consumption of resident fish and shellfish, although incompletely. The potential resultant decrease in fish consumption and fishing activities could produce negative health impacts among the area's fishing populations due to food insecurity and loss of cultural and social activities. Furthermore, perceptions of safety after completion of the active cleanup and shoreline and habitat restoration could lead to an *increase* in fishing and consumption of contaminated fish and shellfish, potentially leading to ongoing or increased exposure to contaminants. To assess these potential unintended health consequences, this report describes:

- Existing conditions among urban, non-tribal subsistence fishing populations;
- Likelihood of potential health effects;
- Recommendations to maximize beneficial health outcomes and minimize harmful health outcomes in this population.

[1] The term "subsistence fishing" is used to describe this population for this assessment. This term is somewhat ambiguous. Schumann and Macinko have suggested that its definition must be context-driven (2007). In the context of the present assessment, subsistence fishing is defined as non-sport fishing performed to provide food occasionally or frequently for the fishers or their friends and families.
[2] Effects of the cleanup on tribal populations are discussed in the Tribal Impacts Technical Report.

Methods

Information about the potentially affected populations was gathered for this report through a review of peer-reviewed documents and other resources, consultation with community advisors, interviews with key informants, and conducting focus groups with fishers (Table 1).

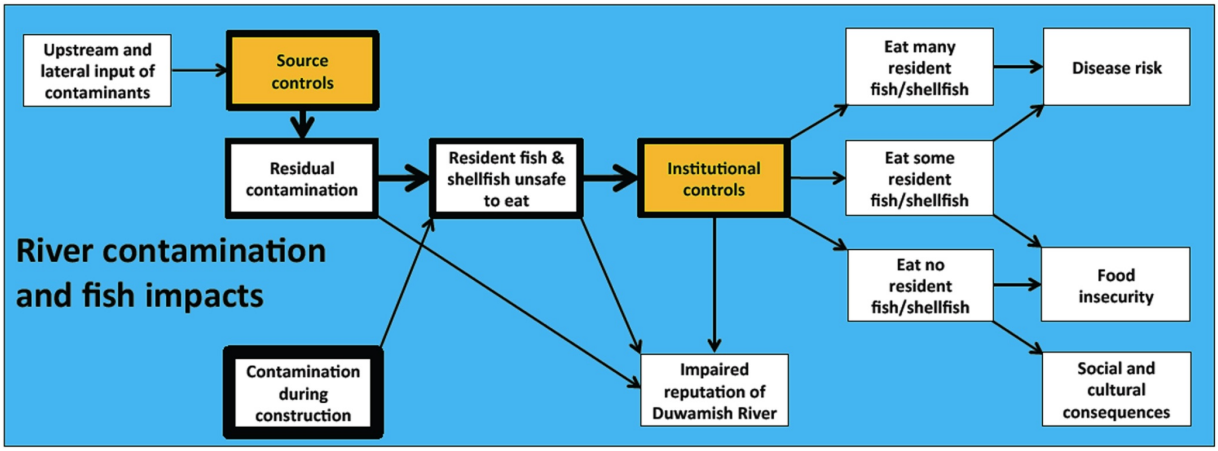
Table 1. Methods

Method	Purpose	Source
Literature Review	• Describe the proposed cleanup plan and potential health outcomes; • define subsistence fishing; • identify key studies around fishing and seafood advisories, fishing practices, and reasons for fishing; and • establish a conceptual framework to guide community-based research.	Peer-reviewed literature; gray literature; Lower Duwamish Waterway-specific publications, such as the proposed plan
Community Analysis	• Characterize important cultural considerations in the potentially affected communities, • assess the barriers and facilitators to participation in community-based research project, and • evaluate the cultural-relevance and appropriateness of interview and focus group guides	Representatives from the potentially affected communities, such as directors or community-based organizations.
Key Informant Interviews	• Revise and develop conceptual framework to guide focus groups, • engage community members as partners in the research, and • identify opportunities to recruit focus group participants	Individuals with knowledge of and connections to the various urban, non-tribal, subsistence fishing communities
Focus Groups	• Test and revise conceptual framework; • compare findings from local fishing communities to those identified in literature review; and • identify community discourse around fishing and seafood advisories, fishing practices, and reasons for fishing.	Urban, non-tribal, subsistence fishers recruited using a "snowball" technique

Conceptual Framework

Existing literature from local studies and studies from other regions provided the basis for a conceptual framework which helped frame each stage of the research. Interviews and focus groups with local fishers allowed for an exploratory evaluation of the conceptual framework, providing a better understanding of the many factors local fishers identify as important in the reasons they fish and their decisions about fishing locations (Figure 1).

Figure 1. Conceptual Framework



Literature Review

Little current information exists about the local urban, non-tribal, subsistence fishing population. Numerous studies have investigated fishing and seafood advisory effectiveness and characterized urban fishing practices in other urban areas (for example, see Burger, 2002). These studies are valuable in beginning to understand people's reasons for fishing and the potential unintended health effects of the cleanup. Findings from examination of peer-reviewed literature, gray literature, and cleanup-related documents are presented in this report.

In addition to a literature review, a community-based research project was carried out to gain a better understanding of Seattle's fishing communities. This research project included a community analysis, key informant interviews, and focus groups with fishers.

Community Analysis

A small group of community advisors with extensive knowledge about some of the local non-tribal subsistence fishing communities were recruited for this Health Impact Assessment. The community advisors served as unofficial spokespeople for communities that commonly practice subsistence fishing, and included representatives from local Vietnamese, Filipino, Japanese, Cambodian, and low-income communities. The community advisors were not fishers themselves, though some assisted with identifying key informants and focus group participants. These advisors helped ground this project in a culturally-appropriate context by identifying potential barriers to and facilitators of community engagement; providing insight into the values, needs, and existing resources of the various diverse fishing communities; and reviewing key informant interview and focus group guides.

Key Informant Interviews and Focus Groups

Detailed data analysis of this research is still in process (as of 6/10/13). Eligible key informants were members of the potentially affected communities, and either fished or knew people who fished in local urban waterways. Interviews with key informants began with a short survey to gather demographic information. Demographic information collected included gender, country of origin, primary language spoken, English language speaking and writing proficiency, and approximate distance between residence and the Lower Duwamish Waterway. In addition to demographic surveys, semi-structured interviews included open-ended questions about reasons for fishing, cultural and traditional significance of fishing in the community, and other areas to better inform the focus group discussions. Key informants were also asked about proposed Institutional Controls and possible alternates to fishing advisories.

Adults who fish in local urban waterways were eligible to participate in focus groups. Focus group participants were recruited using a "snowball" technique. Due to this sampling strategy, many of the focus groups were fairly homogenous and most of the participants were Asian immigrants. The focus groups involve larger group discussions about beliefs, values, and behaviors associated with fishing and fish consumption (see Focus Group Guide).

The focus groups were recorded and are in the process of being transcribed for further analysis. In-depth analysis has not yet been completed, so only initial findings and major themes are included in this report. Where appropriate, these findings are highlighted with this icon:

Local Snapshot

The results from qualitative analysis of the focus group discussions will be incorporated into subsequent versions of this report.

Baseline Characteristics

Who is currently fishing on the Duwamish?

Urban Subsistence Fishing in the United States

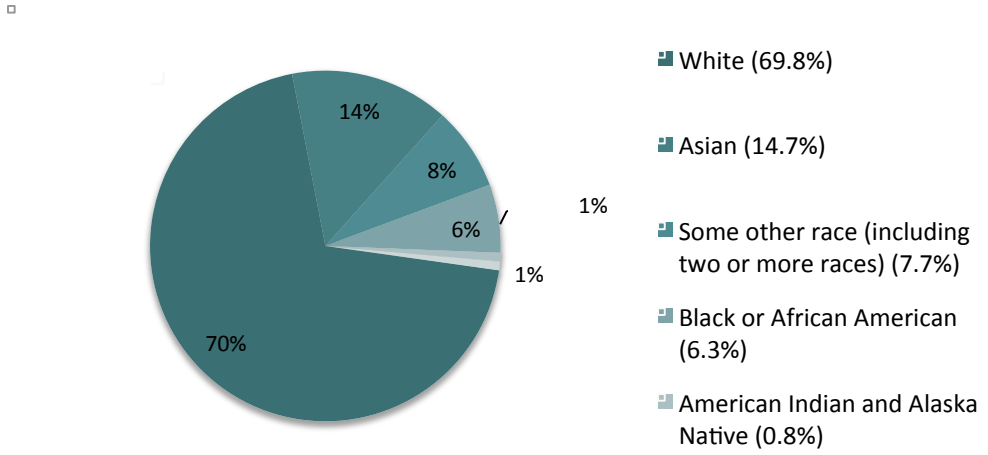
Limited information is available about subsistence fishing specifically along the Lower Duwamish Waterway, so it is helpful to consider findings from the many other studies that have characterized the diverse nature of subsistence fishers in other regions in the United States. Many of these studies have paid particular attention to the often underestimated importance of subsistence fishing in urban areas (Burger, 2002). Nationally, higher urban fishing and fish consumption rates tend to occur among older, lower-income and unemployed individuals, immigrant populations, and people of color (Burger, 2002; Environmental Health News, 2012; Perez et al., 2012; Schlyer, 2012). Urban subsistence fishers commonly share their catches with friends and family members (Kalkirtz, Martinez, & Teague, 2008; Perez et al., 2012); therefore, while they may not fish, pregnant women and children are also likely to be exposed to contaminated fish from urban waterways. This is important to note because children and pregnant women may be disproportionately vulnerable to health effects of contaminants in fish and shellfish (Washington Dept of Health, 2012a).

Urban Subsistence Fishing in King County

Similar to the information available in other regions, the local populations of non-tribal, urban subsistence fishers and their families and friend networks, represent a diverse and poorly characterized range of individuals from many disparate communities.

Most of the current information about subsistence fishing in local urban waters pertains to Asian and Pacific Islander communities. Fishing and shellfish harvesting reflect cultural, lifestyle and dietary traditions for many Asian and Pacific Islander (API) Americans and immigrants (Washington Dept of Health, 2003). Locally, Seattle's largest non-white racial group is Asian (Figure 2), and the highly diverse API community is one of the fastest growing racial groups in the city (U.S. Census, 2010). Nearly 15% of King County residents are Asian, compared to less than 5% at the national level. Similarly, the proportion of Native Hawaiians and other Pacific Islanders in King County is four times as large as the proportion in the United States as a whole (0.8% compared to 0.2%) (American Community Survey, 2011).

Figure 2. Race in King County



(*Source: U.S. Census; 2011 American Community Survey 1-Year Estimates)*

Sechena et al. (1999) characterized seafood consumption patterns among Cambodian, Chinese, Filipino, Hmong, Japanese, Korean, Laotian, Mien, Samoan, and Vietnamese populations in King County. Researchers surveyed 202 first- and second-generation API adults. They reported nearly universal consumption of seafood among these ethnic groups, with shellfish composing almost half (46%) of all seafood consumed. Up to 21% of the fish and shellfish consumed were self-caught rather than purchased from vendors or restaurants, with the majority of harvesting taking place within King County. Among some groups, bottom fish were obtained more often from fishing activities, rather than from vendors. The large quantity of shellfish and bottom fish caught and consumed from potentially contaminated waterways makes the API community of particular interest in this assessment, given that relatively higher levels of chemicals can accumulate in shellfish and bottom fish, as compared with salmonids or pelagic species.

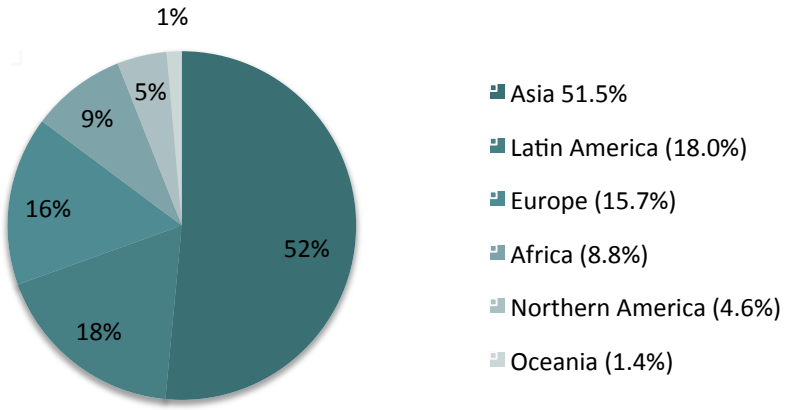
Local Snapshot

Initial discussions with API community advisors and focus group participants for this Health Impact Assessment have shed additional light on these communities locally. While the large, updated Filipino Community Center and food bank with bi-weekly elders' lunches serves Seattle's Filipino and Hmong communities, the local Vietnamese community has no community center or centralized elders services. Many individuals from these communities are plagued with transportation barriers, unemployment, and disproportionate health burdens. Consistent with national and local studies, community advisor interviews and focus group discussions have also suggested that fishing and fish consumption are important traditionally and

culturally for many local API populations.

Individuals from other diverse immigrant and non-immigrant populations also fish in local urban waters, including the Duwamish River. King County's large and growing immigrant population includes many distinct groups, in addition to the API immigrants discussed above. In King County, around 1 in 5 individuals (20%) are foreign-born, compared to only 13% at the state and national levels (American Community Survey, 2011). Compared to the U.S. as a whole, more foreign-born individuals in King County reported their region of birth as Europe, Asia, Africa, Oceania, and North America; people in King County were less likely to report Latin America as their region of birth than in the U.S. as a whole (Figure 3).

Figure 3. World Region of birth of foreign born population (King County)



(*Source: US Census; 2011 American Community Survey 1-Year Estimates)*

Compared to the total population, King County's foreign-born population is:

- over twice as likely to have earned less than a high school diploma (20.3% vs. 8.3%)
- over three times as likely to speak a language other than English at home (83.5% vs. 26.3%);
- more likely to have no health insurance coverage (22.8% vs. 12.3%); and
- more likely to fall below the poverty level (16.9% vs. 11.3% for individuals over 18 years of age) (US Census; 2011 American Community Survey).

In a study by Public Health-Seattle King County (Tolley, 2010), researchers collected information about fishing activities through conversational surveys with 35 individuals fishing at public fishing piers along the Duwamish River. Through their surveys, researchers identified fishing practices among African American, White, Vietnamese, Filipino, Cambodian, Laotian, Hispanic, Thai, and Mongolian individuals,

nearly half (49%) of whom primarily spoke a language other than English. The survey also asked fishers about sharing their catch and found that this highly diverse fishing population likely includes susceptible persons outside of those actually fishing on the river, including children and women of child-bearing age. Sharing was commonly reported, and shares were likely to include bottom fish, crab, and shellfish.

The report notes that, while the purpose of the study was to evaluate the effectiveness of fishing advisories, fishers who avoided fishing along the Duwamish River because of existing advisories were clearly excluded from the surveyed population (Tolley, 2010). Additionally, it is likely that fishers will travel to different locations based on perceptions of current fishing conditions, and those who do not currently fish in the cleanup area may change their habits if they perceive that fish in the Lower Duwamish Waterway are safe for consumption following the cleanup. Additional studies would enhance understanding of the potential future Duwamish River fishing populations by including individuals who rely on other local, urban fishing locations as well.

King County's low-income, food-insecure populations also consume fish from the Lower Duwamish Waterway, regardless of race/ethnicity. One study evaluating levels of fish consumption found that nearly all (96%) of 199 clients surveyed at two Seattle food banks within three miles of the Duwamish River consumed fish, with 40% reporting fish or shellfish harvesting for food (Schmidt, 2011). Participants in this study who fished or harvested shellfish also tended to report higher seafood consumption rates overall than other participants, and typical fish consumption rates (median IQI) were substantially higher than the EPA default value for the general population (30-151 g/day). Schmidt identified the highest seafood harvesting rates among Caucasian and Native American food bank clients (60%), but African Americans, Asians, and Hispanics also reported fishing activities (22-43%). Some participants (8% overall) fished in the Duwamish River, and a small proportion of these reported catching rockfish and other resident fish in particular. Again, this suggests that the non-tribal, urban subsistence fishing population is not only diverse, but also potentially affected by food security issues.

The local subsistence fishing population also includes urban American Indians and Alaska Natives (AI/AN). Historically, regional Tribes have depended on harvesting and consumption of fish and shellfish for traditional and cultural purposes. While existing conditions and potential health effects among Tribal populations will be described in another section of this Health Impact Assessment, much less data exists for the urban AI/AN population of subsistence fishers. According to the Seattle Indian Health Board's Urban Indian Health Institute (2009), urban AI/AN are often excluded from both local neighborhood assessments as well as Indian health community data. Urban AI/AN may live in various

areas across King County, rather than congregating in specific neighborhoods. Additionally, they may represent many distinct, diverse tribes. Therefore, while little data exists about this community, the urban AI/AN population may be part of King County's subsistence fishing population (Schmidt, 2011; Key Informant Interviews).

Why are people fishing in urban waters?

Interviews with subsistence fishers across the country have identified a variety of reasons for fishing and shellfishing. In other regions across the United States, many fishers rate recreation and relaxation as the most important reasons for fishing (Beehler, Mcguinness, & Vena, 2012; Joanna Burger, 2002; Kalkirtz et al., 2008). For these individuals, fishing activities provide a source of exercise and contact with nature in urban environments. Others, especially many immigrant communities, fish for social and cultural reasons (Kalkirtz et al., 2008). Traditional diets among many API populations rely heavily on fish and shellfish. In addition to the cultural and traditional significance of fishing and fish consumption, seafood also provides valuable nutrients, such as unsaturated fats (including omega-3 polyunsaturated fatty acids), protein, and vitamins (Oken et al., 2012; Roos, Wahab, Chamnan, & Thilsted, 2007; Washington Dept of Health, 2003). These nutrients are especially important for residents of neighborhoods with inadequate access to fresh meat, fruit, and vegetables (Kalkirtz et al., 2008). As a convenient source of nutrients and a free or inexpensive meal, fish and shellfish harvesting appeals to many food-insecure individuals. Furthermore, even people who are aware of potential negative health effects associated with consumption of contaminated fish may be likely to share their catch with people in need (Schlyer, 2012). Ultimately, an individual's reasons for fishing reflect a mix of cultural, traditional, and lifestyle factors.

Trends in King County parallel those identified in other regions of the nation. Sechena et al. (1999) found that API immigrants and refugees occasionally fished out of economic necessity and largely considered harvesting and consumption of fish and shellfish to be "healthy activities that reflect a homelike lifestyle."

Local Snapshot

According to API community advisors for this HIA, fish and shellfish are important components of traditional diets, and fishing represents a culturally relevant and acceptable form of recreation. To date, Focus Group Participants have also identified recreation and exercise as important reasons for fishing, as well as relaxation and stress-relief, family time, and contact with nature. Additionally, the

nearly universal fish consumption and high rates of fishing among food bank clients in the study by Schmidt and colleagues (2011) suggests that food insecurity may be a factor locally, as well. However, some API focus group participants actually identified catching fish as secondary to the act of fishing and spending the day outside.

Local Snapshot

What factors influence where people fish?

Factors influencing fishers' decisions about fishing locations vary across the diverse fishing communities. Focus groups with Latino anglers in New York identified transportation as important; those who lived within walking distance of fishing locations were able to fish whenever they liked, while those who did not had to rely on friends and family, public transportation, or bicycle routes (Beehler et al., 2012). Similarly, Kalkirtz et al. (2008) found that anglers relied on the Detroit River despite contamination, because it was near their homes.

Decisions about fishing locations are influenced by many factors, but convenience, cultural traditions, perceptions of safety and quality of fishing locations, and availability of desired fish tend to rank the highest among key informants and focus group participants.

Local Snapshot

Convenience and accessibility may lead some people to the Duwamish River for fishing. Reliance on public transportation and walking limits the distance many urban fishers can travel to fish, especially among recent immigrant, low-income, and food-insecure communities. However, only one focus group participant to date has said she is unable to travel to other fishing locations because of transportation barriers.

Cultural and traditional significance of the river may also play a role in influencing where people fish. For one American Indian key informant, for example, the Duwamish River has been a traditional fishing location in her family for many generations. In one focus group with API fishers, some participants suggested that seeing other people from their community fishing or hearing from friends or family about fishing locations influenced their decisions.

Local Snapshot

Decisions about fishing locations are also influenced by perceived safety and quality. The key informant mentioned above also explained that water quality, physical safety of fishing locations, and quality and quantity of fish harvested also impact her decisions on where to fish. Focus group participants described undesirable fishing locations as places with visible garbage, tires, or bicycles along the shoreline or in the water, or areas where oil was visible on the water surface. In one focus group with Mien fisherwomen, the women explained that some fishing locations were avoided because they were perceived as dangerous or high-crime areas. Favorable fishing locations were identified by focus group participants as those with the species of fish they wished to catch, and those with enjoyable views and people-watching opportunities.

Where are people fishing now? What are the conditions there?

In addition to the many people who fish in the Lower Duwamish Waterway, people are also known to fish in other local waterways. Key informants and focus group participants have identified other popular fishing locations, including:

- Along the I-90 and WA-520 floating bridges
- Seward Park
- Near the mouth of the Cedar River (Lake Washington)
- Green Lake
- Elliott Bay
- Des Moines
- Tukwila (Green River)
- Alki Beach
- Snohomish County and other waterbodies outside King County.

These areas are also affected by state and local fishing advisories, as discussed below.

What factors will influence where people might fish during and after cleanup?

Factors influencing future decisions about fishing locations during and after the cleanup are likely to be similar to the current factors already described. People will continue to choose to fish in locations that

are convenient and accessible, culturally and traditionally important, perceived to be safe (from both physical and contamination threats), and provide sources of suitable fish and shellfish. During or after the cleanup, if fishing locations along the Duwamish River become either more or less convenient, or if they are perceived to provide either less or greater protection from chemical and other hazards, then people may choose to decrease or increase their fishing activities accordingly. During active cleanup, barges and other signs of cleanup activities may increase impressions of contamination or lead people to believe the river is less safe, resulting in decreased fishing. Conversely, improved shoreline areas after cleanup may increase perceptions of quality and safety, or people may believe that the cleanup has decreased fish tissue contamination to acceptable levels. These changes in perception could potentially result in increased fishing activity following active cleanup. It is impossible to predict which factors will be most influential; however, some fishers will likely continue to visit the Duwamish River.

What alternatives are there to fishing the Duwamish River?

Alternatives to fishing in the Duwamish River include two distinct possibilities: continued fishing and shellfish harvesting activities in other locations, or discontinuation of fishing activities. Individuals with access to transportation and knowledge of other fishing locations may choose to travel to different areas to fish and harvest shellfish, such as the Green River, Alki Beach, Lake Washington, or Elliott Bay. However, this alternative would be fundamentally inappropriate and irrelevant for communities with traditional or cultural ties to the Duwamish River. Other individuals may lack time, transportation, or money necessary to change fishing locations. Ultimately, consideration of these alternatives must be informed by the complex mix of cultural, traditional, and lifestyle factors that influence fishing activities and fish consumption.

What are the chemical or other hazards associated with alternative fishing locations?

Fishers who avoid fishing in the Duwamish River and travel to other nearby urban fishing sites may still face potentially harmful levels of contaminants in fish and shellfish. All alternative regional fishing locations are affected by a statewide mercury advisory recommending no consumption of recreationally-caught Northern Pikeminnow and limited consumption of Largemouth and Smallmouth Bass. Many also have water body-specific advisories in place, including for shellfish from all King County shorelines and rockfish, English sole, and other flat fish in Elliott Bay. These advisories will be discussed in greater detail in the Institutional Controls section below. Fish and shellfish in Puget Sound and Lake

Washington are contaminated with mercury and PCBs, and advisories exist for many resident fish and some salmon species (Washington Dept of Health, 2012b).

The 2007 Puget Sound Update technical report provides water contaminant level data in Elliott Bay and the Duwamish River taken from various locations during 2005 (Table 2) (Puget Sound Partnership).

Table 2. 2005 water column PCB congener sampling locations in Puget Sound

	Total PCBs (pg/L)			
Station/Depth	**Aug-05**	**Sep-05**	**Nov-05**	**Dec-05**
Inner Elliott Bay (15 meters)	66	152	151	131
Duwamish River – Harbor Island (1 meter)	1,800	1,100	616	2,050
Duwamish River – Harbor Island (salt wedge)	1,810	No Data	261	679/524*
Duwamish River – 16th Ave. S. (1 meter)	1,430/1,620*	1,160	474	1,130
Duwamish River – 16th Ave. S. (salt wedge)	3,120	1,720	185	1,340
Green River (surface)	248	814	933/113*	83

*Field replicate samples

(Source: Puget Sound Partnership. (2007). Chapter 4. Toxic Contamination. Puget Sound Update (pp. 129–194).

The EPA's ambient water quality criteria for PCBs designed to protect human health is 64 pg/L (Lower Duwamish Waterway Group, 2010). This value was calculated using an estimated fish consumption rate of 17.5g/day (United States Environmental Protection Agency, 2002). This rate is likely much lower than the actual rate of fish consumption among local subsistence fishers. In her study of fish consumption among food bank clients, Schmidt (2011) identified a median seafood consumption rate of 60g/day. Sechena et al. (1999) reported average overall seafood consumption rates of 1.891 g/kg/day. For the average male in that study (body weight = 70kg), this translates to a seafood intake rate of over 130g/day. Water column levels of PCBs tended to be lower at the Elliott Bay sampling site than the sites along the Duwamish and Green River, but these levels clearly still represent a health risk for people who consume resident fish and shellfish.

PCB levels in fish and shellfish tissues across Puget Sound show a similar trend. Data from a 2003 Public Health Assessment of the Lower Duwamish Waterway completed by the Washington Department of Health suggests that the farther fishers travel to distant, non-urban fishing locations, the lower their potential exposure associated with consumption of fish and shellfish. The assessment reported that rockfish from Elliott Bay near Harbor Island contained higher levels of total PCBs (292 ppb) than rockfish from other areas of Puget Sound (11.5 ppb), including non-urban areas such as the Deschutes, Nisqually, Skagit, and Nooksack rivers (Washington Dept of Health, 2003). For fishers with little access to

transportation or those with traditional or cultural ties to the Duwamish River, travel to these areas would likely be impracticable. Consequently, the fishers who continue to fish in contaminated urban waterways, and the people with whom they share their catches, may experience continued exposure to toxicants through consumption of contaminated fish from other water bodies.

Institutional Controls

As discussed above, the proposed cleanup is not expected to decrease cancer and non-cancer risk associated with unrestricted consumption of fish and shellfish below acceptable levels (United States Environmental Protection Agency, 2013). Because of this, the cleanup plan relies on ongoing institutional controls in an effort to reduce exposure to contaminants. The EPA defines institutional controls as "non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination"(United States Environmental Protection Agency, 2012a). Institutional controls include seafood and fishing advisories currently in place, as well as community outreach and education programs. Ultimately, these controls place the responsibility for changing activities and practices on the fishers themselves.

What seafood advisories are currently in place?

State and local guidelines and advisories exist for water bodies in Washington. The EPA issues nationwide advisories and makes state information publicly available online (United States Environmental Protection Agency, 2012b). In addition, the Washington State Department of Health (DOH) evaluates chemical contamination of store-bought and recreationally-caught fish and provides advice to help consumers make healthy choices (Washington Dept of Health, 2012b). This advice comes in the form of a Healthy Fish Guide, available in English and Spanish; fish advisories by water body, including the Duwamish River; information for vulnerable populations; methods to prepare, cook, and select fish to reduce exposure to contaminants; and information about the health benefits of fish. However, Scherer et al. (2008) found that roughly one quarter of all advisories fail to include messages about the nutritional benefits of fish consumption.

The DOH water body-specific advisories include the Duwamish River, which has 14 advisories plus one statewide mercury advisory (Washington Dept of Health, 2012b). The current advisories recommend:

- No consumption of resident fish, including starry flounder, English sole, perch, and rockfish;
- No consumption of shellfish, including clams, crabs, mussels, and oysters;
- No more than 2-3 meals per week of Chum, Coho, Pink, and Sockeye salmon;
- No more than 1 meal per week of Chinook salmon; and
- No more than 2 meals per month of Blackmouth (resident Chinook) salmon.

Similar advisories exist for nearby water bodies, including a broad advisory for Puget Sound salmon that includes Elliott Bay. Additionally, signs along the Duwamish River attempt to inform fishers of these advisories at some fishing locations in a variety of languages, including English, Spanish, Chinese, Korean, Vietnamese, Cambodian, Laotian, and Russian (Figure 4). A Lower Duwamish Waterway Superfund Site Fact Sheet, in English, Spanish, or Vietnamese, is also available on the DOH website, along with a Duwamish River Seafood Meal Warning in multiple languages, which includes images of fish and shellfish to be avoided and preparation recommendations to decrease exposure to contaminants.

Figure 4. Duwamish Warning Sign
Source: Washington Dept of Health. (2012). About the Fish Advisories Program :: Washington State Dept. of Health. Fish. <http://www.doh.wa.gov/>

Generally, what is known about advisory effectiveness?

The term "effective" as it applies to the evaluation of seafood advisories is complicated and highly subjective. The National Environmental Justice Advisory Council (2001) outlined four functional parts of typical advisories, including informing affected groups about contamination and health effects, encouraging avoidance of contaminated fish, and suggesting alternate practices to maintain fish consumption. The fourth potential function of advisories, capacity building and empowerment of affected groups, is very rarely included. "Effectiveness", then, can be discussed in greater detail for each of these functional parts.

Informing Affected Groups

The first function of advisories, informing affected groups about contamination and health effects, can be evaluated based on effectiveness of communicating information in culturally appropriate, understandable ways (National Environmental Justice Advisory Council, 2001). A review of studies across the country demonstrated that many traditional advisories are ineffective in this regard. Despite awareness of advisories, many fishers and fish consumers do not understand the extent of

contamination or associated health effects. For example, fishers frequently believe that immediate sickness from bacterial food poisoning, rather than long-term effects from exposure to carcinogenic or endocrine disrupting contaminants, constitute the most serious threats (Fisher et al., 2010; Key Informant Interviews; Focus Groups). Other studies have found that, regardless of posted advisories, many fishers assume that they can detect contaminated water and fish with their senses. Contaminated water, many assume, would appear cloudy with nearby debris and junk (Beehler, Mcguinness, & Vena, 2012; Fisher et al., 2010). Fish without discolored flesh, deformities, or sores are frequently considered safe to eat (Burger, Staine, & Gochfeld, 1993; Fisher et al., 2010; Kalkirtz, Martinez, & Teague, 2008). In another study, a fisherman reported seeing a posted advisory at one site and subsequently assumed that sites without advisory signs posted must be safe (Fisher et al., 2010). Lastly, numerous studies have found that knowledge of fishing advisories correlates with ethnicity and age, suggesting that advisories frequently fail to be culturally-appropriate and understandable (Shilling, White, Lippert, & Lubell, 2010; Silver et al., 2007). Ultimately, these findings suggest that subsistence fishers' cultures must be considered in the development and communication of effective advisories.

Encouraging Avoidance of Contaminated Fish and Suggesting Alternatives

The second function of advisories, encouraging avoidance of contaminated fish, cannot be evaluated so simply. Many populations value fishing and fish consumption for traditional, cultural, economic, and religious reasons (outlined in greater detail in another section of this report). Thus, an advisory that "effectively" leads to a decrease in fishing and fish consumption may overlook these complexities, and can even "perpetuate cultural discrimination" (National Environmental Justice Advisory Council, 2001). The third function of advisories, suggesting alternate practices for fishing and fish consumption, presents an even more complicated problem and may neglect the many culturally-significant values associated with these activities. Clearly, an evaluation of advisory efficacy based on degree of changed fishing practices alone would be inadequate and culturally inappropriate for most affected populations.

Capacity Building and Empowerment of Affected Groups

The fourth and most often overlooked function of advisories may be the most important in defining effective advisories. Through involvement in the various stages of risk assessment and risk management, affected communities can inform fishing advisories and help ground related work within a relevant cultural context. Based on the analysis presented above, it appears likely that without actions

to support capacity-building and empowerment, efforts to protect affected populations from contamination in fish and shellfish will continue to fall short.

Ultimately, an evaluation of seafood advisory effectiveness should assess the inclusion of culturally-appropriate and relevant sharing of information about contamination, the ability of individuals to continue culturally and traditionally important practices including harvesting and consumption of fish at traditional locations, and the extent of capacity building, empowerment, and engagement of affected fishing populations.

How effective are existing seafood advisories?

The seafood advisories currently in place for the Duwamish River, described earlier, do not fully address the complex cultural context surrounding fishing and fish consumption in the region. First, the advisories often do not effectively communicate the risks associated with contamination.

Local Snapshot

One key informant who reported fishing in the Duwamish River stated that she believed consuming contaminated fish would lead to food poisoning symptoms and suggested that contamination could be observed in the coloring of fish and shellfish. Misperceptions around contamination and health effects of consuming contaminated fish were also prevalent among focus group participants. Many focus group participants associated an oily sheen with contamination, or suggested that they expected an area to be contaminated if there was garbage or debris along the shore. Focus group participants frequently described contaminated fish as those with missing or decomposing flesh. Others believed that contaminated fish would be weaker and are easier to catch than less contaminated fish. Most participants were unfamiliar with specific contaminants or the concept of bioaccumulation.

Additionally, the current advisories primarily discourage fish consumption and do not offer alternative means of fishing or consuming fish. As discussed above, this approach is problematic in that it does not address the varied and complex reasons for fishing. Furthermore, decreased fish consumption alone is not a useful marker of an advisory's effectiveness, since decreased fish consumption may come at the cost of reduced cultural and traditional activities. Lastly, community empowerment and capacity-building are not components of the existing advisories. Local studies have found a diverse population of individuals who fish and consume fish and shellfish from the Duwamish River and other local water

bodies (Schmidt, 2011; Tolley & Public Health of Seattle & King County, 2010b) Since many cultural, traditional, and economic factors drive fishing and fish consumption, future approaches should attempt to understand and engage these affected populations.

Figure 5. Fishing on the Duwamish River *Source: Google Maps Street View (Accessed March 6, 2013)*

What are the proposed institutional controls?

Seafood consumption advisories will remain during and after active cleanup of the Duwamish River. The Lower Duwamish Waterway Group (2012) identified other likely measures in addition to traditional advisories, including public outreach and education efforts to raise awareness and encourage avoidance of contaminated fish. They describe a community-based social marketing approach based on the Palos Verdes Shelf program's Fish Contamination Education Collaborative (FCEC), which focuses more on behavior change and less simply on awareness, which may also be incorporated into new institutional controls (FCEC, 2012). The FCEC incorporates outreach, education, and preparation guidelines for fish contaminated by the Palos Verdes Shelf Superfund Site. Through partnership with state and federal agencies, community based organizations, and local health departments, the FCEC offers education to anglers and families in nearby communities.

The proposed plan for the Lower Duwamish Waterway cleanup outlines informational devices, including advisories, outreach and education, and monitoring and notification efforts (United States Environmental Protection Agency, 2013).

In general, how effective are these types of institutional controls?

Ultimately, future institutional controls will not be effective if they simply attempt to increase awareness and decrease exposure, without accounting for culturally significant values and beliefs associated with fishing and fish consumption. Public outreach and education programs like the Palos Verdes model may successfully reach many people from diverse fishing communities, raise awareness, and lead to some degree of changed behavior, but these outcomes may come at the steep cost of reduced fish consumption and loss of cultural traditions. Follow-up surveys from the Palos Verdes' FCEC program found that the intervention led to an overall increase in contamination awareness and safer cooking habits (Groner, 2007). However, it is also important to note that the proportion of women who reported no fish consumption increased following the outreach and education program. No other evaluations of the FCEC program have been published, so it is difficult to know to what extent changed fishing activities and fish consumption levels may have impacted the affected communities' health and their cultural traditions.

What culturally appropriate alternatives to institutional controls are available?

As outlined by the National Environmental Justice Advisory Council (2001) and discussed above, institutional control advisories, offsets, and other strategies to reduce exposure to contaminated fish tissue should include

- informing affected groups about contamination and health effects,
- encouraging avoidance of contaminated fish,
- suggesting alternate practices to maintain fish consumption, and
- capacity building and empowerment of affected groups.

Potential strategies to achieve these goals have been identified through a review of existing technical and non-technical literature and through discussions with key informants and focus group participants.

Informing Affected Groups about Contamination and Health Effects

Information about contamination and health effects would be better communicated using a multimedia approach. Traditional approaches, including brochures, guidebooks, and web-based advisories do not reach all affected communities, especially low-income, immigrant, or older populations (Fisher et al., 2010). Studies in other regions have found that knowledge is better shared through methods including

classroom discussions and face-to-face approaches (Burger & Waishwell, 2001; Burger et al., 2003; Derrick, 2008), diagrams and images (Fitzpatrick-Lewis, Yost, Ciliska, & Krishnaratne, 2010), and avoidance of technical language (Chess, Burger, & McDermott, 2005). Seeking out culturally- relevant means of communication, such as newsprint and other news media, may be more appropriate for some populations (Beehler et al., 2012; Kalkirtz et al., 2008; Silver et al., 2007).

Efforts to communicate information about advisories and messages about safe and healthful alternative options also need to account for knowledge, beliefs, and cultural, social and economic needs of fishers (Joanna Burger & Gochfeld, 2006; Joanna Burger, 2002; Derrick, Miller, & Andrews, 2008; Kalkirtz et al., 2008; Perez et al., 2012). This can be accomplished through consultation with community-based organizations and an interactive process to develop, test, and revise outreach materials (Burger et al., 2003; Jardine, 2003; Jardine et al., 2003) and deliver messages (Sechena et al., 1999; Shilling et al., 2010).

In a study near a Superfund Site in Georgia, researchers developed a multimedia risk communication strategy for fishers and fish consumers using community-based participatory methods (Derrick et al., 2008). With the help of a Community Advisory Board that included members of the affected community, the researchers produced an outreach and education program that included a PowerPoint and verbal presentation, visual demonstration, and printed materials. Pre- and post-intervention interviews showed increased knowledge about contamination in fish and methods to reduce exposure. The reported average number of fish meals per month *increased* from 1.2 pre-intervention to 1.8 post-intervention, while the quantity of highly contaminated bottom-fish consumed decreased overall. The participants in this study were all African American, and no discussion of the traditional or cultural significance of these changes was included in the report. However, the inclusion of community members in the intervention process likely reduced the magnitude of potential negative impacts.

Encouraging Avoidance of Contaminated Fish and Suggesting Alternate Practices to Maintain Fish Consumption

Local Snapshot

Findings from focus group discussions and key informant interviews suggest that there is a need for innovative, novel approaches to minimize harms and maximize benefits of fish consumption in these communities. The EPA's 2013 Environmental Justice Analysis of the proposed cleanup describes possible "offsets," such as fish trading and sustainable aquaculture projects, suggested to mitigate the potential

health consequences of residual contamination and institutional controls. Focus groups with local fishers suggest that acceptance and cultural appropriateness of offsets will vary between and within populations. For example, fish trading was generally met with doubtful responses among focus group participants, who wondered where and how they would trade fish. Many also remarked that there was a sense of pride in catching a fish that would be lost if that fish was traded. Other strategies were somewhat more acceptable.

Local Snapshot

Some existing programs that could serve as models or starting points include SeaShare, community-supported fisheries, and urban fishing ponds.

SeaShare, a nationally recognized non-profit organization, distributes donated seafood meals throughout Feeding America's national network of food banks (SeaShare, 2012). The seafood products packaged in the meals include canned and frozen products as well as bycatch. SeaShare is the only regional organization allowed to accept bycatch, or unintentionally-caught fish that would otherwise be required by law to be thrown back.

Community-supported fisheries (CSFs) mirror the community-supported agriculture model. No CSFs currently exist near Seattle, but across the country CSFs connect regional fishers with consumers, offering fishers a sense of security and steady source of income and provide participating community members with a regular supply of reduced-cost fish and shellfish. Locally, a CSF could represent an alternative option to consuming contaminated fish or shellfish from the Duwamish River.

Urban fishing ponds across the country provide opportunities to engage in healthful fishing practices for fishers who may be transportation-limited, including low-income, young, or disabled people. In Wisconsin, for example, urban fishing ponds are cooperatively managed and intensely regulated (Wisconsin DNR, 2013).

Urban fishing ponds were generally well-supported in focus groups with local fishers. In one focus group, fishers suggested creating multiple small, visually-appealing ponds stocked with desirable fish. They proposed a low annual fee to access the ponds with the possibility of decreased cost or free access to low-income fishers.

Local Snapshot

In addition to the potential options presented above, local fishers in one focus group recommended distributing maps of fishing locations along with information about contamination and types of fish available and safe for consumption. Maps could be created and distributed in partnership with members of the affected communities. This would ensure the materials account for differing levels of numeracy and literacy and maintain cultural-appropriateness, while also empowering local fishers and building capacity within the fishing communities.

Local Snapshot

Reasons for fishing and fish consumption vary by population, so it is unlikely that a single option would be universally appropriate. Rather, innovative alternatives could be developed in combination with educational and outreach programs and community engagement and empowerment.

Capacity Building and Empowerment

Approaches that engage community members can benefit members of the impacted communities as well as health professionals and researchers. Community empowerment is a valuable outcome when these strategies involve capacity building within the community, offer equitable opportunities for participation and engagement, and promote community ownership of the outcomes. Furthermore, community engagement methods allow researchers to gain indispensable inside perspectives, generate research that is both externally and internally valid, and inform more sustainable interventions (Lazarus, Duran, Caldwell, & Bulbulia, 2012).

Burger, Gochfeld and Fote (2013) recently described a community-based participatory research project in New Jersey. In their study, Burger and colleagues engaged stakeholders, including fishers, angler associations, marina owners, and scientists at all stages of the research. The research goals identified by individual fishers were reducing risk from chemical contaminants in fish while maintaining fishing lifestyles and fish consumption and gaining knowledge of contamination levels in specific fish species. To reach these goals, local fishers assisted the researches with defining and developing the research plan, sampling methods, and sampling locations, and were kept well-informed throughout the research process. Ultimately, Burger and colleagues found that this level of engagement improved the quality and relevance of the research to the local fishing communities.

Summary of Focus Group Findings

Local Snapshot

Translation, transcription, and detailed analysis of the focus group discussions are currently underway, and results from this analysis will be included in a future report. At this time, general themes can be reported:

- Focus group participants identified cultural, traditional, and economic reasons for fishing. Reasons for fishing vary by community, and range from catching fish as a source of food to spending time with friends and family to stress-relief and contact with nature. Many participants valued the act of fishing over actually catching a fish.
- Most participants traveled to many urban fishing locations, choosing locations that were culturally-important, accessible, convenient, safe, and visually appealing.
- Many participants were concerned about contamination in fish, but misconceptions were common. Some participants worried that eating contaminated fish would cause food poisoning. Many believed that they could detect contaminated water and fish using their senses. Few participants had seen or read posted fishing advisories.
- Innovative alternatives to institutional controls should encourage continued healthful fishing and fish consumption practices. Reactions to alternative suggestions varied, and different methods will be more culturally-appropriate and effective for different communities.

These concepts reinforce and add to the findings from the review of key studies. The following assessment of the expected health impacts of the cleanup is based on the literature review, community analysis, key informant interviews, and focus groups.

Expected Health Impacts

How could the health of fishers and their families be impacted during and after the cleanup?

Decreased Fishing and Fish Consumption

Institutional controls during and following the cleanup will attempt to minimize exposure to harmful contaminants by encouraging less consumption of resident fish and shellfish among subsistence fishers in the Duwamish River. In addition, visible signs of the cleanup may discourage fishing practices and use of the river. Confusing or ambiguous advisories aimed at sensitive populations may lead to a decrease in fish consumption as a whole (Scherer et al., 2008). For those individuals who decrease their fish and shellfish consumption, health burdens associated with contaminant exposure will likely be minimized. However, reductions in fishing and fish consumption may be impractical among many subsistence fishers, and discontinuation of these practices may impose other health burdens on these populations (Shilling et al., 2010).

Negative impacts associated with decreased fishing and fish consumption could include:

- food and nutritional insecurity; and
- disruption of social and cultural traditions.

Food and Nutritional Insecurity: In various regions of the United States, fishing has been identified as an important source of food (Beehler et al., 2012). Local studies have similarly found that fishing and shellfish harvesting provide a free and culturally-relevant food source for API-American and immigrant communities and low-income, food-insecure populations (Community Advisors and Key Informant Interviews; Schmidt, 2011). The negative health effects of reduced fish consumption, such as cardiovascular disease, can potentially outweigh the expected benefits gained from compliance with seafood advisories (Rheinberger & Hammitt, 2012). People who rely on fish as a culturally appropriate means of obtaining a seasonally-consistent source of omega-3 fatty acids are thus particularly threatened by efforts to discourage fish consumption (Kalkirtz et al., 2008). To maintain traditional diets and consumption of vitamins and nutrients, others may choose to replace self-harvested fish with store-bought fish.

Considering the cost of seafood from vendors and markets, decreased availability of self-caught fish could increase financial burdens on the many low-income and food insecure fishers. This may lead some people to supplement their diets with unhealthy inexpensive alternatives, potentially increasing their risk of obesity, diabetes, cardiovascular disease, and other negative health outcomes.

Disruption of Social and Cultural Traditions: Fishing is a social and culturally-important activity for many populations and often serves as a means of passing knowledge from generation to generation (Kalkirtz et al., 2008).

Local Snapshot

When asked about reasons for fishing, key informants and focus group participants have emphasized family traditions, relaxation and spending time with nature, interaction with family and friends, and exercise. One key informant related a story about fishing with her grandfather, describing, "I was raised around fishing…. I remember when I was smaller than my daughter my earliest memory was of us going fishing."

To encourage the members of these communities to reduce their fishing activities is to encourage them to give up important recreational activities and culturally-significant traditions. Among people who fish for cultural, traditional, and recreational reasons, discontinuation or reduction of these activities may result in the degradation or loss of health or health-favorable activities, increasing stress and anxiety and impairing well-being.

Exposure to Chemical Contaminants

During and after the cleanup, some people who now fish on the Duwamish River may decide to fish in alternate locations, including other local urban waters. It is also likely that other fishers will continue to fish in the Duwamish River, because of convenience, preferences or limited transportation options. The cancer and non-cancer risks of continued fishing are described in the EPA's 2007 *Human Health Risk Assessment*. Non-cancer risks can include cardiovascular and other diseases, and neurological and developmental problems.

Continued Exposure through Consumption of Contaminated Fish from other Water Bodies: Some fishers with access to transportation may choose to fish in other locations rather than

discontinuing fishing altogether. However, fish and shellfish in nearby waterways may still present potential exposure pathways.

Local Snapshot

When asked to identify their fishing locations on a map of Seattle, focus group participants pointed out various local waterways. Popular fishing locations identified besides the Duwamish River were Lake Washington (including near the two floating bridges, Seward Park, and near the mouth of the Cedar River), Green Lake, and Elliott Bay. Focus group participants reported walking, busing, driving, and carpooling to access these fishing locations. Only one participant said she would not be able to travel to other waterways to fish, so it is likely that some people will continue to consume fish from other waterbodies.

Continued Exposure through Increased Consumption of Contaminated Fish from the Duwamish River: In addition, perceptions about the quality of fish in the Duwamish River may change following active cleanup; people may believe that the cleanup has brought contaminant levels in resident fish and shellfish to levels safe for consumption. Consequently, fish consumption may even intensify, potentially increasing exposure.

Table 3. Health Effect Characterization Summary[3]

Health Impact	Direction	Likelihood	Magnitude	Severity	Distribution
Food and nutritional insecurity	Adverse	Likely	Limited to Moderate	Medium	Disproportionate harm to low-income and food-insecure people
Disruption of social and cultural traditions	Adverse	Likely	Limited to Moderate	Medium	Disproportionate harm to people who fish for social, cultural and traditional reasons
Exposure to chemical contaminants	Adverse	Very Likely	Limited to Moderate	Medium to High	Disproportionate harm to lower income and non-English speaking people, and people who fish for social, cultural or traditional reasons

[3] These terms are defined and methods for characterizing health effects are described in the Methods Technical Report.

Recommendations[4]

These are preliminary recommendations based on the literature review and initial analysis of key informant interviews and focus groups. Finalized recommendations will be included in the Final Report.

1. Institutional controls should go beyond restrictive and informational actions, such as advisories to avoid contaminated fish. Interventions should emphasize positive alternatives, such as identifying, encouraging and providing options for safe fishing and healthful fish consumption.

Advisories have repeatedly proven to have limited effect on the targeted fishing practice, locally on the Duwamish River and elsewhere. Efforts to dissuade fishing on the Duwamish River may have the best chance to be truly effective and least discriminatory if people are provided other, healthier options that will directly address and satisfy the reasons that they harvest or consume fish or shellfish.

2. There is a clear need for innovative thinking about how to discourage fishing (for resident fish and shellfish) on the Duwamish River and how to promote safe and healthful fishing alternatives. Possible options to explore in consultation with fishing communities include:

- **Explore some of the "offsets" identified in the EPA *Environmental Justice Analysis* for the Duwamish River cleanup.**

  Our focus groups with local fishers suggest that acceptance and cultural appropriateness of offsets will vary between and within populations. Some of the listed options might appeal to some fishing populations, but we found mixed or negative responses to some of the options.

- **Provide a sufficient and reliable supply of fish to food banks in the communities where current and prospective fishing populations are located.**

  One survey of local food bank clients found 40% of client families fished for food, including 8% who fished in the Duwamish River. Providing a reliable source of fish for these lowest income and food insecure populations through programs such as SeaShare may alleviate at least their dietary drivers for fishing, and may give them flexibility to be more selective in choosing locations when they fish for other reasons (e.g., cultural tradition, family recreation, etc.).

[4] No single recommendation should be expected to entirely address the unique needs of any of the region's diverse fishing populations. Rather, recommendations could be considered in combination with these or other innovative ideas. Similarly, many recommendations may be culturally inappropriate for local tribes (see Tribal Technical Report).

- **Establish community supported fishery (CSF) programs—analogous to community supported agriculture (CSA) programs—in communities where fishing populations are located.**

  As with CSA programs, CSFs allow members to purchase shares of fish and other seafood caught by local fishers. These shares provide members with a regular source of lower-cost fish and shellfish, and directly benefit local fishers with financial support.

- **Build and maintain urban fishing ponds near the affected fishing communities.**

  Reasons for fishing vary between populations. Many people fish for cultural and recreational reasons in addition to fishing for an inexpensive source of food. Other states have developed urban fishing ponds to provide safe, local fishing locations for urban or land-locked communities. Allowing people to keep and consume the fish they catch would encourage continued fish consumption while maintaining fishing activities. Catch-and-release ponds would also allow for continued opportunities for exercise, nature contact, and socializing. Urban fishing ponds were generally well-supported by focus group participants, who agreed that these locations should be aesthetic and relatively natural environments to maximize the appeal for fishers.

3. Efforts to promote safe or safer fishing practices should acknowledge that the target audience is more than just people who currently fish on the Duwamish River. The target audiences include people who *might* fish on the Duwamish in the future. Any intervention effort should include plans to periodically reassess if all appropriate populations are being served.

A cleaner river after active cleanup may eventually attract people who do not currently fish on the river, either because of misperception that resident fish are then safe or because fishing there is a best or better option in a limited set of options. It is important to note that some minority or immigrant populations that are presently small in number in the Seattle area are projected to grow, and the composition of the urban fisher population may change over time.

4. All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should be culturally appropriate and relevant for each target audience, and should be designed to help individuals make informed choices.

Current and prospective future fishers on the Duwamish River are highly diverse in terms of race, ethnicity, nationality and language. Their reasons for fishing and fish consumption are equally diverse. There are probably no interventions that will broadly address the perspectives and needs of all groups,

without tailoring the intervention for individual groups. Methods to ensure that individuals have the information and awareness to make informed choices could include:

- **Distribute maps to fishing communities that identify regional fishing locations, the associated advisories or concerns about contamination, and the types of fish available to catch that are safe for consumption.**

  Fishers could more easily choose safer, less contaminated fishing locations if they have clear descriptive information on other local fishable waters. These maps and other materials would need to account for the different languages and levels of literacy and numeracy in the diverse fishing communities. This could be accomplished by involving members of affected communities in developing, reviewing, and distributing these materials.

- **Incorporate community engagement efforts to develop outreach and educational strategies around fish advisory awareness.**

  The methods used for the Palos Verdes Shelf Superfund cleanup site represent one good community-participation model to consider. We emphasize, however, that the most valuable lessons to learn from this model relate to community engagement and participation, and not the primary focus on fish advisories. This model could be useful for some populations but not others.

- **Partner with fishing community members to develop specifically tailored risk communication interventions.**

  The community-engagement model used in Georgia by Derrick and colleagues (2008) is a good example of an effective approach to developing a culturally-tailored risk communication strategy to increase knowledge of contamination and fish advisories and improve ability to make informed choices.

5. All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should engage and empower members of fishing populations so they can participate meaningfully in all stages of any prospective interventions, from initial conception and planning through implementation and follow-up monitoring for success.

The methods used by Burger and colleagues (2013) in New Jersey provide an excellent model for effectively engaging community members as research partners in planning and implementing research, evaluating and interpreting findings, and developing and disseminating risk communication information.

Community-based participatory methods can best ensure that interventions will account for the knowledge, beliefs, and cultural, social, and economic needs of fishers and their families. Although these methods are more time and resource intensive than traditional agency or "expert" driven approaches, they are more likely to ensure success.

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School of Public Health

Begin with mapping exercise, then move to discussion:

1. What does fishing mean to you (*prompt: what are some of the reasons that you fish – inexpensive food source, exercise, culture, etc.?*)?

2. Do you have cultural or traditional reasons for fishing?

3. What makes an area a good place to fish (*prompt: Why do you choose to go where you currently fish? close to where you live, types of fish, quality of fish, etc.)*?

4. How important is the location of the place you fish in your decision to fish there?

5. How far do you travel to reach your fishing site(s), and how do you travel to get there?

6. What types of fish do you like to catch throughout the year?

7. What do you do with the fish you catch (*prompt: Do you share the fish with friends or family? Eat the fish yourself? Sell the fish? Release the fish back into the water?*)

8. What do you know (or what have you heard) about eating fish contaminated with chemicals (D*o you think that eating contaminated fish is a major health risk? Do you believe that certain fish are less dangerous to eat than others? How do you try to avoid contamination in fish?*)?

9. Are you concerned about eating contaminated fish?

10. [Explain that people currently fish in the Duwamish River, and fish in the Duwamish River will continue to be unsafe to eat during the cleanup and after the cleanup. The EPA wants to find ways to discourage people from eating contaminated fish from the Duwamish River. What do you think about these possible ways to keep people safe from contaminated fish:

    a. Trading a clean fish for each contaminated a person catches?

    b. Giving people coupons or vouchers to buy clean fish?

    c. Driving people who want to fish to a place where fish are less contaminated?

    d. Adding salmon (which are usually safer to eat) to the River?

    e. Making a fish pond nearby where people can catch clean fish?

11. Can you think of any methods that would be better (more appropriate)?

12. Do you have any additional comments or questions about these issues, or is there anything else you would like to share?

SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON

JustHealthAction

DUWAMISH RIVER CLEANUP COALITION
Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Addendum for Public Comment Report

June 13, 2013

Assessment and Recommendations

Effects of the proposed cleanup plan on health of workers and employment in Lower Duwamish area industries

Part A

Technical report

This technical report supports our *HIA Public Comment Report*, which will be submitted to EPA on June 13, 2013. Part A of this technical report will be included within the *Public Comment Report*, and Part B will be submitted as an accompanying appendix.

A *Final HIA Report* will follow soon after June 13, for broader distribution. It is possible that this technical report will undergo changes between June 13 and the *Final Report*, because we will invite stakeholder input in the interim.

Acknowledgment and disclaimer

We are indebted to the many agencies, organizations, and individuals who have contributed their time, information, and expertise to this project.

This project and report is supported by a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts; and also by the Rohm & Haas Professorship in Public Health Sciences, sponsored by the Rohm & Haas Company of Philadelphia.

The views expressed are those of the authors and do not necessarily reflect the views of the Health Impact Project, The Pew Charitable Trusts, the Robert Wood Johnson Foundation, or the Rohm & Haas Company.

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Table of Contents

Readers are encouraged to focus on "Part A" of this report.

Part A is the actual "report, with text written by the report authors. Part B includes the evidence base for Part A, and consist of annotated references organized according to the research questions that guided this assessment. In many instances the annotations are substantial but consist almost exclusively of text, tables, and figures copied verbatim from the cited source, with nominal or no report-author comment. Substantial text by the report authors is generally confined to Part A. Reference citations in Part A [shown in square brackets] refer to chapter and section numbers in Part B.

PART A

Part A is the actual "report," with text written by the report authors. Part B is the evidence base for Part A, and consists of annotated references organized according to the research questions that guided this assessment. Reference citations in Part A [in square brackets] refer to chapter and section numbers in Part B.

1. Overview

This portion of the HIA examined possible effects of the proposed cleanup plan on the health of workers and employment in Lower Duwamish area industries. This assessment was prompted by concerns expressed by people in business and labor communities that the costs of cleanup, or cleanup-associated uncertainties, could have a negative effect on business performance, resulting in loss of jobs and employment options. Many types of uncertainty are mentioned, but common concerns are uncertainty about the ultimate dollar cost of liability, fears of legal actions or litigation, and seeming endlessness of the situation and liability.

From a health perspective, the major concern is job loss or under-employment. Employment is one of the strongest favorable determinants of health and well-being.[1] Employment and skill development generate personal income and increase the likelihood of future employment and income stability. Steady employment with a decent wage allows individuals and families to live in safe home and safe neighborhood with access to basic services, purchase healthful food, ensure education for their children, and afford child-care services. Steady employment and a decent wage can provide disposable income and time to enjoy pleasures of life, exercise, and ensure adaptive capacity to deal with unanticipated life challenges. Good jobs with benefits may provide health insurance which, along with a decent wage, ensures regular and timely access to health care, preventive, and health promotion resources. Together, these factors can reduce the risk of major preventable health problems such as obesity, diabetes, high blood pressure, heart attack, and stroke. Employment and higher income are associated with longer lifespan.[2]

Traditional manufacturing, wholesale trade, transportation and warehousing businesses in the Lower Duwamish area face a variety of pressures that could influence their productivity and economic viability, and that could stimulate changes in land use analogous to ongoing residential gentrification in local neighborhoods. It is plausible that the proposed cleanup of the Lower Duwamish River and related decisions could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employment. Lower skilled and lower income workers might face disproportionate risk of being laid off. Alternatively, it is plausible that existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river, and if this stimulated industry revitalization and economic robustness.

This assessment considered four major categories of possible cleanup-related effects: cleanup job creation, cleanup costs and business liability, business uncertainty, and industry revitalization. Any potential effects of the proposed cleanup plan on workers and employment in the Lower Duwamish area industries would not occur in a vacuum. Therefore, the assessment considered the context in which any cleanup-related effects would occur, recognizing that: cleanup-related effects could combine or interact with existing challenges faced by local industries; the priority of a problem or opportunity might appear more or less important, when viewed relative to other problems or opportunities; and possible future options or strategies may be more appealing to stakeholders if they can be tailored to address more than one problem or serve multiple needs.

1. Robert Wood Johnson Foundation. How Does Employment—or Unemployment—Affect Health? *Health Policy Snapshot: Public Health and Prevention*. March 2013.
2. Waldron H. Trends in Mortality Differentials and Life Expectancy for Male Social Security–Covered Workers, by Average Relative Earnings. *ORES Working Paper*, No. 108. US Social Security Administration. Oct. 2007.

2. Methods

A. Disclosure

This "workers and employment" assessment for the Duwamish Superfund HIA is a *desk-based* health impact assessment. The original HIA plan (and funding) was to focus only on three populations of concern: South Park and Georgetown residents, local Tribes with cultural ties to the Duwamish River, and non-tribal subsistence fishers. However, our Resident and Tribal Advisory Committees and Liaison Committee expressed additional concern about possible effects of the proposed cleanup on local industries and worker employment. In response, we added this fourth population assessment but had limited funding, staffing, and resources to do so. Therefore, this assessment was based almost entirely on review of existing literature and data.

In contrast to our three other population assessments, this assessment was *not* guided by a population-specific advisory committee or community advisors. We drafted plans to conduct key-informant interviews (and obtained UW Human Subjects exempt-status approval), but did not have enough time or staff to conduct them. We identified several existing reports that included interviews with local industry representatives about challenges that they face,[9.B; 9.C; 9.E] although none of those interviews focused specifically on possible effects of the proposed cleanup. Also in contrast to our three other assessments, we did not complete this assessment in time to share draft recommendations with our Liaison Committee (before the end of the EPA public comment period, June 13, 2013), for Committee member suggestions on how to word recommendations to be optimally understandable and potentially implementable by decision-makers. Consequently, we have erred on the side of making our recommendations more general than specific.

We welcome opportunities to meet with stakeholders, discuss our findings, explore recommendations and options, and consider whether any modifications or enhancements are warranted.

B. Materials

This assessment relied entirely on existing data and printed (pdf) or web-based materials that were available in the public domain. Data were obtained by download of existing datasets or by query at an online agency portal. Data sources included: U.S. Census, Washington Employment Security Department, and Puget Sound Regional Council. The assessment focused on workers and employment in major Duwamish Valley industries, particularly manufacturing (NAICS 31-33), wholesale trade (NAICS 42), transportation and warehousing (NAICS 48-49), and utilities (NAICS 22). Location-specific data were often not available specifically for utilities, because of agency policies preventing disclosure of data for an individual employer.

C. Procedures

Very few data analyses were conducted for this assessment but, when conducted, used MS-Excel.™ More than 250 printed or web-based resource materials were reviewed for this assessment. Copies of most materials were retained on a local computer, stored in a cloud-based Mendeley™ reference manager, and/or bookmarked. All materials were reviewed by William Daniell with assistance from Jonathan Childers. In order to facilitate review and re-review over the drawn-out period of assessment, relevant sections of text from *selected* materials were copied verbatim and pasted into this assessment document, organized according to the major HIA research questions that we identified during scoping (and formatively modified during the assessment). Selection of source material was based on relevance to a research question, source credibility, and contribution of new or more recent information without substantial redundancy relative to other selected source material. Copied text

was generally distinguished from author-generated text by indentation and bullet marks, without quote marks. The original resource citation was documented at the start of each respective copy/paste section. Materials viewed relatively recently during the period of assessment were often only documented by placing the reference citation under the appropriate reference question, without additional annotation.

Characterization of health effects (impacts) used the criteria described in our "Methods" technical report. All of our technical reports, including the present report, are included as appendices to our *Final HIA Report*.

D. Definitions

Many terms are used or defined differently in different source materials, particularly "industry" and the geographic bounds of industry in the Lower Duwamish area.

This assessment generally defined local "industry" as including manufacturing (NAICS 31-33), wholesale trade (NAICS 42), transportation and warehousing (NAICS 48-49), and utilities (NAICS 22). The term, WTU, is used in many sources to encompass wholesale trade, transportation and warehousing, and utilities (NAICS 42, 48-49, 22). At least one cited source studied "basic industry" in Seattle and additionally included construction (NAICS 23). Another source used the term "principal industry" sectors to denote manufacturing, wholesale trade, and transportation and warehousing.

The geographic scope of "Lower Duwamish River area" industries is variably defined by others as: the Duwamish Manufacturing Industrial Center (MIC), confined to Seattle or extending beyond the Seattle city limit; the natural watershed of the Lower Duwamish River (often called the Duwamish Valley or Lower Duwamish Valley); or the "constructed" watershed,[6.A.1] which includes portions of Seattle that are outside the natural watershed but contribute stormwater or combined sewer overflows (CSOs) to the Lower Duwamish River. The boundaries of geographical units in various data sources (e.g., ZIP codes, census tracts, forecast analysis zones) do not align perfectly with any of the "Duwamish" geographic categories, and therefore, summary statistics are generally only (reasonably close) approximations of the underlying reality.

This report attempts to specify or clarify at the point of use, what industry sectors and geographic scope are discussed. In general, when we refer to the Lower Duwamish area, we refer to the valley and natural watershed associated with the Lower Duwamish River, with particular attention to industries in the Duwamish MIC. Note, the section of demarcated as the Lower Duwamish Waterway Superfund site is just one 5.5 mile stretch of the Lower Duwamish River. There is additional waterway to the north (downstream), along Harbor Island and opening into Elliot Bay, and additional river to the south (upstream).[3]

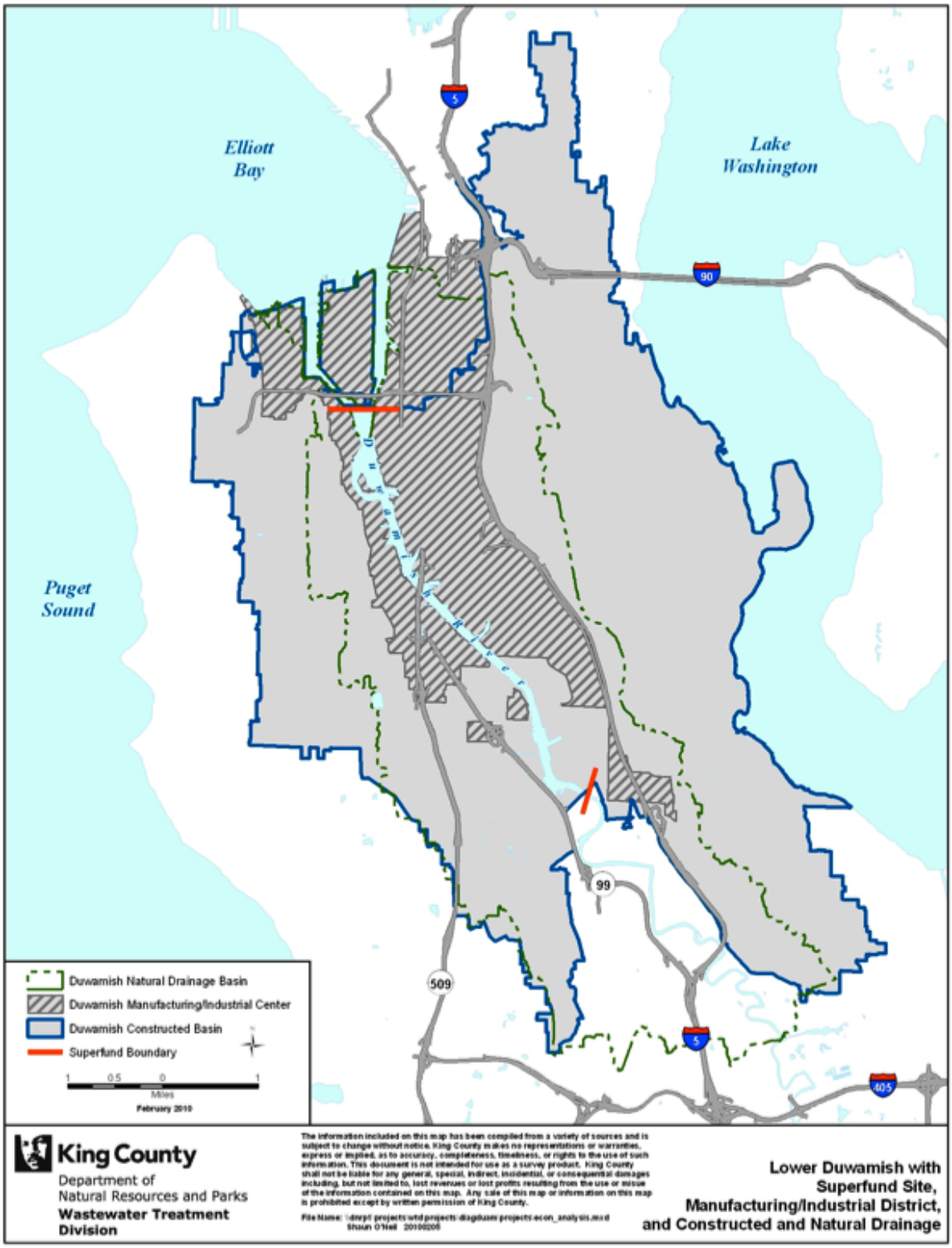
Maps in Figures 1 and 2 (next pages) illustrate these geographic relationships.

3. Note, Harbor Island and the East Waterway are part of the separate Harbor Island Area Superfund Site.

Figure 1: Map of Seattle's Manufacturing and Industrial Centers (MICs), including the Duwamish MIC and the *separate* Ballard-Interbay North-end MIC.[4]

4. Source of map: Exhibit 1 in *Basic Industries Economic Analysis* by Medford C, Forsyth M, Babb M, Couch D, Schrag T, Schwed R. (Community Attributes; produced for Seattle Office of Economic Development). July 2009. Original source: City of Seattle, 2008.

Figure 2: Map of Lower Duwamish River showing Lower Duwamish Waterway Superfund Site, Duwamish Manufacturing and Industrial District (MIC), and constructed and natural drainage.[5]



5. Source of map: Figure 1 in *Lower Duwamish Economic Analysis* by by Voight T, Josephson A, Goodman B, Warren E. (ECONorthwest; produced for King County Dept. of Natural Resources and Parks). March 2010. Original source: King County, 2010.

3. Baseline community profile

A. Employment

The Lower Duwamish River area is home to Seattle's and King County's largest concentration of industry, including the Duwamish Manufacturing Industrial Center (MIC) and Port of Seattle. The Puget Sound Regional Council (PSRC) estimated Duwamish MIC total covered employment in 2008 to be 65,333, representing about 38% of employment across the eight MICs in the Central Puget Sound Region.[7.A.3] Duwamish MIC employment included 15,445 employees in manufacturing and 15,696 employees in wholesale trade, transportation and warehousing, and utilities (WTU).

Another estimate by ECONorthwest, using data derived for an area larger than but encompassing the Duwamish MIC (ECONorthwest "Tier 2"), estimated 2010 employment to be about 25,000 people working in manufacturing and another 30,000 working in WTU industries (see "Table 1" below; by ECONorthwest).[6] [6.A.1]

Table 1: Geographic, Demographic, and Economic Characteristics of Tier 1 and Tier 2 Areas

Characterization*	Tier 1: Broader Area, Contributing Stormwater & Combined Sewer Overflows Reaching the Superfund Site	Tier 2: Narrower Zone, More immediately adjacent to the Area; Focused on Manufacturing/Industrial Zoning
Geography		
Characterization	Mixed uses; Mostly within Seattle; Many residential communities	Concentrated area of manufacturing & industrial activity; Mostly within Seattle
Size / Percent of County**	33.5 square miles / 1.5%	8 square miles
Population & Demographics		
2010 Population / Percent of County	135,000 / 7%	60,000 / 3%
Percent of King County's Low Income HHs	9%	4%
Forecast Population Growth 2010-20	Moderate; slower than rest of County	Moderate; slower than rest of County
2010 Households / Percent of County	51,000 / 6%	24,000 / 3%
2010 Person Per Household***	2.6; Higher than County average	2.5; Higher than County average
Employment & Economic Output		
2010 Employment / Percent of County	129,000 (10% of County)	106,000 (8% of County)
Percent in Manufacturing	21% (County = 10%)	24% (County = 10%)
Percent in Wholesale Trade, Transportation, Warehousing	24% (County = 14%)	29% (County = 14%)
Jobs/Resident Ratio	0.96 - higher than rest of City and County	1.75 much higher than rest of City and County
Average Annual Wage (2008)	$53,000 (County average = $57,000)	$56,000 (County average = $57,000)
Total Wages / Percent of County (2008)	$9 billion / 10%	$4.4 billion / 5%
Total Economic Output / Percent of County (2008)	$27.3 billion / 9%	$13.5 billion / 4.3%
Total Value Added (2008)	$15.6 billion / 9%	$7.3 billion / 4.3%
Forecast Job Growth 2010-20	Slightly slower than rest of County; share of manufacturing/industrial forecast to increase	Slightly slower than rest of County; share of manufacturing/industrial forecast to increase

Source: ECONorthwest analysis of data from PSRC, IMPLAN, and other sources.

*All 2010 population, demographic, and economic information based on PSRC Population, Household, and Employment Forecast, 2006

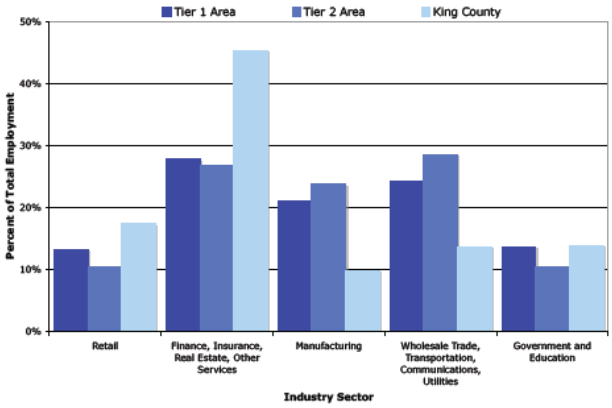
**Due to overlap of the zip codes and FAZs used to represent the Tier 1 and Tier 2 areas, the size of the area analyzed is greater than the areas shown in Table 1. For Tier 1, the area analyzed is 45 square miles based on zip code data and 39 square miles based on FAZ data; For Tier 2 area, the size of the area analyzed is 16 square miles based on zip code data and 24.6 square miles based on FAZ data. .

***Household population (not total population) used in denominator.

6. Source of Table 1: *Lower Duwamish Economic Analysis* by by Voight T, Josephson A, Goodman B, Warren E. (ECONorthwest; produced for King County Dept. of Natural Resources and Parks). March 2010.

The MIC represents less than 1% of King County land area but employment represents about 19% and 17% of manufacturing and WTU employment in the county, respectively (See "Figure 2," right; by ECONorthwest).[7] [6.A.1] Although sizable numbers of people are employed in retail (11,000) and services (28,000) in these areas, their percentages are much lower than King County averages.

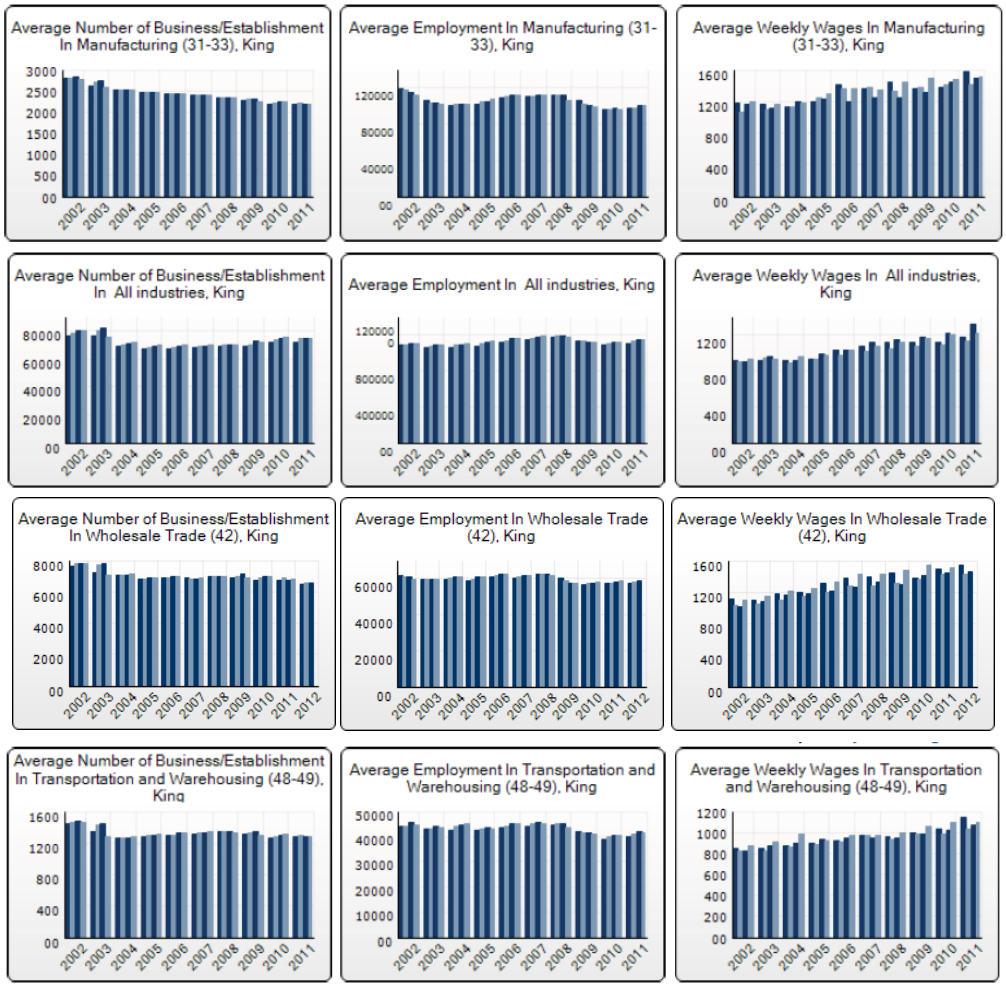
Figure 2: Distribution of Employment by Industry Sector, Tier 1 and Tier 2 Areas, and King County (2010)*



Source: ECONorthwest analysis of data from PSRC.
*Based on PSRC Population, Household, and Employment Forecast, 2006.

If one extends the geographic boundary to the larger, "constructed" watershed (ECONorthwest "Tier 1")—which includes businesses and employees that might be affected by the proposed cleanup—total employment is larger by an additional 23,000 (total 129,000), including 2,200 manufacturing and 900 WTU workers.[6.A.1]

Employment has been relatively stable in these industries, with signs of recovery since the 2008 economic recession. Overall, U.S. manufacturing has shown substantial growth since 2008,[7.A.6] and the Seattle area has led this trend, primarily due to aerospace jobs.[6.A.6] In the past decade, there has been cyclical variation in manufacturing employment in King County, with a steady decline in the number of businesses, but a relatively steady increase in average wages (see figures to right, compared to all industries; WA Employment Security Dept.). [7.A.2.a)] Wholesale trade, transportation and warehousing showed less variation in employment but also showed steady increase in wages.



7. Source of Figure 2: *Lower Duwamish Economic Analysis* by by Voight T, Josephson A, Goodman B, Warren E. (ECONorthwest; produced for King County Dept. of Natural Resources and Parks). March 2010

B. Wages

The Duwamish MIC is widely known for providing, "the largest concentration of family wage jobs in the Puget Sound region." [Puget Sound Regional Council; 6.A.1] However, as a study of "basic industry"[8] in Seattle noted, "While Basic Industry jobs do provide higher than average wages in Seattle, not all jobs are created equal."[6.A.5] This statement referred to the substantial differences between average wages for manager and professionals, compared to production workers, but can also be applied to differences between manufacturing industries. The Duwamish MIC does, without doubt, provide a large concentration of good-paying jobs that do not require higher education and that offer opportunities for people with entry-level skills. However, the average-wage statistics do not necessarily reflect wages of workers in production occupations.

The average annual wage in King County in 2011 was about $63,300.[7.A.2.c)] The average wage for relevant industries was about:

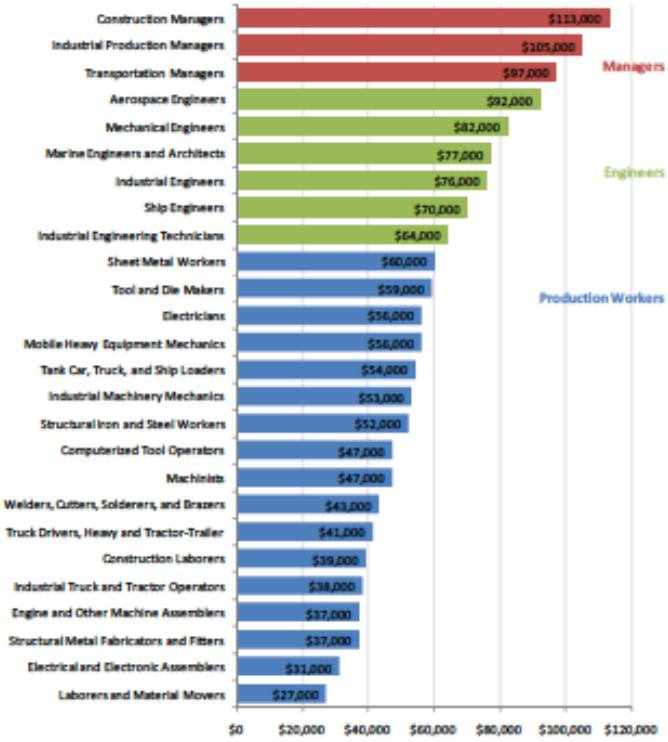
- $78,300 in manufacturing,
- $76,700 in wholesale trade, and
- $56,700 in transportation and warehousing.

However, manufacturing wages were highest for some industries that tend to require higher entry skills and/or have higher concentrations of employment outside the Duwamish area:

- $99,700 in transportation equipment mfg. (which includes aerospace mfg.),
- $92,200 in chemical mfg., and
- $86,000 in computer and electronic equipment mfg.

Manufacturing wages are, in fact, lower on average in the Duwamish area than for manufacturing elsewhere in King County. The ECONorthwest study found that the MIC ("Tier 2") region accounted for 19% of manufacturing employment in King County, but only 7% of wages in that sector.[6.A.2] In contrast, this region accounted for 17% of WTU employment, but 12-14% of wages in those sectors.

Exhibit 19
Average Basic Industry Occupational Wage Rates for the Seattle-Bellevue-Everett-Tacoma MSA, Selected Occupations, 2008



Source: Washington State Employment Security Department, 2008.

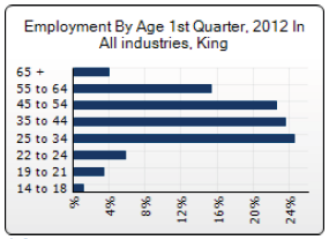
Wages differ substantially between occupations, as illustrated for "basic industry" in the Seattle-Bellevue-Everett metropolitan region (see "Exhibit 19" figure, above).[9] [6.A.5] In 2010, "production" occupations accounted for one-third (34%) of metropolitan regional manufacturing employment, and "transportation and material moving" occupations accounted for 6%.[7.A.2.d)] Nearly one-quarter (23%) of production occupations and half (50%) of transportation and material moving occupations had average annual wages under $30,000. For comparison, the U.S. Census poverty threshold for a four-person household in 2010 was $22,113,[10] and the average annual wage in King County was $63,600 in 2011.[7.A.2.c)]

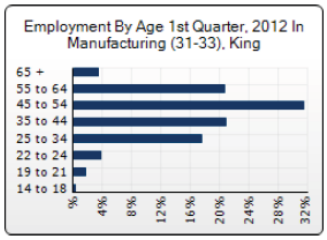
8. The "basic industry" category includes construction, in addition to manufacturing and WTU.
9. Source of Exhibit 19: *Basic Industries Economic Analysis* by Medford C, Forsyth M, Babb M, Couch D, Schrag T, Schwed R. (Community Attributes; produced for Seattle Office of Economic Development). July 2009. Original source: City of Seattle, 2008.
10. http://www.census.gov/hhes/www/poverty/data/threshld/

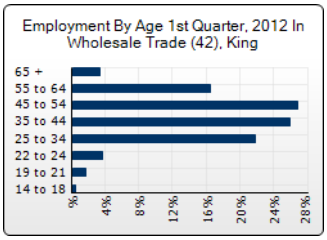
C. Demographics

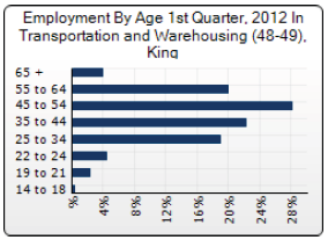
There is limited demographic information that is readily available for Duwamish area manufacturing and WTU workers. A 2009 study by the Port of Seattle found that about half (53%) of its 12,428 direct jobs were held by King County residents, and about one-quarter (28%) were held by Seattle residents.[6.B.2]

On average, workers in manufacturing and WTU industries tend to be older, based on Employment Security data for King County (see figures, below; compared to all industries).[7.A.2.b)] This is noteworthy because some employers are concerned about aging of their workforce and the seemingly limited interest among younger people in manufacturing or WTU employment.[9.B.3]









D. Economic connections

Lower Duwamish area industries have widespread economic connections throughout the local region and Washington state. This is relevant because any change or reduction in Duwamish industry employment could have economic and employment repercussions beyond the Duwamish industries. We did not identify estimates of economic connections for all Duwamish industries. However, Port of Seattle estimates are illustrative: a 2009 economic impact study of marine cargo and vessel operations identified: [6.B.2]

12,428	"direct" jobs (maritime services, 8,410; trucking, 1,931; railroad, 1,621; and administration),
4,224	"indirect" jobs, through local purchases by firms that directly depend on the seaport,
16,639	"induced" jobs, supported by purchases of directly employed workers, and
135,084	"related" jobs in Washington state, in firms connected to cargo moving through the seaport.

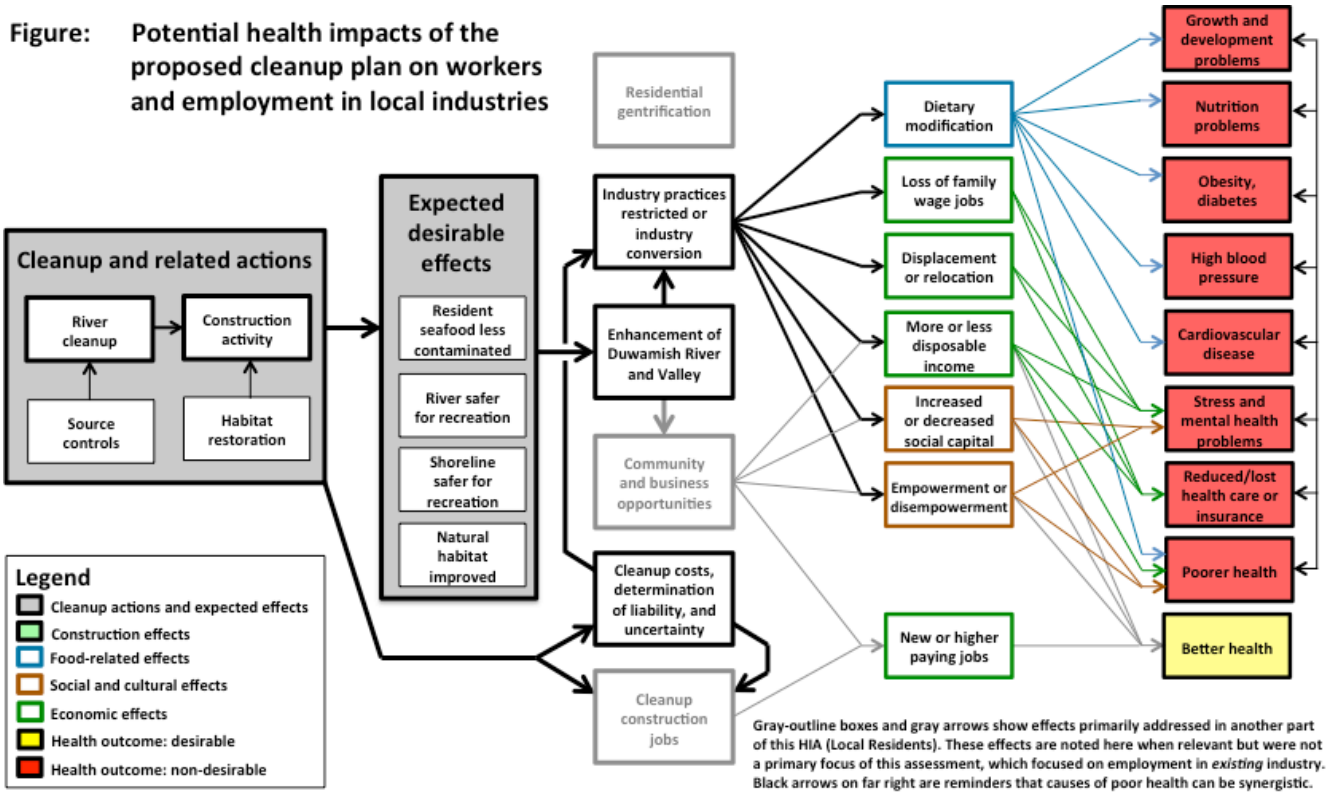
4. What are the major health outcomes of concern?

The potential health impacts of greatest concern for this assessment are related to employment in local industries—for current workers and local owners and for employment opportunities in the future.

Traditional manufacturing, wholesale trade, transportation and warehousing businesses in the Lower Duwamish area already face a variety of pressures that could influence their productivity and economic viability, and that could stimulate changes in land use analogous to ongoing residential gentrification in local neighborhoods. It is plausible that the cleanup and related decisions could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employment. Alternatively, it is also plausible that existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river, and if this stimulated industry revitalization and economic robustness.

The following logic model (see figure, below) illustrates potential health impacts of the proposed cleanup plan on workers and employment in Duwamish area industries.

Figure: Potential health impacts of the proposed cleanup plan on workers and employment in local industries



1. Health outcomes associated with employment

Employment is one of the strongest favorable determinants of health and well-being.[11] Employment and skill development generate personal income and increase the likelihood of future employment and income stability. Steady employment with a decent wage allows individuals and families to live in safe home and safe neighborhood with access to basic services, purchase healthful food, ensure education for their children, and afford child-care services. Steady employment and a decent wage can provide disposable income and time to

11. Robert Wood Johnson Foundation. How Does Employment—or Unemployment—Affect Health? *Health Policy Snapshot: Public Health and Prevention*. March 2013.

enjoy pleasures of life, exercise, and ensure adaptive capacity to deal with unanticipated life challenges. Good jobs with benefits may provide health insurance which, along with a decent wage, ensures regular and timely access to health care, preventive, and health promotion resources. Together, these factors can reduce the risk of major preventable health problems such as obesity, diabetes, high blood pressure, heart attack, and stroke. Employment and higher income are associated with longer lifespan.[12]

2. Health outcomes associated with unemployment or under-employment

Unemployment or under-employment means that an individual or family may compromise or sacrifice any of the health-promoting aspects of employment. Unemployment is also associated with stress and depression, which can substantially impair health and well-being.[13] Unemployment, particularly during business downturns, is associated increased risk of suicide.[14] Under-employment or unemployment might prompt individuals to seek alternative employment. For individuals who have limited or no transferrable job skills, alternatives might include expending additional time and cost to travel to a geographically distant area where similar work exists or taking a job in a closer area that requires fewer skills and may pay less. Both alternatives yield lower net income and could disproportionately harm lower-income households.

3. Importance or "severity"

Importance (or severity) is one of the categories used by this HIA to characterize possible health effects (impacts) of the proposed cleanup. The effects-characterization categories and definitions are described in the "Methods" technical report for this HIA. We use the terms, severity and importance, interchangeably. "Severity" is more intuitively understandable when applied to a potential adverse effect, but seems illogical when applied to a potential beneficial effect. Therefore, we use "importance" when considering a potential beneficial effect. We defined severity/importance with the question, "How important is the effect with regards to human function, well-being, or longevity, considering the affected community's current ability to manage the health effects?" [15] We rated severity/importance on a three-category scale: mild, medium, or high (or insufficient evidence).

In general, we rated the health outcomes associated with employment—and with unemployment or under-employment—as "medium." Although the associated health outcomes can truly range from mild to high, we concluded that medium was the best single, representative rating for the present situation. The potential health benefits of employment can vary substantially, depending on the individual's salary and employment benefits, total hours of employment (and hours of free time), household size, and other sources of household income. Conversely, the potential adverse health outcomes of unemployment and under-employment depend on the duration of that status, options for re-employment, and social safety net. At this particular point in time, economic conditions in Seattle and King County have substantially improved since the 2008 recession, with a recent reported unemployment rate of 4.4%, among the lowest in major U.S. cities.[7.A.1; 7.A.2] Unemployment benefits have generally proven to be relatively secure and long-lasting during the recession. Consequently, we concluded that "medium" ("Acute, chronic, or permanent effects that substantially affect function, well-being, or livelihood but are largely manageable within the capacity of the community health system") was the optimal single rating for employment-associated beneficial and adverse health outcomes.

12. Waldron H. Trends in Mortality Differentials and Life Expectancy for Male Social Security–Covered Workers, by Average Relative Earnings. *ORES Working Paper*, No. 108. US Social Security Administration. Oct. 2007.
13. Zukin C, et al. Out of Work and Losing Hope: The Misery and Bleak Expectations of American Workers. *Work Trends*. Sept. 2011. John J. Heldrich Center for Workforce Development at Rutgers, State University of New Jersey.
14. Luo F. Impact of business cycles on US suicide rates, 1928-2007. *Am J Public Health*. 2011; 101(6):1139-46
15. Bhatia R. *Health Impact Assessment: A Guide for Practice* (2011).

5. Assessment

This chapter describes our assessment of potential effects of the proposed cleanup plan on workers and employment in Duwamish area industries. The chapters in Part B of this report provide the evidence base for the assessment, and consist of annotated references or simple reference citations organized according to the research questions that guided the assessment.

A. Context

Any potential effects of the proposed cleanup plan on workers and employment in the Lower Duwamish area industries would not occur in a vacuum. Potential cleanup-related effects are best appreciated by considering the context in which they would occur. It is conceivable that cleanup-related effects could combine or interact with existing challenges faced by local industries. The priority of any one problem or opportunity might appear more or less important, when viewed relative to other problems or opportunities. Most importantly, possible future options or strategies may be more appealing to stakeholders if they can be tailored to address more than one problem, serve multiple needs, or aim for broader goals.

Manufacturing, wholesale trade, transportation and warehousing businesses in the Duwamish Valley already face a variety of pressures that could or already do influence their productivity and economic viability. Some of these are longstanding, but others are newly manifesting or looming on the horizon.

1. Economic conditions

The existing surveys of local industry representatives about the influence of general economic conditions are colored by whether the survey was conducted before or since the onset of the 2008 recession. However, the U.S. economy and particularly the local economy show clear signs of recovery.[8.B] Unemployment in Seattle and King County had dropped to 4.4% as of April 2013, almost half of rates still seen in other major U.S. cities.[7.A.1; 7.A.2] As mentioned earlier, U.S. manufacturing has shown substantial growth since 2008,[7.A.6] and the Seattle area has led this trend, primarily due to growth in aerospace employment.[6.A.6] The Puget Sound Regional Council projects that regional manufacturing employment will decline slightly between now and 2040, although employment is expected to grow in the Lower Duwamish area.[6.A.2; 8.A; 8.C] Higher growth rates are projected for other regional industries, such as information technology, life sciences, and clean technology.[8.C]

2. International trade

To quote the Puget Sound Regional Council's *Vision 2040*, "More than any other state in the nation, Washington's economy depends on foreign trade — and the central Puget Sound region is vital to the majority of the state's trade activity." [8.C] The Seattle area is a leader among U.S. export markets: 6th largest in 2011, with $41 billion in exports, up 16% compared to 2010,[6.B] although shipping volume declined between 2011 and 2012.[9.I.5] Other leading metropolitan areas, notably New York, are reported to have made larger overall recoveries than Seattle since the 2008 recession.[9.I.5]

The Port of Seattle is geographically and strategically well positioned for future trends in Pacific shipping but faces serious competition. The global trend in cargo shipping is toward larger and more fuel-efficient ships (per ton of cargo), which are too large to traverse the Panama Canal even after canal expansion.[9.I.2] For Asian cargo ships bound for the U.S., including east coast markets, it is cost competitive to transload cargo at west

coast ports and then ship overland by rail. The ports of Los Angeles and Long Beach are larger than Seattle but already operate at or near full capacity. They are also farther from east and northeast Asian ports than Seattle. Ports in British Columbia offer major competition to the Port of Seattle for these markets, particularly given existing resources and plans for port expansion in Vancouver and Prince Rupert.[9.I.2; 9.I.6] Of note, the rail route from Prince Rupert has less elevation gain than the route from Seattle.[9.I.2]

The Port of Seattle has made important steps toward expanding port capacity. In its recently adopted *Century Agenda* strategic plan, the Port of Seattle ambitiously aspires, "Over the next 25 years, we will add 100,000 jobs through economic growth led by the Port of Seattle, for a total of 300,000 Port-related jobs in the region, while reducing our environmental footprint." [9.I.1] The Port has made substantial infrastructure improvements toward this goal. The 2013 *North American Port Analysis* by Collier's International reported, "Norfolk, Seattle, and Miami have already spent in excess of $100 million in [capital expenditure] from 2010–2012, or have appropriated project funding after 2013 that will likely place them among [the] top five in 2014." [9.I.5] As of July 2012, the Port had installed 13 "super post Panamax" cranes, capable of handling the largest container ships.[6.B.1]

Traffic congestion and limited access to major highways and freeways are longstanding local problems for the Port of Seattle.[9.G] Although most imported cargo containers are transferred by truck to local rail facilities, the majority of exports are delivered to the Port by truck. Thus, street access is essential, and traffic congestion creates a serious bottleneck for Port operations. Street infrastructure improvements in recent years have not alleviated the problem. The situation is worse during events at the existing stadiums and is projected to worsen if a third stadium is constructed (see below).

3. Location, location, location

The Lower Duwamish area, and specifically the Manufacturing-Industrial Center (MIC), is an ideal location for many businesses and essential for others.[9.A; 9.B.2; 9.C; 9.D] The marine cargo services of the Port of Seattle could not exist anywhere else. There are few or no alternative choices of location in Seattle, where water-dependent businesses could have as much unrestrained water access and mobility as they have with the Lower Duwamish Waterway and Harbor Island. The marine terminals, Boeing Field, and rail and highway-freeway infrastructure offer access to sea, land and air transportation that is unrivaled in the region. The high concentration of industry in the Duwamish area allows transactions between suppliers, customers, and interdependent businesses that would be much less robust in a smaller or outlying location. The "close-in" location, close to downtown Seattle, also allows proximity to the urban workforce and professional and technical support services.

The closest alternative manufacturing-industrial center, the Kent MIC, offers many appealing features, such as greater availability of land, more building vacancies, lower lease or purchase costs for buildings or land, and newer and larger building stock.[6.F] However, even if it was feasible for a business to relocate there, the cost savings of relocation could easily be outweighed economically by the loss of advantages available in the Duwamish MIC.

The Duwamish MIC location does, however, have shortcomings. Industry representatives commonly describe problems with road infrastructure and traffic congestion.[9.B.3; 9.C; 9.D; 9.E; 9.G] Some areas are relatively isolated from others by rail lines, major highways, the Duwamish River, and the disabled South Park bridge.[6.G.2; 6.G.3] The Duwamish MIC is built on flat, low-lying landfill, and the associated drainage problems make it difficult to maintain streets.[6.G.2; 6.G.3] Seattle land use policies and regulatory structures are often described as burdensome or restrictive.[9.B.3; 9.C; 9.D; 9.E] Much of the building stock is relatively old, and options for business expansion are substantially constrained by a variety of factors including little to no unbuilt

land, fragmented ownership of land parcels, low turnover of property ownership and leases, low lease vacancy rates, and high costs of renovating or replacing existing buildings.[6.D.1; 6.E; 6.E.1; 6.G.2; 6.G.3; 6.G.4]

4. Industrial development

The City of Seattle has made major commitments to sustain industry in the Duwamish MIC, embodied in the Seattle Comprehensive Plan and reinforced by a 2007 ordinance that limits the size of non-industrial development in Seattle MICs, particularly in the general industry IG1 and IG2 zones.[6.C.1; 6.C.2; 6.C.3] The Industrial Development District Pilot Program is one manifestation of this commitment, offering potential incentives and efforts to resolve regulatory challenges to industrial development.[9.E] The Port of Seattle was added to the Seattle Comprehensive Plan in 2012.[6.C.2.c)]

Nonetheless, industry representatives often express concern about encroachment on and conversion of industrial land in and around the MIC.[9.B.3; 9.C] These concerns are readily acknowledged in King County commercial real estate assessments,[6.G.2; 6.G.3] and are reinforced by the highly visible and popular pressures for non-industrial development in the "Stadium Transition Overlay" within the SODO subarea of the Duwamish MIC (see below).[9.H.1]

5. Industrial workforce

Several workforce-related trends pose challenges for industry. In one study of Seattle basic industries,[16] half of the interviewed business owners said the limited availability of skilled workers was a major constraint on business growth.[9.B.3] One offered explanation was that younger people are less interested in and less prepared for blue collar jobs than in the past. This impression is supported by the observation that the age distribution is generally older among existing employees in manufacturing, transportation and warehousing industries, compared to the overall regional workforce.[7.A.2.b)] The high cost of living in Seattle is another factor that limits the available labor pool.

6. Commercial real estate

Seattle is increasingly a national and even international target for real estate investors. A recent, large nation-wide survey of real estate industry experts placed Seattle in the top ten cities with favorable overall real estate prospects: #7 overall and #4 specifically for industrial/distribution property.[9.F] The report noted, "Interest is also very strong in industrial space, with over 51 percent indicating now is the time to buy. Investors favor Seattle industrial space for a few reasons, including the 'industrial-to-mixed use transition taking place for many suburban industrial and business park sites,' as well as the city's position 'serving as the main corridor to Asia.'"

These survey findings are supported by local statistics for industrial real estate.[6.F] Vacancy rates are signifi-cantly lower for the Seattle "close-in" industrial market than elsewhere in the county and state. Warehouse rental costs are steadily increasing. Real estate speculation is likely to drive conversion of warehouse space, particularly in the SODO district. The 2012 report of the King County Assessor for large warehouses noted:

> The Sodo-Seattle district has seen extensive redevelopment in recent years. The industrial owners are watching this area sharply with the prospect of more new development by the stadiums. Land values have risen near the stadiums which have caused a couple larger warehouses to be obsolesced. A very recent proposal by a wellfunded consortium of investors (headed by a San Francisco hedge fund manager with ties to the local area) to construct a third sports arena just south of Safeco Field is also fueling further interest in this area.... There were no industrial market sales of

16. Basic industries: manufacturing, WTU, and construction.

warehouses over 100,000 square feet in area 500-60 [Seattle close-in] in the last three years…. Many property owners are sitting back and waiting to see what develops in this area.[6.G.4]

7. SODO area and stadiums

Development pressures in the SODO area pose one of the biggest current challenges to the integrity of the Duwamish MIC. A group of investors has proposed building a third athletic stadium in this area, to be home for an NBA team and possibly an NHL team. Seattle and King County have entered into a formal Memorandum of Understanding with the investor group.[9.H.2] In December 2012, two volunteer public boards, Washington State Major League Baseball Stadium Public Facilities District (PFD) and Washington State Public Stadium Authority (PSA) put forth a concept plan with "A Vision for Tomorrow: Create a unique and lively destination stadium district for all with retail, residential, entertainment and other complementary uses." [9.H.2] The concept has high profile support, including Seattle former mayor Charles Royer as PFD chair.

The stadium and development proposals have met resistance, particularly from the Port of Seattle, Seattle Manufacturing Industrial Council, and the International Longshore and Warehouse Union. A report by the Seattle Planning Commission plus reports commissioned by the Port of Seattle voiced concerns about detrimental economic and traffic impacts on the Port and the Duwamish MIC.[9.H.3] The City of Seattle recently began an Industrial Lands Study of the Duwamish MIC, with draft recommendations expected in July 2013, "to make sure we can protect industry and port operations in light of the proposed basketball arena and other nearby changes." [9.H.4] The City is also preparing to undertake an Industrial Areas Freight Access Project, with recommendations expected January 2014.[9.H.4]

What is often called the stadium "district" is more correctly identified as the "Stadium Transition Area Overlay District," superimposed on the MIC.[9.H.1] The SODO "district" is a subarea of the Duwamish MIC, most of which is zoned as Industrial Commercial (IC; as opposed to IG1 and IG2, for general industry). Stadium siting is allowed in this zone, as well as office, retail, and restaurant land use. A zoning change or variance would be necessary for more expansive use, such as proposed hotel and residential development. Although the investor group suffered a recent setback in its bid to purchase and relocate an NBA team to Seattle, their continued efforts, the concept plan for development, and associated real estate speculation provide strong momentum towards possible conversion of this MIC subarea to non-industrial uses.

B. Experiences in other places

Pressures to convert industrial land to non-industrial use are not unique to Seattle. The Seattle Department of Planning and Development in 2007 surveyed city staff in eight North American cities about industrial land use issues: Portland, OR; Vancouver, BC; San Francisco, CA; Los Angeles, CA; Chicago, IL; Minneapolis, MN; Boston, MA; and Philadelphia, PA.[11.A] Respondents in all eight cities reported pressures, in some cases "tremendous," to convert industrial lands to non-industrial uses. "According to most respondents, demand generates pressure on city government to change land use regulations or grant special conditions. High demand also generates land speculation, which inflates land values and rents. Respondents also indicated that conversion pressures were keenly felt by industrial lands in shoreline areas."

Urban waterfront revitalization efforts often focus on brownfields or post-industrial lands, where there is no longer a substantial industry presence. However, when revitalization targets abut or overlap active industrial land, particularly in cities with active maritime industries, the result can be intense conflict and encroachment on or conversion of industrial land; contemporary examples include Brooklyn, NY, Providence, RI, and Portland,

OR.[11.E; 11.E.1.a); 11.B] Portland provides one opportune situation for comparison with Seattle, especially given its geographic proximity and similarities in "west coast" culture.

The federal Urban Waters partnership, which began in 2011 and now has seven pilot locations, may eventually provide additional examples for comparison.[11.F] However, the Great Lakes restoration efforts provide a particularly interesting examples to consider, especially the active partnerships with industry.[11.G.1]

Many cities have invoked measures to preserve or protect industrial land. There is a plethora of "industrial lands" studies in various U.S. cities, documenting the status of and challenges to industrial land use in that location. The experience in Chicago, however, is probably most informative because of its long history.[11.C]

1. Portland, Oregon

In a situation parallel to that with the Lower Duwamish River of Seattle, the Willamette River in Portland, Oregon has been contaminated by more than a century of urban and industrial pollution. Downstream of downtown Portland, the soil and sediment along the river have been found to contain 29 compounds that constitute risks to human health and 89 chemicals that pose ecological risks.[17] In 2000, EPA added the Portland Harbor site to the Superfund priority list. By the end of 2014, EPA plans to finalize the cleanup plan for the site.

While the EPA has composed its cleanup plan, the City of Portland developed its North Reach River Plan, which encompasses the Portland Harbor Superfund Site.[11.B] As adopted by the Portland City Council in 2009, the River Plan is intended to comprehensively update the City's Willamette Greenway Plan, zoning code, and design guidelines, in order to support "the uses and development that make up the working harbor while balancing the need for a clean and healthy river."[18]

Adding to the complexity of planning in the harbor area, local industries have expressed concerns regarding limited land available for growth and pressures from residential encroachment and industrial land conversion. In addition, the harbor industries report that perceived risks regarding Superfund liability, and the general complexity and difficulty of negotiating brownfield development, currently inhibit industrial waterfront development.[19] In light of these issues, the City Council's adoption of the River Plan was appealed by three industrial parties: Gunderson, Schnitzer, and the Working Waterfront Coalition (WWC), an "organization of businesses concerned about the environmental health and economic vitality of the Portland Harbor."[20] The industries argued that, according to State Planning Goal 15's requirement to protect lands committed to urban uses, the City shouldn't be able to regulate waterfront industrial land, other than for new development.

The local Land Use Board of Appeals and the Court of Appeals upheld the legitimacy of the River Plan in 2011, as did the Oregon Supreme Court in 2012, finding that "nothing in the text of Goal 15, its relevant context, or its adoption history supports the conclusion that the goal unambiguously expresses an intention to preclude local governments from regulating developments of industrial and other urban uses that do not constitute intensifications' or 'changes' to those uses."[21] The legal challenge did reveal the need for additional economic analysis and inventories to inform the River Plan. Planning staff has outlined the intent to review implications of the new findings with stakeholders representing industry, communities, and the environment, in order to make plans that comply with state law, foster ecological recovery, and support health and a working river.[22]

17. Lower Willamette Group. 2011. Executive Summary: Portland Harbor Superfund Site Remedial Investigation Report.
18. City of Portland Bureau of Planning and Sustainability. 2013. North Reach River Plan. www.portlandoregon.gov/bps/42542
19. City of Portland Bureau of Planning and Sustainability. 2006. Working Harbor Reinvestment Strategy Business Interview Results.
20. Working Waterfront Coalition. 2013. About the Working Waterfront Coalition. www.workingwaterfrontportland.org/about_wwc.shtml
21. *Gunderson, LLC v. City of Portland*, 352 Or. 648, 290 P.3d 803 (Or. 2012)
22. City of Portland Bureau of Planning and Sustainability. 2012. Update on North Reach Court Ruling and the Path Ahead. www.portlandoregon.gov/bps/article/420929

The situation in Portland offers many points for comparison with the Lower Duwamish area, particularly if community or industry revitalization efforts are considered here. However, the Portland situation is still early in its evolution, and comparison options are limited. If nothing else, the situation in Portland illustrates the adversarial relationships that can arise if revitalization efforts are not adequately inclusive of all stakeholder interests, particularly those of industry.

2. Great Lakes restoration

The Great Lakes restoration, propelled by the 2002 Great Lakes Legacy Act, is a regional U.S.-Canadian effort to revitalize waterfront land, and to remediate brownfields and contaminated lake and river sediments, particularly at 40 "Areas of Concern," accomplished through public-private partnerships and coalitions of community organizations, municipalities, industry and academic institutions.[11.G] A 2007 benefit-cost study estimated that investment of $26B (billion dollars) in ecological restoration would eventually yield more than $50B in benefits to the national economy, and $30-50B to the regional economy.[23] Although some of the active restoration sites involve industrial lands or commercially active waterways, one of the more noteworthy aspects for the present HIA are the relatively active partnership roles and contributions of industry.

The Council of Great Lakes Industries (CGLI) "represents industries and businesses with significant investments, facilities, products, or services in the Great Lakes region. Members are drawn from manufacturing, utilities, transportation, natural resources, financial, services, and trade." [11.G.1] Members include major corporations and institutions such as the American Chemistry Council, BP Corporation, Dow Agrosciences, Dow Chemical, DuPont, Lafarge North America, and Shell Canada. Their vision statements provide an enviable model and goals for other industry coalitions to consider; for example:[24]

> Our vision for the future, which we are working to achieve, has been shaped by many of the region's stakeholders. Essential to achieving the following breadth of vision within the Great Lakes basin, is broad implementation of an equitable public. How the region's emerging issues are addressed by all participants in the Great Lakes region policy process. It is the best way to harness all of the region's energy and resources behind a collective vision. This requires that policy in the region is created and implemented utilizing the best science and risk/benefit principles and is based on an integrated view of economic, societal and environmental health and safety issues.
>
> Working together, the members of the CGLI along with the governments of the U.S., Canada, States and Provinces; educational institutions; public and private agencies; and the hundreds of public interest groups focused on the Great Lakes region can achieve this vision of a region for future generations.
>
> Our Vision for the Environment: CGLI's vision for the future of the Great Lakes environment is one that includes lakes which are appreciated for their beauty, healthful to mankind and to wildlife, and useful to the population. This vision of our lakes may be measured by the following criteria:
>
> - Fishability: No restrictions on the human consumption of fish as a result of the presence of contaminants in the lakes.
> - Swimmability: No bathing beaches being closed as a result of human activities.
> - Drinkability: Treated drinking water is safe for human consumption.
> - Healthy Human Populations: Human populations in the Great Lakes basin are healthy and free from acute illness associated with high levels of chemical or microbiological contaminants, or chronic illness associated with long-term exposure to low levels of contaminants in the Great Lakes.
> - Biological Community Integrity and Diversity: Evolutionary cycles that encourage the diversity of biological communities and the genetic variation within species are maintained.
> - Physical Environment Integrity -- Wetlands are restored in appropriate areas, land use is well planned and sustainable forestry practices are used. Progress in land planning and funding for restoration of wetlands is achieved.

23. Austin JC, et al. *America's North Coast: A Benefit-Cost Analysis of a Program to Protect and Restore the Great Lakes*. Healing Our Waters – Great Lakes Coalition, and Council of Great Lakes Industries. Sept. 2007.
24. CGLI. *Council of Great Lakes Industry's Vision for the Great Lakes Region*. [Accessed June 2013]. www.cgli.org/vision.html

3. Chicago

In reaction to gentrification and encroachment on industrial land, the City of Chicago in 1988 created the Clybourn Corridor Planned Manufacturing District (PMD), followed by the Goose Island and Elston Corridor PMDs in 1990, and eventually 11 more PMDs.[11.C] One recent praiseworthy article reported, "Chicago's success has been heralded as a model for economic development in cities across the country, including New York, Seattle, Portland and Milwaukee."[25] However, a 2005 study by University of Wisconsin examined performance of those first three PMDs during 1988-2004 paints a mixed picture of success.[26]

> Of the three PMDs, the Clybourn Corridor has fared the worst in terms of industrial retention. Despite the establishment of the PMD in 1988, the Clybourn Corridor has transitioned from a largely industrial area to a retail area. For every new retail job created during the 1988- 2004 period, roughly one manufacturing job was lost.
>
> The Goose Island PMD has performed the strongest of the three PMDs. Jobs on Goose Island rose from 1,256 in 1988 to just over 2,000 in 2004. Manufacturing did not fare as well as 3 other sectors, however, with employment falling from 406 workers in 1988 to 310 workers in 2004. A worker on Goose Island today is more likely to be employed in a warehouse than in an industrial firm. The decline of value-added activities on Goose Island and in the other PMDs has likely affected the earnings of workers in a negative way.
>
> The industrial retention performance of the Elston Corridor PMD has been comparable to Goose Island, with manufacturing experiencing a decline from 1988 to 2000 but showing signs of recovery in more recent years. Confidence in the PMD among Elston Corridor stakeholders is weak in places. Vacant property in some locations has created the perception that the PMD is no longer working effectively.

The first in a University of Chicago series on *Manufacturing Chicago's Future* concluded, "Current enthusiasm for local and regional policies to strengthen manufacturing in metropolitan Chicago is founded."[27] However, the conclusion included a cautionary note about decentralization and inadequate coordination:

> The decentralization of manufacturing from the city of Chicago and, to a lesser extent, from suburban Cook County, presents a challenge for local manufacturing policy because manufacturers are more productive when they locate in areas that have dense concentrations of other manufacturing and service companies. Cook County, with nearly half of all manufacturing jobs in the metropolitan area, offers manufacturers those benefits of density, as do concentrations of business in other parts of the metropolitan area. In deciding where to locate, manufacturers (and other companies) do not take into account the benefits that their individual decisions to locate in areas of greater density have on other companies. Likewise, they do not take into account the costs that they impose on other companies when they move away from such dense areas. Public policy should strengthen manufacturing in existing areas of manufacturing density. To design the right policies, it is important to know why decentralization is occurring (e.g., outlying areas may offer better access to highways and O'Hare Airport or more modern industrial facilities). Such knowledge can help county and municipal governments determine whether it is possible to offset the incentives to decentralize that companies face and, if so, how.
>
> A final challenge for Chicago-area manufacturing policy efforts is that they are not, at present, coordinated with one another. This creates the danger that different policy efforts may work at cross purposes or that separate efforts may not be large enough to take full advantage of economies of scale. Although there is no need for all policy efforts to be conducted by a single public or private organization, manufacturing policy in Chicago would benefit from some looser form of coordination.

Thus, one take-home lesson is that, even with a renowned model of planned-manufacturing development, the pressures against centralized urban industry are continuous and require ongoing maintenance and coordination.

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25. Chambers G. *The LEED Council: Three Decades of Industrial Preservation*. LISC Chicago. June 20, 2012. http://www.lisc-chicago.org/news/1898
26. University of Wisconsin-Milwaukee Center for Economic Development. *Curbing Industrial Decline or Thwarting Redevelopment? An Evaluation of Chicago's Clybourn Corridor, Goose Island, and Elston Corridor Planned Manufacturing Districts*. Nov. 2005
27. Wial H. *Manufacturing Chicago's Future*: *Locating Chicago Manufacturing: The Geography of Production in Metropolitan Chicago*. Center for Urban Economic Development, University of Illinois at Chicago. Feb. 2013.

C. Potential health impacts of the proposed cleanup

This HIA assessment considered four major categories of possible cleanup-related effects: cleanup job creation, cleanup costs and business liability, business uncertainty, and industry revitalization. For each category, the health outcomes of concern are related to employment, particularly loss of employment or under-employment attributable to business turnover or change in the types of industry in the Lower Duwamish area. The potential associated health outcomes and their severity/importance are described in Chapter 3 of this report.

In looking at these possible effects, it is important to consider at least three different industry categories where employment and economic output might be affected by the proposed cleanup:

1. All businesses in manufacturing and WTU industries in the Lower Duwamish area;
2. Potentially liable entities: private businesses and public entities that have been identified as Potentially Responsible Parties (PRPs), or that believe EPA might eventually consider them potentially liable, for costs of the Lower Duwamish Waterway cleanup; and
3. Liable entities: private businesses and public entities that are ultimately determined to be liable for cleanup costs.

A City of Seattle study identified 1,083 "basic industry" workplaces in the Duwamish MIC in 2007.[28] [6.A.5] Four PRPs voluntarily organized as the Lower Duwamish Waterway Group (LDWG)—City of Seattle, King County, Port of Seattle, and The Boeing Company—completed the site assessment for the Remedial Investigation and Feasibility Study, and has conducted or planned Early Action cleanups.[10.A] As of November 2012, the EPA had sent General Notice Letters to an additional 111 PRPs, and Information Requests to 325 other entities. The latter will not necessarily be PRPs, but they might reasonably believe themselves to be at risk for PRP determination. The EPA can continue to identify PRPs before, during, and (within limits) after the cleanup. In some situations, the identified PRPs may attempt to identify other, yet unidentified PRPs to potentially share cleanup costs.

1. Cleanup job creation

Will the proposed cleanup create jobs in the Lower Duwamish area, and whom will they benefit?

Direction of effect:	**BENEFICIAL**
Likelihood:	**Very likely**
Magnitude:	**Limited-moderate**
Importance (severity):	**Medium**
Distribution:	**Disproportionate benefits**
Adequacy of evidence:	**Somewhat incomplete**

It is not possible to quantify the number and type of jobs, nor how many local businesses will be involved, until the cleanup plan is finalized and logistic planning begins.

A 2010 economic impact study by ECONorthwest (conducted for King County) estimated economic impacts and job creation for each cleanup alternative identified in the Lower Duwamish Waterway Feasibility Study.[10.D] The analysis assumed that King County firms would do the cleanup work where possible, and ultimately concluded that "as much as three-quarters of spending may be allocated to firms located within King County and 60% allocated to firms in the City of Seattle…. Spending on some clean-up activities, especially

28. The "basic industry" category includes construction, in addition to manufacturing and WTU

landfill costs, will take place outside of King County." EPA originally projected the cleanup costs for the 5C alternative to be $299M (million dollars; note, the proposed plan uses alternative "5C+"). The ECONorthwest study estimated that alternative 5C would produce $377M total economic output in King County, considering the direct costs plus associated indirect and induced economic effects, and would generate an average of 270 "full year" jobs in King County during the 7.7 year construction period. Of these jobs, 69 were estimated to be with firms in the Lower Duwamish area. Many of the jobs would be full-time but part-year (estimated, 480). The amount spent for each King County job was estimated to be about $140,000, which is lower than typical for construction jobs in King County ($170,000), because the materiel needs for cleanup are less than for other types of construction.

a) Magnitude and distribution of beneficial effect

The ECONorthwest analysis suggests that the proposed cleanup is very likely to generate a substantial number of jobs throughout the construction period, and a majority of those jobs could go to King County-based workers and businesses, if there are intentional efforts to do so. Thus, much of the direct cleanup expenditures could be retained in the local economy. The number of jobs generated with local, Lower Duwamish area businesses would be small relative to overall number of workers and businesses in that local area, and the healthful benefits would accrue to workers (and business owners) employed in a limited subset of businesses; for example, marine construction, barging, intermodal transfer (barge to rail), and rail operations. The direct benefits of job creation would probably be limited or none for a substantial majority of the Lower Duwamish businesses that will be liable for cleanup costs.

The healthful benefits of employment are potentially more likely to serve workers who already have necessary trade skills or related job experience, than unskilled and lower-income workers. The Superfund Jobs Training Initiative (see "Local residents" technical report for this HIA) or other training or hiring initiatives could help reduce this potential inequity.

2. Cleanup costs and business liability

Who will bear the costs of the proposed cleanup, and how might that affect employment and health?

Direction of effect:	**ADVERSE**
Likelihood:	**Likely**
Magnitude:	**Insufficient evidence; limited-moderate**
Severity/importance:	**Medium**
Distribution:	**Disproportionate harms**
Adequacy of evidence:	**Moderately incomplete**

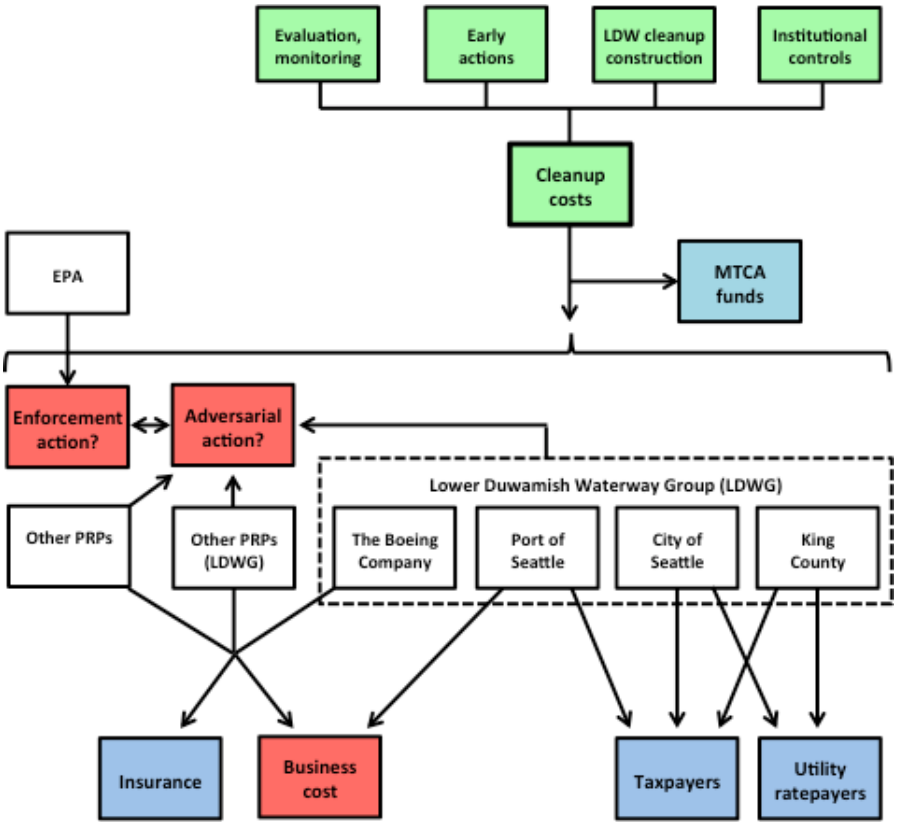
The EPA estimates the cost of the proposed cleanup to be $305M. The Lower Duwamish Waterway Group (LDWG) is a voluntarily formed working group consisting of four potentially responsible parties: King County, City of Seattle, Port of Seattle, and The Boeing Company. LDWG reports having already spent "over $135 million both on studies to date and on cleaning up early action areas." [www.ldwg.org]

The distribution of liability has not been resolved. As of November 2012, the EPA had identified 111 PRPs, in addition to the original four LDWG parties. LDWG indicated in February 2013 that they planned to "invite about forty other parties to participate with them in a non-judicial proceeding designed to allocate the costs associated with the environmental clean-up of the Lower Duwamish Waterway." [10.A]

The ultimate allocation of liability will not mean that responsible parties must directly pay a straight percentage of the *total* cost, because other funding streams will be involved (see figure, next page). Some funds will come from Washington Department of Ecology, supported by a tax on hazardous substances imposed by the voter-approved Model Toxics Control Act (MTCA).[10.B] Euring the 2009-11 biennium, the total Ecology expenditures from the State Toxics Control Account were $120M, including $35M specifically for Toxics Cleanup. Local governments can receive Oversight Remedial Action Grants, which requires a 50% match by the grant recipient. Of note, the $8M cost for the Slip 4 Early Action cleanup was funded by The Boeing Company, City of Seattle, and MTCA matching grant funds.[10.A]

Figure: Conceptual pathways for payment of costs of the proposed cleanup

Note: green boxes = cleanup costs; red boxes = costs paid by businesses; blue boxes = costs paid by other sources.



Some costs will also be borne by insurance companies, although the amount, if any, will differ between parties depending on their insurance coverage and history. The three public entities can potentially pass along their share of costs to taxpayers and/or utility ratepayers. The remaining share of costs for private businesses will presumably be absorbed as a cost of business.

The costs of cleanup could potentially be compounded by legal costs, particularly if allocation of liability becomes adversarial or if a business became a subject of EPA enforcement action (e.g., for not accepting liability). If the actual, direct cleanup costs for any one business were substantial, then those costs could restrict that business' ability to continue operations as usual, invest in improvements, or attract lenders or investors. It is impossible to estimate those potential costs for individual businesses; however, it is conceivable that those costs could be substantial relative to one business' capital resources or operating margin, particularly for a small or

medium size business. This added liability could inhibit a business' ability to secure a loan or attract investors. It is conceivable that a business might have to cut employment as a result of these factors.

a) ECONorthwest economic analysis

A second study by ECONorthwest (for King County) estimated economic impacts of the proposed cleanup.[10.E] Their literature review reportedly identified numerous studies of Superfund site proximity on property values, but few such studies focused on commercial or industrial property. They identified no evidence foundation upon which to estimate the magnitude of potential economic impact. The economic impact analysis was based on assumptions that a business could experience direct liability costs or indirect costs ("economic stigma and uncertainty"), and that business investment could be stimulated by cleanup timeliness and "perception that the cleanup will ultimately be successful." The analysis examined two hypothetical scenarios:

- "**'Pessimistic' Scenario A**: For the Scenario A, we assume that businesses perceive the clean-up effort is not going well and there is a reasonably high likelihood of negative surprises, such as not-yet-identified contamination and/or the possibility of inheriting liability for contamination by a past polluters. One or more of the following occur: Firms operating in the principal industries decide to decrease spending on updating and maintaining current capital and put on hold any investments in additional capital. The operating lines of credit of firms operating in the affected area are decreased or financing costs increased due to banks' perceptions of increased risk associated with the Superfund cleanup. Firms once considering moving into the affected area, look to other sites outside of Seattle and King County because of these concerns."

  "Because no definitive figure was available from a literature review, the analysis examines the regional impacts resulting from a 10 percent decrease in economic output in the principal industry sectors in the affected area from current levels. This decrease in economic activity by the principal industries will persist into the future as long as businesses and investors perceive that the clean-up effort is not going well."

- "**'Optimistic' Scenario B**: For the Scenario B, we assume that businesses perceive the clean-up effort is going well and there is a low likelihood of any negative surprises, such as not-yet-identified contamination and/or the possibility of inheriting liability for contamination by a past polluters. Firms operating in the principal industries decide to increase investments and/or additional firms in these industries move into the affected area. The converse of scenario A, this assumes that economic output in these sectors in the affected area increases by 10 percent from current levels. This increase in output by the principal industries will persist into the future as the new baseline of economic activity."

The authors stressed:[10.E]

> "…while both scenarios appear well within the realm of possibilities given the potential magnitude and complexity of the Duwamish Superfund cleanup, neither scenario represents a projection of anticipated outcome. We affix no likelihood to occurrence or outcome of either scenario. Rather, the two scenarios are intended to be illustrative of what could happen given the perceptions of businesses and investors regarding cleanup of the site. They demonstrate the regional economic significance of the Lower Duwamish area."

One table from the ECONorthwest report (Table 10, next page) shows the predicted *annual* economic impact of a cleanup-associated 10% change in economic output.[10.E] In the "optimistic" scenario, annual output would *increase* by these amounts. In the "pessimistic" scenario, annual output would *decrease* by these amounts.

The arbitrarily chosen 10% decrease in economic output probably substantially over-estimates the potential outcome of a "pessimistic" scenario, when considered in context. The predicted *annual* decrease in wages for Lower Duwamish area workers ($192M) is approximately equal to half of the *total* potential cleanup costs (including LDWG expenses to date, plus the EPA estimated cost of the proposed cleanup, which will extend over 7-8 years). In addition, that total cost would be reduced by MTCA grant(s) and insurance coverage. Furthermore, the City of Seattle, King County, and Port of Seattle, who will probably bear a substantial share of liability, would more likely pass their share of cleanup costs along to utility ratepayers and/or taxpayers, rather

than significantly cutting government or utility services. The 10% pessimistic scenario would require negative responses among private businesses that are markedly disproportionate to their shares of cleanup liability. Therefore, the speculated 10% decrease in economic output (and loss of "3,052" direct jobs) seems highly implausible; if any such decrease occures, it would probably be substantially smaller.

On the other hand, there is no context against which to assess validity of the estimated impact for the speculated "optimistic" scenario. Arguably, the original ECONorthwest premise is still valid, or at least not disproven: "what could happen given the perceptions of businesses and investors regarding cleanup of the site."[10.E]

Table 10: Impacts of a 10 Percent Change in Economic Output by the Principal Industry Sector Located in the Tier 2 Lower Duwamish Manufacturing/Industrial Center (Estimated for 2010)

Impact Measure	Direct	Indirect	Induced	Total
Within Affected Area (Tier 2: Industrial/Manufacturing Center)				
Output	$727,460,892	$171,168,657	$40,849,524	$939,485,736
Total Value Added	$335,877,996	$92,734,475	$25,033,510	$453,656,140
Wages	$192,929,347	$51,271,825	$11,881,980	$256,081,272
Business & Other Income	$103,561,800	$32,892,330	$10,324,400	$146,786,056
Indirect Business Taxes	$39,386,849	$8,570,321	$2,827,130	$50,788,812
Jobs	3,052	883	277	4,214
Elsewhere in Seattle				
Output	$0	$48,743,559	$136,287,361	$181,641,939
Total Value Added	$0	$25,169,509	$86,023,179	$109,405,188
Wages	$0	$12,157,051	$43,580,160	$54,708,814
Business & Other Income	$0	$11,939,832	$34,508,683	$45,830,637
Indirect Business Taxes	$0	$1,072,626	$7,934,338	$8,865,738
Jobs	0	219	962	1,158
Elsewhere in King County				
Output	$0	$131,947,686	$113,380,927	$246,909,812
Total Value Added	$0	$69,362,789	$63,975,170	$133,999,872
Wages	$0	$36,094,765	$30,065,698	$66,662,269
Business & Other Income	$0	$29,219,577	$27,907,063	$57,231,525
Indirect Business Taxes	$0	$4,048,447	$6,002,409	$10,106,079
Jobs	0	612	601	1,227
Total Countywide Impacts				
Output	$727,460,892	$351,859,902	$290,517,812	$1,368,037,487
Total Value Added	$335,877,996	$187,266,773	$175,031,859	$697,061,200
Wages	$192,929,347	$99,523,641	$85,527,838	$377,452,355
Business & Other Income	$103,561,800	$74,051,739	$72,740,146	$249,848,218
Indirect Business Taxes	$39,386,849	$13,691,394	$16,763,877	$69,760,629
Jobs	3,052	1,714	1,840	6,599

Source: ECONorthwest analysis of data from 2008 IMPLAN modeling system

It is conceivable that an *increase in employment* could occur if "businesses perceive the clean-up effort is going well and there is a low likelihood of any negative surprises, such as not-yet-identified contamination and/or the possibility of inheriting liability for contamination by a past polluters. Firms operating in the principal industries decide to increase investments and/or additional firms in these industries move into the affected area."[10.E] We discuss this further in the next section (Business uncertainty). [0]

b) *Magnitude and distribution of adverse effect*

It is not possible with available information to estimate the magnitude or distribution of a potential adverse effect of cleanup costs on employment and associated health outcomes. It is possible such an effect could occur. Any adverse effect would disproportionately harm workers in private businesses, particularly smaller businesses, where there may be fewer options for the business to absorb their allocated cleanup cost. In any given business, it is conceivable that less skilled or lower paid workers might be considered more expendable, and they could be disproportionately impacted.

The ECONorthwest estimate helps to set an upper bound on possible magnitude of such an effect. The hypothesized "pessimistic" 10% adverse impact on economic output in the Lower Duwamish area appears to be a substantial over-estimate, particularly for the overall industry population. "Moderate" magnitude seems unlikely overall, across the potentially affected businesses and worker population. "Limited magnitude seems more likely, overall, although any one business might be affected much more than another.

3. Business uncertainty

Could business uncertainty about cleanup liability or cleanup progress affect employment?

Direction of effect: **ADVERSE**
Likelihood: **Possible to likely**
Magnitude: **Insufficient evidence; limited, possibly moderate**
Severity/importance: **Medium**
Distribution: **Disproportionate harms**
Adequacy of evidence: **Substantially incomplete**

OR

Direction of effect: **BENEFICIAL**
Likelihood: **Possible**
Magnitude: **Insufficient evidence; limited to moderate**
Severity/importance: **Medium**
Distribution: **Diffuse; possible disproportionate benefit**
Adequacy of evidence: **Substantially incomplete**

As discussed in the preceding section, it is plausible that business perceptions about the proposed cleanup could affect business behavior, investment, and economic output, and this could influence a business' ability or choice to sustain the usual level of employment. There is no concrete evidence upon which to assess the likelihood or distribution of such an effect in the present situation. We identified little information or research about perceptions or consequences of uncertainty in Superfund or comparable situations involving environmental liability. However, there is no doubt, "The prospect of shouldering a cleanup burden for a mess they did not necessarily create is worrying small businesses and property owners along the Duwamish, many of whom contend they had nothing to do with creating the problem." [29]

A 2009 U.S. Government Accountability Office (GAO) report identified many points where uncertainty can arise in the EPA process for identifying PRPs and allocating liability, but notes that the frequency of EPA Superfund litigation has declined over time, in favor of non-judicial settlements.[10.C] Presumably that has resulted in some reduction of uncertainty overall in the Superfund liability process. One line of research distinguishes between two sources of Superfund uncertainty: "site" uncertainty, about overall cleanup cost and duration; and "allocation" uncertainty, about allocation of total cleanup cost across multiple parties. In one study of large companies, greater uncertainty of either type was associated with higher valuation of a firm's estimated Superfund liability, which in turn affects the firm's cost of capital.[30] However, this was only observed in one industry, the chemical industry, and was not affected by the source of uncertainty. A later study by the same researchers found that (large) companies' uncertainty was reduced by disclosure of company-held information about the site, beyond publicly available EPA information.[31]

It is difficult if not impossible to assess the potential influence of business uncertainty in the Lower Duwamish area, associated with the proposed cleanup. Most of the information about uncertainty in the Superfund liability process is descriptive or anecdotal in nature, and the limited available research has little applicability. However, it is at least intuitively plausible that uncertainty could *adversely* influence business decisions and secondarily,

29. Wilhelm S. Businesses brace for Duwamish cleanup bills, without knowing the final amount. *Puget Sound Business J*. April 27, 2012.
30. Campbell K, et al. Site uncertainty, allocation uncertainty, and superfund liability *valuation. J Account Pub Policy* 1998; 17:331-366.
31. Campbell K, et al. Disclosure of Private Information and Reduction of Uncertainty: Environmental Liabilities in the Chemical Industry. *Review of Quantitative Finance and Accounting* 2003; 21: 349–378.

employment. The plausibility should also be acknowledged, as hypothesized in the ECONorthwest study, that resolution of some uncertainty could have a *beneficial* effect, the "optimistic" scenario, with resultant increase in regional economic output and employment. Finally, it is essential that any cleanup-related uncertainty be considered in the broader context of uncertainties affecting Lower Duwamish area industries. It is helpful to consider these variables in one place.

Unfavorable cleanup-related uncertainties (note, this is not intended to be a comprehensive list):

- Although there is an estimated cost for the proposed cleanup, the eventual cost could be higher.
- Although unlikely, unidentified contamination could be discovered.
- Some cleanup modes, such as capping in place, are not as permanent or certain as others, such as dredging.
- Moving targets: cleanup requirements could become more stringent in the future; what is "clean enough" at one point in time, may not meet later requirements.
- A liable party could later be liable for new costs to remove capped sediments, if circumstances change in the future: disruption of capped contaminants; improved technology making removal more feasible; reduction in contaminant concentrations from upstream or lateral source controls
- Entities that are not currently identified as PRPs, could still eventually be identified as a PRP.
- Designation as a PRP does not necessarily mean a PRP will ultimately be deemed liable.
- Allocation of liability is still completely unknown.
- It is hopeful that LDWG is promoting a non-judicial process to allocate liability among some PRPs, presumably the larger PRPs; however, excluded or smaller PRPs could be at a disadvantage, particularly if the allocation process became adversarial.
- Need for legal representation even if the liability allocation process is non-judicial.
- Possible litigation between PRPs, or legal actions if EPA initiates enforcement actions.
- Independent of EPA, larger PRPs could make their own efforts to identify yet-unidentified PRPs, to increase the number of parties and reduce costs per party, but creating hostility within the industry community.
- Smaller PRPs fear aggression by larger PRPs, who have more resources including legal representation.
- Liable parties could be liable for "orphan" liability, from companies that no longer exist or are bankrupt.

"Pessimistic" cleanup-related scenarios, as described in the ECONorthwest study: Businesses believe the cleanup is not going well and negative surprises are likely: [10.E]

- PRPs (or firms with self-perceived risk for PRP status) decrease capital or updating expenditures.
- Banks associate risk with the cleanup, and decrease credit or increase financing costs for businesses.
- Businesses choose not to move into the area, because of liability concerns.

"Optimistic" cleanup-related scenarios, as described in the ECONorthwest study: Businesses ultimately believe that cleanup is going well, with less chance of negative surprises, with the opposite consequences:

- Regional businesses increase capital and updating expenditures.
- Banks increase credit or decrease financing costs for businesses in the area.
- Businesses choose to move into the area (if they can find space).

Unfavorable uncertainties, with no direct connection to the proposed cleanup, as described in section 5A:

- Proposed third stadium and development in the SODO area.
- Real estate speculation
- Gentrification in Georgetown and South Park neighborhoods (see "Local residents" report for this HIA).
- Longstanding and still unrelieved problems with freight routes and traffic congestion.
- West coast competition for international trade and port activity.

a) Magnitude and distribution of adverse or beneficial effect

It is not possible with available information to predict the net result of these uncertainties, particularly in the context of substantial uncertainties that have no direct connection to the proposed cleanup. Both adverse and beneficial cleanup-related effects on business performance are plausible, with secondary effects on employment and worker health. It is plausible that efforts to address areas of uncertainty, such as the LDWG-promoted non-judicial process for allocation of liability, could decrease the likelihood of adverse effects and increase the likelihood of beneficial effects.

As described in the preceding "Cleanup costs" section, the ECONorthwest "pessimistic" scenario is very unlikely to be as high as the arbitrarily postulated 10% decrement in economic output, and any adverse impact of uncertainty would probably have much lower magnitude, particularly when considered across all Lower Duwamish area industry. The impact could be greater for some individual businesses, particularly if their situation was complex. The "optimistic" scenario remains a realistic possibility, and although there is no context with which to judge the potential magnitude, neither is there any evidence to refute the 10% increment that was arbitrarily postulated in the ECONorthwest study.

Again, any adverse effects related to uncertainty would disproportionately harm workers in private businesses, where there may be fewer options for the business to create a real or perceived margin of safety. In any given business, it is conceivable that less skilled or lower paid workers might be considered more expendable, and they could be disproportionately impacted.

On the other hand, any beneficial effects of reduced uncertainty would probably be relatively diffuse across Lower Duwamish area industry, but possibly with some disproportionate benefit for businesses that currently have PRP status or perceive themselves at risk for PRP status.

4. Industry revitalization

Does the proposed cleanup offer opportunities or a foundation upon which industry revitalization might occur?

Direction of effect:	**BENEFICIAL**
Likelihood:	**Possible**
Magnitude:	**Insufficient evidence**
Severity/importance:	**Medium**
Distribution:	**Insufficient evidence**
Adequacy of evidence:	**Substantially incomplete**

There is no evidence to suggest that the proposed cleanup would produce substantial industry revitalization, without intentional and planned revitalization efforts. The "optimistic" scenario mentioned in preceding sections would, if it occurred, probably have a diffuse beneficial effect on business performance, employment, and worker health in the Lower Duwamish area. However, even though it is impossible to predict its magnitude, it is unlikely the effect would be so pervasive or systematic that it would constitute "revitalization."

Furthermore, cleanup-related industry revitalization seems unlikely unless it occurs in parallel with other, more broadly based industry revitalization efforts. One such ongoing effort is the City of Seattle's Industrial Development Pilot Projects.[9.E] It is hopeful that the City is also undertaking a Duwamish MIC Industrial Lands Study, to reevaluate policies in light of the proposed third stadium and SODO development.[9.H.4] Ideally, the City will also consider possible influences of the proposed cleanup in this study. Regardless, this

study occurs in the context of a series of fairly recent Seattle "basic industry" and "industrial lands" studies,[32-34] perhaps justifying reserved optimism about additive influence of the current study.

On the other hand, the proposed cleanup could provide an opportunity to stimulate expanded interest in industry revitalization. Eventually, the stigma of a contaminated river will be removed, the natural environment will be restored, immersed in a functioning industrial setting. Enhancements of the Lower Duwamish River will undoubtedly continue to attract attention of members of the public, beyond the local residential neighborhoods and industry employees and owners. At least theoretically, this could be an opportunity for industry representatives to build supportive connections beyond their usual circles of stakeholders, to pursue shared goals of revitalization. Realistically, however, as described in the "Experiences in other places" section, collaborative ventures with industry do not always work out in favor of industry, particularly when there are active trends or pressures toward community gentrification. Nonetheless, there are examples from other cities that could provide models or lessons (including "don't do that" lessons) to pursue industry revitalization in the context of broader urban revitalization efforts.

There also may be a timely opportunity to align any regional industry revitalization efforts, cleanup-related or otherwise, with national efforts to stimulate American manufacturing.[11.D] In 2012, President Obama announced his plan to invest $1B to develop hubs of manufacturing excellence around the country, built around manufacturing innovation institutes. The ultimate goal is to "make America a magnet for jobs by investing in manufacturing."[35] The first public-private institute was funded in August 2012, in Youngstown, OH. Up to 15 institutes are proposed.

a) Magnitude and distribution of effect

The existing evidence is inadequate to assess the likelihood or magnitude of industry revitalization efforts in Seattle, and particularly whether the proposed cleanup might influence any such efforts. However, there are reasons to believe that this is possible, with models and examples to learn from, and national momentum to align with.

32. Seattle Planning Commission. *The Future of Seattle's Industrial Lands*. July 2007.
33. Mayor Greg Nickels. *The Future of Seattle's Industrial Lands: Mayor's Recommendations.* August 2007.
34. Medford C, Forsyth M, Babb M, Couch D, Schrag T, Schwed R. (Community Attributes; for Seattle Office of Economic Development). *Basic Industries Economic Analysis*. July 2009.
35. White House, Office of the Secretary. *The President's Plan to Make America a Magnet for Jobs by Investing in Manufacturing* [fact sheet]. Feb. 13, 2013

D. Recommendations

Democracy is a core principle of HIA, "emphasizing the right of people to participate in the formulation and decisions of proposals that affect their lives, both directly and through elected decision-makers. In adhering to this value, the HIA method should involve and engage the public, and inform and influence decision-makers."[36]

We acknowledge again that our assessment of "workers and employment in local industry" has been conducted as a desk-based HIA. In contrast to our three other population assessments, this assessment was *not* guided by a population-specific advisory committee or community advisors. We drafted plans to conduct key-informant interviews (and obtained UW Human Subjects exempt-status approval), but did not have enough time or staff to conduct them. Also in contrast to our three other assessments, we did not complete this assessment in time to share draft recommendations with our Liaison Committee, for Committee suggestions on how to word recommendations to be optimally understandable and potentially implementable by decision-makers.

In the absence of such input, we will provide recommendations, but we offer them for broader consideration and discussion by stakeholders and decision-makers, along with the findings of our assessment.

We welcome opportunities to meet with stakeholders, discuss our findings, explore recommendations and options, and consider whether modifications or enhancements are warranted.

1. Hire local

Selection of firms for cleanup construction and related activities should, as much as possible, give priority to firms that are based in Seattle or King County.

This recommendation is directed to the City of Seattle, King County, and Port of Seattle.

Barring an unforeseen turn of events, we anticipate that the Potentially Responsible Parties will continue their primary role in the cleanup (with EPA oversight), including remedial design and action. It is noteworthy that Seattle and King County are not only Potentially Responsible Parties for the cleanup, but as civic entities they are also responsible for protecting and improving the health and well-being of all people in their jurisdictions. This recommendation could optimize their ability to meet both sets of responsibilities. Placing a priority on hiring local firms and local workers will maximize the likelihood that healthful benefits of employment will go to local workers, *and* that indirect and induced economic impacts of the cleanup will further support local employment.

We refer readers to our other job-related recommendation, based on our "Local residents" assessment: EPA should provide cleanup job training and placement assistance to local community members and affected residents.

2. Minimize uncertainty

Selection of the final remedy (cleanup plan) and the process for allocating liability should attempt to reduce or eliminate uncertainty, whenever possible.

This recommendation is directed to EPA, as well as the City of Seattle, King County, and Port of Seattle.

36. From the International Association of Impact Assessment (Quigley 2006). As printed in: Bhatia R. *Health Impact Assessment: A Guide for Practice*. Oakland, CA: Human Impact Partners, 2011.

We offer these options to explore and welcome the opportunity to discuss these or other options:

- Allocation of liability: It is hopeful that the first four identified PRPs—the Lower Duwamish Waterway Group (LDWG)—are promoting a non-judicial process to allocate liability, and that they plan to invite other PRPs to participate. Ideally, this will engage all willing PRPs, so that exclusion will not feed into uncertainties or adversarial relations between LDWG members and excluded parties.
- Scope of cleanup: We purposely focused this HIA exclusively on the proposed cleanup plan ("5C+"), and we did not assess alternative cleanup scenarios. However, we encourage EPA and the PRPs to consider that uncertainty about the finality of the chosen remedy will probably be higher with a heavy reliance on more uncertain and impermanent methods (such as natural recovery and, to a lesser extent, capping). In contrast, uncertainty will probably be lower with increased reliance on permanently removing contaminated sediments and taking measures to prevent recontamination.

3. Pursue opportunities for industry revitalization

Convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.

This recommendation is directed to the City of Seattle, King County, and Port of Seattle.

We believe that Seattle is at the cusp of a new era. Beginning with the cleanup, and accompanied by source control and natural restoration efforts, the Lower Duwamish River and surrounding area have a chance to become a regional asset and symbol of pride, rather than an environmental stigma. There will be opportunities to turn river cleanup and restoration into a national model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own.

It would be a devastating loss for Seattle and Washington state to suffer any substantial erosion of industry, port capacity, or employment in the Lower Duwamish area. Experiences in other places suggest that industry does not necessarily fare well with urban revitalization efforts, but a broad-based, collaborative endeavor might be more likely to achieve success than if industry pursues its own path.

In this report we described experiences in other places that could provide models upon which to build a collaborative Duwamish Valley revitalization effort. There are undoubtedly others to consider too. Portland has proposed a river renaissance, and Seattle can probably draw lessons from industry dissatisfaction with that proposal. Chicago offers the example of a city with longstanding efforts to preserve manufacturing in the urban center and plans to renew those efforts. Efforts such as these will undoubtedly give cities the advantage in trying to become one of the proposed national hubs of manufacturing innovation. Finally, the Great Lakes restoration efforts, particularly the vision of the Council of Great Lakes Industries, offers inspiration to find new and better modes of public-private collaboration.

Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG