Appendix B: Environmental Justice Analysis for the Lower Duwamish Waterway Superfund Cleanup

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Environmental Justice Analysis for the Lower Duwamish Waterway Cleanup

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[Draft]

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Part I: Introduction and Environmental Setting

Introduction and Purpose of the Analysis

The Lower Duwamish Waterway (LDW) is an urban estuary with a long history of alteration and industrialization. The LDW was listed on the National Priorities List (NPL), in 2001.

This environmental justice analysis provides an assessment of the environmental and environmental health the impacts of the proposed Superfund cleanup actions on the affected community[1]. This includes an assessment of the outcomes of proposed Superfund actions on the community, and what environmental justice concerns stem from those proposed actions.

Included in this document are data on the burden faced by the community, such as the health status and indicators of health risk in the community, and other exposures to environmental pollution faced by the community living around the LDW. The neighborhoods directly affected by construction-related impacts include the Georgetown neighborhood east of the waterway, and the South Park neighborhood to the west, along with segments of other neighborhoods that flank the length of the LDW. Other individuals work on its shores or use the river for fishing and recreation and are also considered part of the affected community.

The LDW also includes local tribes who have a presence in or use resources within the Duwamish River watershed. Two tribes, the federally recognized Muckleshoot and Suquamish tribes, have federal treaty rights to fish along the Duwamish River, and usual and accustomed harvesting and gathering areas in and along, and just north of the LDW. The federally recognized tribes are considered part of the affected community or affected populations as they have fishing and gathering rights within the Lower Duwamish Waterway and its outflow, and resident seafood, fish and shellfish habitat, and other resources available to tribes within the waterway will be directly affected by the cleanup actions.

Historically and currently, the Duwamish tribe has lived along and utilized the Duwamish River and its resources, although it does not have federal status and federally established treaty rights.

The purpose of this EJ analysis is to assess the environmental impacts faced by the affected community in light of the cleanup alternatives identified for the LDW Superfund Cleanup in the Remedial Investigation/Feasibility Study (RI/FS; AECOM 2012). The role of the EJ analysis is to:

1. Synthesize evidence of and information on the background of the affected community, environmental and health burdens in the community in comparison to reference sites in order to provide a summary of known or identified environmental justice concerns in the community affected by the potential agency action.
2. For the EJ issues identified in 1, determine how the different alternatives compare in ameliorating or exacerbating an existing environmental justice concern or creating an environmental justice concern.

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[1] The community affected by the proposed action is assessed – for different actions, the area affected varies, and the affected community varies (Final Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses April 1998. Available at: http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_epa0498.pdf

3. Provide input to EPA's selection of the preferred cleanup alternative described in the Proposed Plan and finalized in the Record of Decision.
4. Provide recommendations for reducing or eliminating disproportionate adverse impacts associated with the cleanup if found to the extent possible and practicable.
5. Identify uncertainties and data gaps needed to improve the quality of the EJ analysis objectives identified above.
6. Recommend ways to enhance outreach around the cleanup activities, if there are populations who may require enhanced outreach methods such that they are meaningfully involved in the cleanup process.

The environmental impacts identified and examined within this analysis include:

- risks from consumption of resident seafood.
- risks from direct contact with contaminated sediment.
- risks from air pollution, proximity to hazardous waste sites, and other environmental factors that affected residents are cumulatively exposed to.
- disruption to the community and tribal resources during the cleanup process.
- socioeconomic impacts of living near a Superfund site before and after cleanup.
- the lack of environmental benefits such as green space.

The recommendations from this analysis will be provided to the Superfund Program for consideration in the development of the Proposed Plan for the Lower Duwamish Superfund Cleanup. The document is organized into two main parts, 1) Description of the Environmental Setting, and 2) Assessment of Impacts.

Background on Environmental Justice and Applicable Regulations, Policy, and Guidance

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Environmental justice has been part of EPA's mission since the1994 publication of Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.* The Executive Order requires federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities…" It also specifies that environmental justice work include "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions." There is also a special provision for cases where tribal and subsistence resources are affected by an action.

More recently (since 2012), EPA identified three goals in Plan EJ 2014, EPA's strategic plan for addressing environmental justice in the agency's work, to shape work on environmental justice:

- Protect the environment and health in overburdened communities.
- Help communities to take action to improve their health and environment.

- Establish partnerships with local, state, tribal and federal governments and organizations to achieve healthy and sustainable communities.

The above goals of Plan EJ 2014 provide the framework for the recommendations in this analysis.

Commenters requested this environmental justice analysis during the comment response process on the draft Feasibility Study of the Lower Duwamish Waterway Superfund Cleanup Options (AECOM 2010). Many community members, including a tribal representative from a federally recognized tribe, submitted comments requesting that environmental justice concerns be synthesized and discussed in an "environmental justice analysis". EPA Region 10 agreed that an environmental justice analysis would help define the most significant issues of concern and provide a direct route for community input into the decision-making process to improve cleanup outcomes and reduce exposure for the affected populations.

Although no environmental justice analysis guidance document currently exists for Superfund, this analysis was developed using: EPA guidance documents, other EJ analyses references and EJ related documents on seafood consumption. Guiding principles and techniques were identified in the Council on Environmental Quality (CEQ) guidance, *Environmental Justice Guidance Under the Environmental Policy Act* (1997), and the *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (1998). The EPA *Toolkit for Assessing Potential Allegations of Environmental Injustice* (2001) and the *Interim Guidance in Considering Environmental Justice in the Development of an Action* (US EPA 2010a) were also sources of information that were used to develop this analysis. Particularly, the EPA "Toolkit" excerpts the Department of Justice Guidance Concerning Environmental Justice[2], which identifies a number of factors for consideration in determining whether a particular decision raises an issue, including the following:

- whether individuals, certain neighborhoods or federally recognized tribes suffer disproportionately adverse health or environmental effects from pollution or other environmental hazards;
- whether individuals, certain neighborhoods, or federally recognized tribes suffer disproportionate risks or exposure to environmental hazards, or suffer disproportionately from the effects of past under enforcement of state or federal health or environmental laws;
- whether individuals, certain neighborhoods, or federally recognized tribes have been denied an opportunity for meaningful involvement, as provided by law, in governmental decision-making relating to the distribution of environmental benefits or burdens. Such decision-making might involve permit processing and compliance activities.

Further, the EPA "Toolkit" provides some definitions of use in this document. For one, it defines a disproportionately high and adverse effect or impact as one that is either predominately borne by any segment of the population (such as a minority or low-income population), or will be suffered by a minority and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect or impact suffered by a non-minority and/or non-low-income population.

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[2] Department of Justice, "Guidance Concerning Environmental Justice," January 9, 1995, available online at http://www.usdoj.gov/enrd/79648environmentaljusticestrategy.pdf

The EPA "Toolkit" also provides a list of possible reference communities[3] including: a community of equal size to the area of interest; the surrounding county; the region or metropolitan statistical area; the state; or the entire United States, depending upon the scope of the decision to be made.

In considering how EPA's Superfund project could affect or create EJ concerns for those who subsist on or consume fish from within the Lower Duwamish Waterway, this analysis used the National Environmental Justice Advisory Council *Fish Consumption and Environmental Justice Report* (2002) as a source of guidance.

Environmental Setting

Superfund Site Background

The Lower Duwamish Waterway is an urban estuary with a long history of alteration and industrialization. The LDW was listed on the National Priorities List as a Superfund site in 2001. EPA and the Washington Department of Ecology signed an Administrative Order on Consent with the Lower Duwamish Waterway Group, consisting of the Port of Seattle, City of Seattle, King County, and The Boeing Company, in 2000. EPA is the lead agency for the cleanup of the contaminated sediments, while Ecology has the lead on controlling sources of contamination to the LDW.

As part of the consent decree, the parties involved agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS). The Remedial Investigation is an investigation of the nature and extent of contamination posed by hazardous substances at the site. The RI was completed in 2010.

As an outcome of the RI process, five highly polluted areas were selected for early cleanup either prior to or after Superfund listing. Of these five Early Action Areas (EAAs), three have been completed, and two more will be completed by 2015. The rest of the waterway is currently in the cleanup plan decision process to select the alternative for remediation and is the focus of this document. LDWG has developed a Feasibility Study (AECOM 2012) that describes a suite of different cleanup alternatives for the LDW and the relative costs and benefits of each alternative.

The four main contaminants of concern for human health include three groups of chemicals whose members all have similar chemical structure: polychlorinated biphenyls (PCBs), dioxins/furans, and carcinogenic polyclic aromatic hydrocarbons (cPAHs), as well as the chemical element arsenic. PCBs are a legacy contaminant, which means that their manufacture and use in the United States is now outlawed. They were widely usedin the past for a variety of purposes including as an electrical insulator and as a plasticizer in paints and other materials.

PCBs are known for being persistent, for not breaking down easily in the environment, and are broadly distributed throughout the environment. PCBs are bioaccumulative, increasing in concentration at higher levels of the food web. Dioxins/furans and cPAHs are produced during combustion processes (e.g. burning of plastics or garbage, cooking, heating, and engine operation) and many other industrial processes; cPAHs can also be released from creosote-treated wood, paving/tar sealers, and used motor oil.

[3] Reference community is a comparative community (non-minority or low-income) to determine if minority/low-income neighborhoods or communities share a disproportionate environmental burden

Arsenic could come from a variety of sources, given the industrial history of the waterway. Emissions from the ASARCO smelter in Tacoma broadly distributed arsenic throughout Puget Sound. Arsenic is also a naturally occurring element found in the waters, soils, and sediments of the Puget Sound region.

All of the above contaminants, PCBs, cPAHs, dioxins/furans, and arsenic are all carcinogenic, and all have been found to have non-cancer human health effects as well. In particular, PCBs pose developmental impacts for the developing fetus and children. In addition to human health concerns, forty-one contaminants of concern are present in some areas of the Lower Duwamish Waterway at concentrations toxic to benthic invertebrates.

The Lower Duwamish Waterway: development, history, resources, and culture

Up until the 1850s, the land surrounding the Duwamish River (Figure 1) was occupied by Native Americans and remained forested, but after that time, settlers began clearing surrounding lands. For the Native Americans who live here, the river has served as a transit corridor, spiritual haven, and harvesting and fishing ground. Estuaries such as the Duwamish River served as protected places where native tribes could gather salmon, other fish, and shellfish, as well as plants, berries, and other subsistence resources on a seasonal basis.

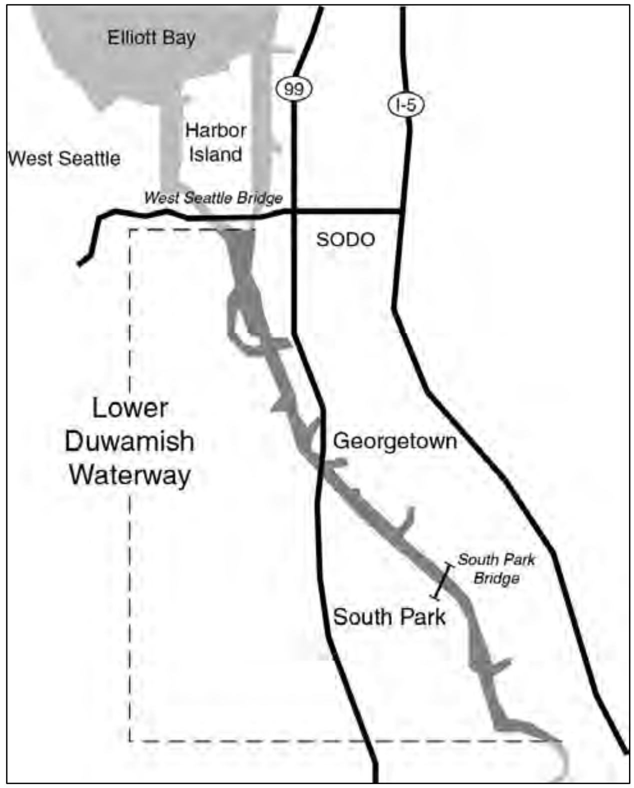

Figure 1 *– Lower Duwamish Waterway in Reference to Downtown Seattle*

The flow of the various rivers (the Green, White, Black and Cedar Rivers) that are the source of the Duwamish, Seattle's only river, were modified in the early 1900's for flood control and navigational purposes. These flow modifications as well as dredging and straightening the Duwamish itself to enhance navigability, resulted in monumental changes to the river. Despite these alterations, the Duwamish remains a cultural, commercial, and subsistence resource for tribes in the area. Currently, the Duwamish River connects the Green River to the south and Puget Sound to the north. The Lower Duwamish Waterway Superfund study area extends a little over 5 miles south of the southern tip of the man-made Harbor Island (Figure 1) to just beyond the Norfolk Combined Sewer Overflow/storm drain (CSO/SD) near the Boeing Developmental Center in Tukwila. The Lower Duwamish Waterway drainage basin is approximately 32 square miles, of which point and nonpoint source runoff and combined sewer overflows discharge into the Lower Duwamish Waterway.

The Upper Duwamish and Green River watersheds further drain over 480 square miles into the LDW. As a result of the dredging, straightening, and armoring of the channel in the early-mid 20th century, the LDW is highly altered. In total, 9.3 miles of meandering river were replaced by 5.3 miles of straightened channel by 1916 (Battelle et al. 2001). Although peak flows have been

much reduced with the upstream flow diversions and Howard Hansen Dam, sediment loads remain significant.

It is estimated that over a typical two year period, maintenance dredging for the channel within the LDW removes roughly 34,000 to 199,000 cubic yards (roughly 42,000 to 246,000 metric tons assuming a density of sand - 2700 lbs/cubic yard) of sediment (RI; Windward 2010).

Few natural meanders remain along the lower stretches of the river, with the exception of Kellogg Island, which, although far reduced in size and character from its original state, serves as productive intertidal habitat for birds and mammals, including raptor and various shorebird and songbird nesting-sites. Eagles nest and forage within the Lower Duwamish Waterway, along West Marginal Way[4]. Almost all of the original mudflats and tidal marshes from the time of the historical Duwamish estuary have been filled in or dredged, leaving only 59 acres of mudflats and tidal marshes remaining (RI; Windward 2010).

Subsequent to the channelization in the early 1900s, the area surrounding the Duwamish River became further developed by a variety of different industries, ranging from wood products manufacturers, to marinas and airplane parts manufacturers. Shipyards, airplane manufacturing, cement manufacturing, food processing, and cold storage were early industries along the Lower Duwamish Waterway that became increasingly important with the onset of World War I (Sato 1997). Other common industries at this time included lumber storage and milling yards, metal fabrication, and equipment manufacturing (Sato 1997). Several of these past industries resulted in “legacy” contamination issues in the LDW, such as PCBs.

The waterway is a classic strongly stratified salt-wedge estuary, where fresh water flows over the top of a salt water wedge (Pritchard 1967) with little vertical mixing. The water column is mostly fresh north of river mile 8.7, with salt stratification present throughout the waterway, and the position of the leading edge of the salt wedge dependent upon tidal conditions and river flows. Model-derived mass-balance budgets have provided estimates that bed sediments deposited throughout the LDW are dominated by Green River-derived sediments (AECOM 2012).

As a dynamic estuary, the waterway is home to a diverse ecology, with abundant anadromous and resident fish, shellfish, other invertebrates, marine mammals, and birds. Recent sampling events yielded a particularly diverse group of crustaceans. The most abundant crustaceans found were crangon and coonstripe shrimp and slender crabs.

Dungeness crabs are also common where salinities are higher. Up to 33 species of fish have been found during prior studies. During sampling for the Superfund RI in 2004 - 2007, 53 species of fish were found, including English and rock sole, Pacific herring, starry flounder, and salmonids (including Chinook, Coho, and chum salmon). The sampling found the most abundant fish catches in late summer and fall (Windward 2010). Altogether, nine salmonid species are found in the Green and Duwamish rivers. The LDW is also home to 87 species of birds and 6 mammals (Windward 2010).

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[4] City of Seattle “Seattle Biological Evaluation”, Appendix C: http://www.seattle.gov/util/EnvironmentConservation/Projects/SeattleBiologicalEvaluation/SBEDocument/index.htm (accessed 1/22/13).

Affected Area and Populations

The two main mixed residential/industrial/commercial Seattle neighborhoods adjacent to the LDW are South Park and Georgetown, and there are other segments of neighborhoods that are within a 1 mile radius of the LDW, which is estimated to be the area that will be directly affected by cleanup construction. Others who come to the LDW to fish, recreate, and are culturally tied to the Lower Duwamish Waterway, including the Muckleshoot and Suquamish tribes who have fishing rights here and who may or may not be residents within the 1 mile radius, are also considered affected populations. The South Park neighborhood, within and adjacent to the southern edge of the Seattle city limit, borders the west bank of the LDW. The Georgetown neighborhood is located east of the LDW and E Marginal Way S.

The two neighborhoods foster a diverse and vibrant range of cultures and ethnicities, and Georgetown, in particular is known for its concentration of artists' studios. The neighborhoods flanking the LDW, including the South Park and Georgetown neighborhoods, are considered by EPA and Ecology to have environmental justice concerns in accordance with Executive Order 12898, *"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*".

There are relatively large low-income populations and/or large minority populations in the affected neighborhoods around the LDW, in comparison to Seattle and King County residents (Census, 2010; Tables 1.1 and 1.2), and the federally recognized Muckleshoot and Suquamish Tribes use the waterway and fish that pass through the waterway for usual and accustomed fishing rights. For this analysis, and consistent with previous EPA guidance documents (CEQ 1997; EPA 1998b), "minority" refers to people who are identified as Hispanic/Latino, as well as those who are non-Hispanic/Latino of a race other than White or European-American. For the purposes of this analysis, we are defining low-income as less than 1.25 times the Census 201l poverty threshold[5] (consistent with EPA 1998b). For households, where the average household size in Seattle is 2.8, 1.25 times the poverty threshold for three people is ~$22,500. As a threshold, and because of the way Census 2010 median household income data is summarized, any household with an income under $25,000 is considered low-income in this analysis.

As Table 1.1 shows, minority populations are significantly larger in South Park than in Georgetown, Seattle and King County. The non-Hispanic Georgetown minority population has decreased since the 2000 Census, and the percentage of non-Hispanic minorities is smaller than that of Seattle (based upon census tract data), although the Hispanic population remains significantly larger than that of Seattle or King County.

The per capita incomes are statistically significantly less in both the Georgetown and South Park census tracts than for Seattle and King County, and similarly, the percentages of households earning less than $25,000 are statistically significantly larger and those in poverty are significantly larger[6] in South Park and Georgetown than in Seattle or King County. It should be noted that demographic changes have occurred throughout King County and South Seattle between the two census data collection efforts, the U.S. Census 2000 and 2010. These trends and the speed of change in LDW and King County demographics should be kept in mind in planning

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[5] Thresholds available at: http://www.census.gov/hhes/www/poverty/data/threshld/

[6] Margin of error for percentage in poverty is very large and swamps the range of data for Census Tract 109 and 112; central tendency is still meaningful

future activities in these neighborhoods, since the decision, design, and construction will likely take a decade or longer to fully implement.

In Table 1.2, a broader analysis shows that for the total population living within 1 mile (based upon an area-weighted population distribution at the block-group level) of the LDW, the minority population is significantly larger than and incomes are significantly lower than those of Seattle and King County residents on average (Table 1.2).

Table 1.1 – Demographic Data for South Seattle

Demographic Characteristic	South Park: Census Tract 112	Georgetown: Census Tract 109	Seattle	King County
Total Population	3906	1287	620,778	1,969,722
% Minority	55.4%	29.8%	30.5%	28.1%
Race/Ethnicity Breakout	44.6% White 10.3% Black 1.9% American Indian 15.8% Asian (0.3% Asian Indian 1.2% Chinese 1.7% Filipino 0.3% Japanese 0.1% Korean 6.9% Vietnamese 5.3% Other Asian) 1.6% Pacific Islander 19.9% Some Other Race 37.3% Hispanic of Total	70.2% White 7.4% Black 1.9% American Indian 9.8% Asian (0.1% Asian Indian 4.3% Chinese 1.6% Filipino 0.2% Japanese 0.2% Korean 1.6% Vietnamese 1.9% Other Asian) 0.3% Pacific Islander 6.4% Some other Race 12.3% Hispanic of Total	69.5% White 7.9% Black 0.8% American Indian 13.8% Asian 0.4% Pacific Islander 6.6% Hispanic of total	71.9% White 6.5% Black 1.1% American Indian 15.0% Asian 0.8% Pacific Islander 9.2% Hispanic of total
Per Capita Income	$18,575	$23,936	$40,868	$38,211
% Households with Income less than $25,000	27.3%	37.5%	20.4%	18.4%
% Poverty Status in last 12 mos.	16.1%	14.0%	12.7%	10.2%

Demographic data for South Seattle Neighborhoods of South Park and Georgetown, Seattle, and King County (U.S. Census 2010 and ACS 2005-2009). Poverty status based upon U.S. Census ACS 2010 5-yr computations and average threshold. Margins of error are found in ACS 2010-5yr average data; data sets used can be found in the administrative record of the Proposed Plan.

Table 1.2 – GIS Screening Assessment

Location	Population	Race	Language	Income/ Education	Age	Land Area/ Water Area	All EPA FacilitiesPermitted[4]	TRI Facilities
Seattle I5[1]	Tot: 1,003,516 Dens: 5,111/mi^2 Minority: 33%	White: 71% Black: 7% Amer. Indian: 1% Asian: 14% Pac. Islander: 1% Other: 3% Hispanic of Total Population: 8%	Non-English at home: 23% English less than well: 5%	Per capita: $40,307 $25K or less: 19% % 25+ no HS diploma: 8%	0-4: 6% 0-17: 18% 18+: 82% 65+: 12%	196.35 mi^2 46.08 mi^2	Total: 4169 21.2 Facilities/mi^2	Total: 133 <1/ mi^2
Salmon Bay to Gasworks[2]	Tot: 86,573 Dens: 8,530/mi^2 Minority: 19%	White: 83% Black: 2% Amer. Indian: 1% Asian: 9% Pac. Islander: 0% Other: 1% Hispanic of Total Population: 4%	Non-English at home: 12% English less than well: 1%	Per capita: $46,535 $25K or less: 16% % 25+ no HS diploma: 2%	0-4: 4% 0-17: 11% 18+: 89% 65+: 8%	10.5 mi^2 2.8 mi^2	1134 108 Facilities/mi^2	24 ~2 Facilities/mi^2
LDW[3]	Tot: 21,864 Dens: 2,525/mi^2 Minority: 52%	White: 59% Black: 8% Amer. Indian: 2% Asian: 18% Pac. Islander: 2% Other: 6% Hispanic of Total Population: 18%	Non-English at home: 36% English less than well: 11%	Per capita: $26,802 $25K or less: 20% % 25+ no HS diploma:19%	0-4: 8% 0-17: 21% 18+: 79% 65+: 9%	8.66 mi^2/0.76 mi^2	1601 185 Facilities/mi^2	61 7 Facilities/mi^2

The GIS-based screening assessment compared the characteristics of populations and facility density within one mile of the LDW, with populations located within one mile of the Salmon Bay and Lake Union water bodies (Table 1.2). Salmon Bay and Lake Union, both within Seattle, were chosen for comparison with the LDW because they share a similar history of industrialization along major waterways. Finally, the LDW and Salmon Bay/Lake Union data were contrasted with data extracted from along the I5 corridor. The I5 transect is considered to be representative of Seattle more generally while being compiled using similar GIS-based methods for comparability. As in Table 1.1, above, % minority includes the Hispanic population.

Affected Area and Populations

Continued

mapped demographic and environmental data from a 6-mile buffer around the centerline of the interstate 5 were also compiled to capture a snapshot of socio-demographic information for the city of Seattle. Data sources included the Census 2010 and the American Community Survey database (data from 2006-2010), together with EPA databases of permitted facilities[7] (Table 1.2). Highlights from this analysis include:

1. per capita incomes are 34-42% lower in the LDW corridor ($26,802) than near the Salmon Bay to Lake Union ($46,535) and Seattle ($40,307) areas;
2. the diversity is much higher in the LDW location, greater than 50% minority, compared to 19 and 33%;
3. the percentages who do not speak English well and who do not possess a high school diploma are much higher in the LDW location than in the other two transects;
4. the total number of facilities (all EPA permitted facilities) and total Toxics Release Inventory (TRI) facilities (large sources only) per square mile is much higher for the LDW transect than the other transects examined. There are 185 total facilities, of which 7 are TRI-reporting (large source) facilities per square mile for the LDW compared to 108 total with 2 TRI per square mile and 21 total with < 1 TRI-reporting per square mile for the Salmon Bay and Seattle transects, respectively.

Tribal Rights and Presence

The federally-recognized Muckleshoot and Suquamish tribes have fishing rights within or just north of the Lower Duwamish Waterway. The treaty rights for tribes along the Duwamish were established in the Treaty of Point Elliott. The fishery catch allowed by tribal treaty rights were further defined in the 1974 Boldt decision (*U.S. v. Washington*, 1974)[8], which affirmed that 50% of the catch from an area identified as a tribal usual and accustomed fishing and harvesting area should go to tribes with rights for that area as defined in the Treaty of Point Elliott. Usual and accustomed areas for different Tribes often coincide in Washington, as is the case in the Duwamish Waterway. The LDW is primarily a treaty fishing area for the Muckleshoot tribe, which has an active salmon fishery, while the Suquamish tribe manages fisheries just north of the Lower Duwamish Waterway (North of Lower Duwamish Waterway – see Waterway extent in Figure 1). Resident seafood from the Lower Duwamish Waterway can be present in or pass through the Suquamish Tribe’s usual and accustomed harvesting and gathering area.

The Duwamish tribe (ancestors along with the Suquamish Tribe of Chief Si’ahl or Seattle) remains a presence in the region, with a newly-constructed Duwamish Longhouse located along the Duwamish River, and the use of Herring House Park for cultural ceremonies.

Past tribal seafood consumption surveys (which included surveys of the Tulalip and Suquamish Tribes) have found that seafood consumption rates for tribal members are much higher than EPA’s National Toxics Rule default rate of 6.5 g fish/day and EPA’s recommended water quality national default fish consumption rate of 17.5 g fish/day.

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[7] Permitted facilties are industrial or commercial facitilies that have permits to pollute or handle possible pollutants. The permits are granted under federal

[8] *United States v. Washington*, 384 F. Supp. 31 D (W.D. Wash 1974)

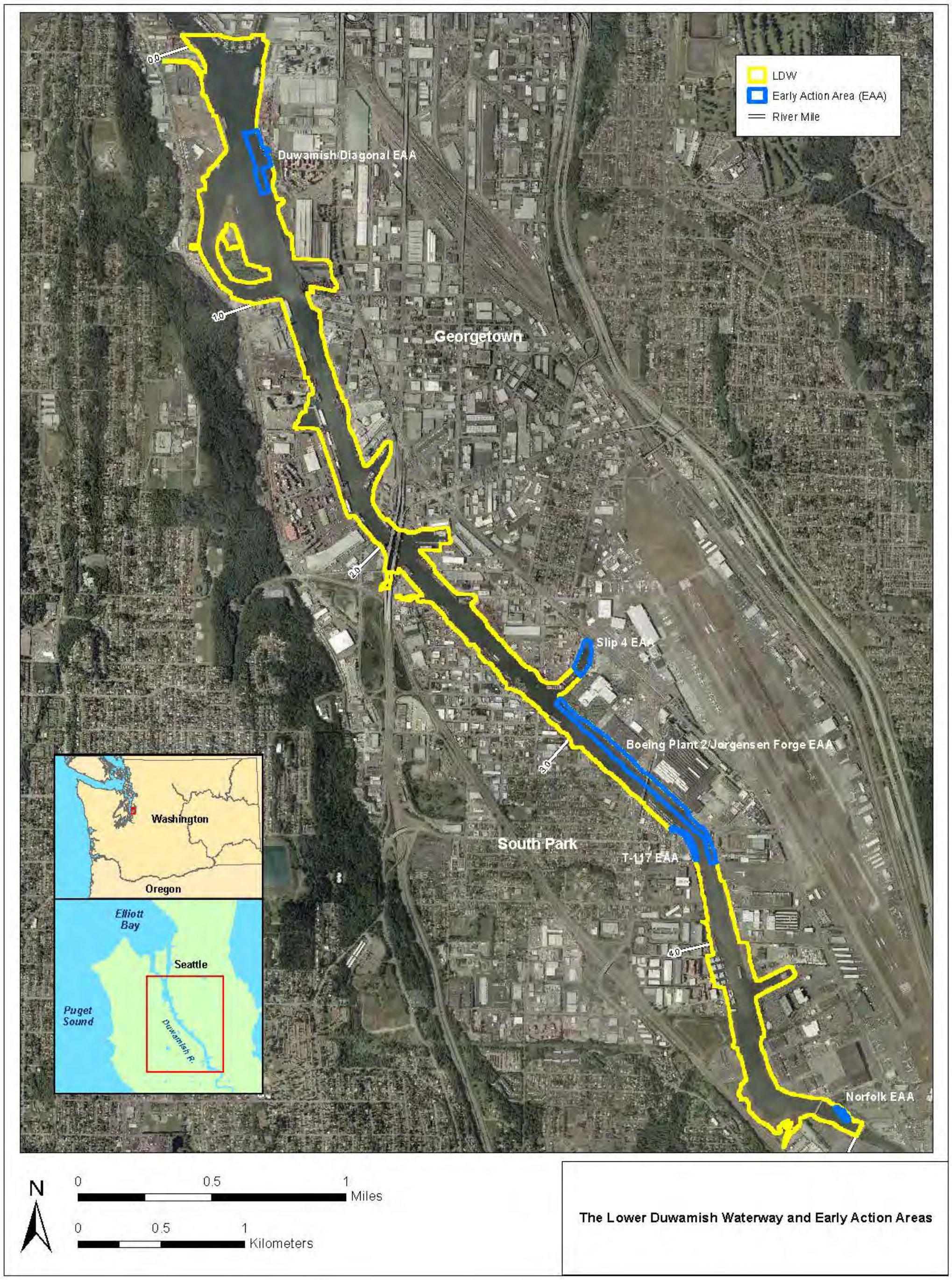

***Figure 2** – Aerial photo of the Lower Duwamish Waterway with early action areas highlighted*

Tribal rates from various surveys range up to a maximum of 1,453 grams per day for the Suquamish Tribe (as determined by computing the gram per kilogram per day consumption rate by a body weight of 79 kilograms), with the actual rate depending upon the tribe, age (child or adult), and the source, species of shellfish or finfish. The Suquamish rate information after excluding salmon (which are not the focus of the cleanup) established the upper 95% confidence limit consumption rate for resident seafood as 584.2 g/day, which was presented in the risk assessment (Windward 2010) as the upper end of the seafood consumption rate range.

Because seafood consumption rates for the Muckleshoot Tribe have not been documented, the

RI/HHRA (Windward 2010) included a range of known tribal rates, including those of the Tulalip tribe (total seafood consumption RME of 194 g/day[9] for resident and non-resident seafood). It should be noted that present tribal seafood consumption rates are based on current consumption patterns which are suppressed, and not the unsuppressed consumption rates that would take place with improved access to more/cleaner resident seafood resources.

Tribal access to fish and shellfish along the LDW is not just a matter of consumption but of culture. See for example the expression of ties to Puget Sound fisheries in the Suquamish Tribe's seafood consumption survey (Suquamish Tribe, 2000[10]):

> *The Suquamish culture finds its fullest expression in the acknowledged relationship of the people with the land, air, water, and all forms of life found within the natural system. River systems, lakes and numerous small creeks historically supported abundant coho, Chinook, sockeye, and chum runs, with other salmonids and marine fish available as well. The same forests which sustained life in the riparian zones also harbored deer, bear, and other wildlife.*
>
> *Vast expanses of intertidal habitat supported shellfish....Despite degraded water quality and habitat, tribal members continue to rely on fish and shellfish as a significant part of their diet. All species of seafood are an integral component of the cultural fabric that weaves people, the water, and the land together in an interdependent linkage which has been experienced and passed on for countless generations.*

Non-tribal Seafood Consumption Patterns and Rates in the LDW — Available Data

In general, seafood consumption rates for non-tribal populations available for the Puget Sound and the Lower Duwamish Waterway area have considerable uncertainty and are not ideal for quantitative risk assessment due to methodological considerations (Mayfield et al. 2007, USEPA 1988[11]). Recreational angler fish consumption rates from Puget Sound urban bays may also be subject to suppression due to fears of chemical contamination. Use of suppressed consumption rates for risk assessment and cleanup standard development leads to underestimation of risk and inappropriately lax risk based cleanup standards (US EPA 2002[12]). The available tribal surveys are generally used as a surrogate representing what exposure might be in the future, should consumption of resident fish be less restricted in a cleaner river. Some quantitative data and some more anecdotal data have been gathered in King County, along the Duwamish River, and at the waterway and in local neighborhoods.

Sechena et al. (1999)[13] gathered quantitative consumption date from the adult Asian and Pacific Islander (API) community in King County, and included ten API ethnic groups. Asian Pacific Islanders are a fast-growing immigrant population and comprise people who have origins in Far East Asia, Southeast Asia, the Indian subcontinent, or the Pacific Islands. The researchers found that the respondents consumed seafood at a high rate, with a median of 51.5 g/day for a typical API consumer. There was a preference for shellfish (49% of all seafood). First generation APIs

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[9] 97.5 g/day for resident fish, only

[10] Suquamish, 2000. Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region. August 2000. The Suquamish Tribe Fisheries Department, Suquamish, WA.

[11] US EPA. 1988. Health Risk Assessment of Chemical Contaminants in Puget Sound Seafood. Prepared by Tetratech Corporation. TC-3338-28

[12] US EPA. 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

[13] Sechena, R. et al. 1999. Asian and Pacific Islander Seafood Consumption Study. EPA 910/R-99-003.

consumed more than second generation for all fish categories except pelagic fish (fish that reside in the water column).

Out of all the populations surveyed, the Vietnamese and Japanese communities had the highest total seafood consumption rates. The pattern of parts of fish consumed varied by ethnic group. Overall, skin was consumed with fillet a majority of the time, and the hepatopancreas of crabs ("crab butter") was often eaten with the meat. Seafood cooking fluids were also often consumed.

An angler survey was conducted in King County and included the LDW (Mayfield et al. 2007[14]; King County 1999[15]). Due to the study design[16], the seafood consumption rates provided in the study should be interpreted with caution, however, it does provide evidence that a diverse group of individuals fish out of the Duwamish and provides some qualitative information on fishing and consumption patterns.

Of the 152 Duwamish River respondents, 20% consumed their catch alone and 51% shared their catch with other family members. Other respondents gave away the fish, re-released it, or used it as bait. 80% of respondents were fishing for finfish, 8% for shellfish (mostly crabs), and 12% for both. It should be noted that the part of the Duwamish River that was surveyed was estuarine in nature, and anglers there exclusively caught marine species. The majority of respondents (59%) who ate the finfish caught in the Duwamish River consumed the fish fillet without skin, 29% consumed the fillet with skin, and 12% ate other parts of the fish such as the head or organs.

For all marine sites in King County (North King County, Duwamish River, and Elliott Bay, all locations) sampled by Mayfield et al. (2007)/King County 1999, ethnic differences in seafood consumption rates were observed. Again, use of creel survey derived consumption rates for quantitative risk assessment is not recommended given creel survey methodology issues

In addition to the above surveys, the Environmental Coalition of South Seattle (ECOSS) conducted a qualitative survey of seafood consumption patterns in November 2010[17], using outreach specialists to survey recent immigrants and others who live in neighborhoods near the LDW. Because many residents had limited English proficiency, they conducted the surveys in multiple languages.

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14 Mayfield, D.B., S. Robinson and J. Simmonds. 2007. Survey of fish consumption patterns of King County (Washington) recreational anglers. Journal of Exposure Analysis and Environmental Epidemiology. 17:604-612.

15 King County. 1999. King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay; Appendix B: Methods and Results, B2: Human Health Risk Assessment. Prepared by Parametrix and King County DNRP, Seattle, WA. Available at http://www.kingcounty.gov/environment/watersheds/green-river/cso-wqa/reports.aspx

16 Creel surveys (e.g. field interviews of anglers) provide qualitative information about fishing pressure on water bodies and demographic characteristics of anglers using those water bodies. However, creel surveys are not ideal for quantitative estimates of fish consumption. Creel surveys over-sample frequent anglers and hence do not provide a representative sample of the population of interest. Difficulties in use of models to quantify portion size, accounting for consumption of all seafood preparations, a less than ideal interview environment, and the necessary brevity of field interviews are additional factors that adversely affect creel survey use in FCR development. In the case of King County 1999, some individuals did not allow catch to be weighed. Basing the rate on the weights of others' collected fish could bias the data depending on differences in fish consumption for individuals that refused to have their fish weighed relative to the overall survey sample. For more information on creel surveys and other survey designs, advantages and disadvantages see: EPA's Guidance for Conducting Fish and Wildlife Consumption Surveys (USEPA 1998a) accessible at:
http://water.epa.gov/scitech/swguidance/fishshellfish/techguidance/upload/1999_11_05_fish_fishguid.pdf

17 ECOSS report to EnviroIssues, 1/31/11: letter subject: Lower Duwamish Waterway Outreach Summary

The survey questions centered on individuals' fish consumption practices and knowledge of fish contamination issues. The ECOSS findings showed that people fished in the Duwamish for consumption and recreation. It also found that several respondents had friends and relatives who fished locally and acquired fish from roadside stands[18]. Consumption patterns (parts of fish eaten, times of year or rates) differed among interviewees based on cultural and religious characteristics and beliefs. Many responded that having a source of inexpensive fresh fish is important, and others mentioned the importance of having safe places to fish and knowing the health risks involved with fishing. Some respondents asked for more information on the cleanup process and what it means for health and recreation.

[18] Survey did not indicate where fish were caught or species of fish purchased

Part II: Assessment of Impacts

This Section will cover:

- the assessment methodology;
- an overview of health status and vulnerability identified through available data;
- potential cumulative exposures and risks along the LDW;
- the impacts of this decision on affected populations; and
- mitigations for disproportionate adverse impacts, where found

Methodology

Lower Duwamish Waterway Remedial Alternatives

The Lower Duwamish Waterway Feasibility Study (AECOM 2012) proposed remedial alternatives comprise 12 different cleanup scenarios (6 alternatives and variations of the alternatives). These range from a "no action" alternative, Alternative 1, where no additional measures are taken to clean up the waterway beyond the early action cleanups that have already taken place or have been planned, to alternative 6R, which is the alternative with the largest remedial footprint and the most sediment removal and disposal of all of the options.

Several figures in the Feasibility Study (AECOM 2012) (Figures 8-5 to 8-17) describe the remedial alternatives in great detail, including the footprints for each alternative, and the remedial actions that would take place throughout the waterway, ranging from natural recovery, to enhanced natural recovery, to sediment capping, to sediment dredging, and removal. The Proposed Plan (remedial alternative 5c plus) is presented as Proposed Plan Figure 18. Figure 3 in this document (same as Proposed Plan Figure 14) provides specifics for each alternative, including construction time, dredging volume, cleanup methods, time to reach cleanup objectives, and costs. The potential for the different alternatives to disproportionately and adversely impact people affected by the site are examined in this part of the EJ Analysis.

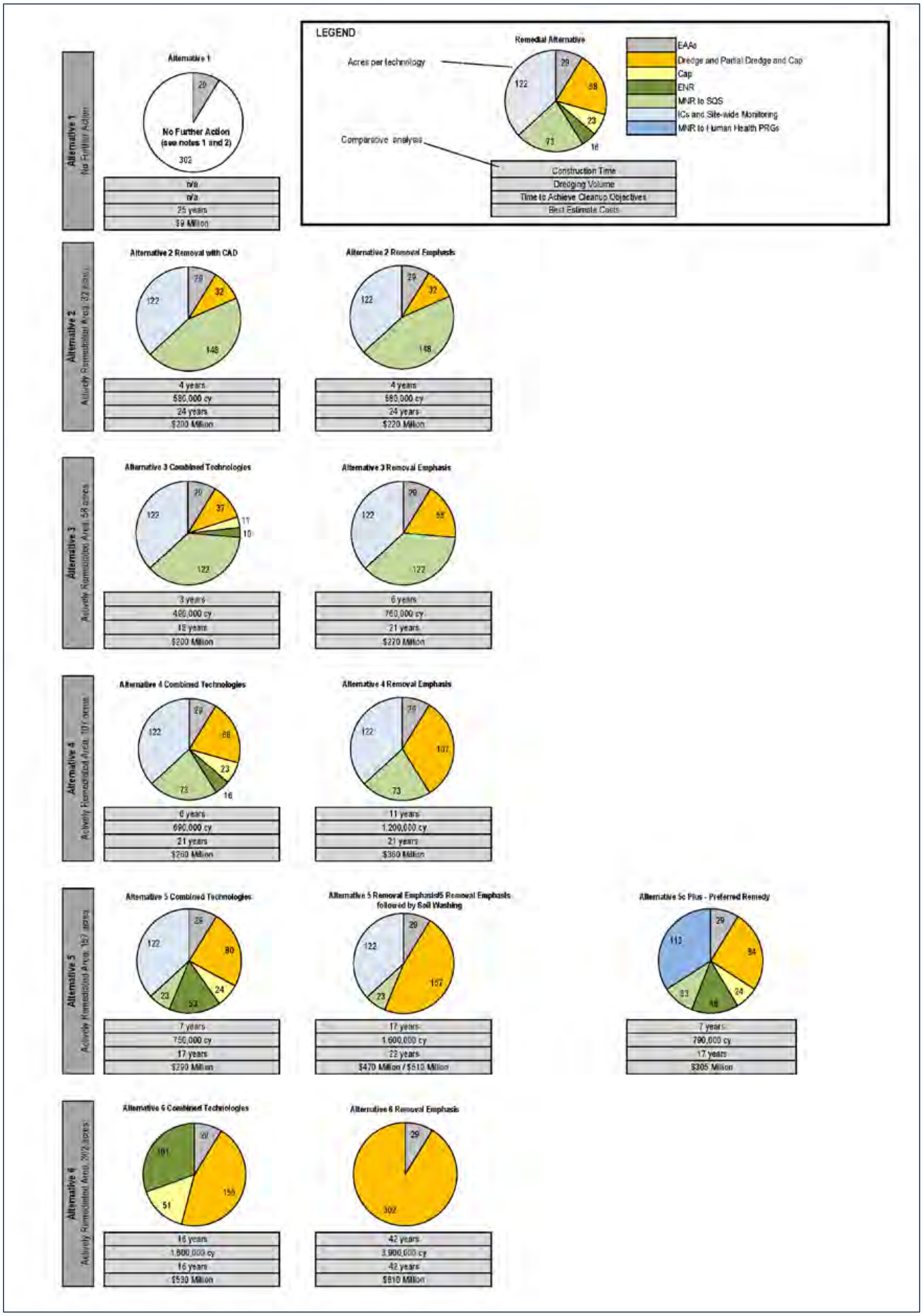

Figure 3 *– Summary of Alternatives*

Health Concerns and Impacts Evaluated in the Risk Assessment

In the Lower Duwamish Waterway Human Health Risk Assessment (HHRA; Windward 2010) several possible routes of exposure for excess cancer and non-cancer risks associated with the site were identified. The exposure route with the greatest cancer and non-cancer risks was identified as the eating of contaminated resident (majority of life cycle spent in the LDW) seafood from the LDW.

The risks were evaluated for reasonable maximum exposure (RME) consumption rates for the following scenarios: tribal adult RME consumption rates; tribal child RME consumption rates; Asian and Pacific Islander RME consumption rates; and a one meal per month consumption rate[19]. The consumption rates and years of exposure for consumption were derived from EPA (2007[20]) and the Sechena et al. Asian and Pacific Islander Consumption Rate Study as reinterpreted for risk assessment purposes by Kissinger (2005[21]). In addition to seafood consumption, direct contact with sediments (incidental ingestion of sediment and dermal contact) was evaluated in the human health risk assessment and determined to be of potential risk.

Environmental Justice Concerns from the Affected Community

In comments on the Draft Feasibility Study (AECOM 2010), some community members have expressed concern for the multiple exposures present near the site, due to the concentration of facilities and mobile sources (major roadways, areas of concentrated vehicle traffic) in the vicinity, and the relative vulnerability of the populations in the area. Some community members and tribal comments emphasized the need to protect the most vulnerable populations exposed to the contamination in the waterway.

Tribal comments also asserted that for any remaining contamination that may be left in the waterway under caps or other engineered devices, the methods used should ensure no recontamination of the waters and fish tissue and not inhibit tribal rights in the LDW. Industries located in the LDW have expressed concern over the duration of the cleanup, the costs of cleanup and impacts to jobs and the economy locally.

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

Identifying Disproportionate Adverse Impacts and Mitigations

Previous work, studies, and data sets were reviewed to identify existing cumulative (multiple) impacts from exposure to contaminants for affected residents who reside near the LDW, and whether there are disproportionate adverse impacts for those affected by exposure to contaminants at the site (the affected community that resides near the site). The risks or exposures for the affected populations are compared to risks or exposures (depending upon the data available) elsewhere in Seattle, King County, and Puget Sound (where adequate comparative data were available), together with health-based standards.

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[19] One meal per month is not a realistic seafood consumption rates for affected populations and is presented only for seafood consumers to be able to calculate their individual risks

[20] Add shellfish framework citation

[21] Kissinger L. 2005. Application of data from an Asian and Pacific Islander (API) seafood consumption study to derive fish and shellfish consumption rates for risk assessment. Office of Environmental Assessment, US Environmental Protection Agency Region 10, Seattle, WA.

These data represent our current understanding of environmental burdens and the distribution of the environmental benefits in the LDW which could potentially be impacted by cleanup actions, and help establish whether or not the impacts are adverse and disproportionate.

From this set of data, the impacts identified are then evaluated in light of the decision in hand, for each of the cleanup alternatives given the data provided in the Feasibility Study (AECOM 2012) nine-criteria analysis (Table 10-1 of FS 2012; part of the table is excerpted in this document as Table 2.1).

Appropriate mitigations are suggested for any adverse disproportionate impacts that are found. In this document we are further breaking down an adverse impact in two ways. First, an impact will be considered significantly adverse and disproportionate when some populations are more exposed to risk or adverse effects, and unacceptably so (risks are above federal and state standards or will significantly impact day to day life) than others and the cleanup actions either exacerbates the health risk or will not fully address the existing impact or effect such that the risks for the affected community are within the federal and state standards for acceptable risk or will disrupt cultural or economic resources and daily life[22].

Second, an impact will be considered moderate and adverse when risks from the cleanup do not result in health impacts that are above health-based standard for risk from potential exposure. However, the known health outcomes linked to the route of exposure are adverse and disproportionate for the affected populations and mitigations are still warranted to avoid any additional excess risk to impacted populations.

[22] US EPA. 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

Current understanding of community vulnerabilities exposures and environmental risks along the LDW

Site-specific local data is required to better define cumulative environmental burdens, social vulnerabilities, and environmental justice concerns within LDW communities. There are many sources of local data available for establishing an understanding of current health status, vulnerability to chronic disease, environmental burden, and underlying socioeconomic factors which may exacerbate the impacts of a particular decision on the affected community.

These factors present a picture of current conditions, health status, and environmental burdens that can be useful in determining environmental impacts and outcomes for populations affected by the Superfund cleanup. In particular, community attributes, including environmental features, contribute to health status. Examples of environmental features that contribute negatively or positively to the health status of a population, include the presence of: food deserts;[23] green space, parks, bike lanes; current or former sites with hazardous materials present, including brownfields;[24] and pollution sources.

Health Status of Affected Populations

Epidemiological data on the health status of a community can provide information on the vulnerability of a community to environmental contamination, and many diseases are associated with exposure to environmental contaminants[25]. Several studies have examined health disparities around King County, and some disparities have been shown in King County's most recently summarized health statistics from 2009[26] (based upon 2003-2007 data).

The King County health planning areas (HPAs, geographic areas with populations that are sufficiently large enough to provide statistically significant data for comparison) consolidate neighborhood data together for the Duwamish region. The South Park and Georgetown neighborhoods are within the Beacon Hill planning area (Beacon HPA). In the most recent set of data, South Seattle and the Beacon Hill HPAs have higher rates of some chronic illnesses and worse outcomes for life expectancy, infant mortality, and some well being indicators than many other HPAs in Seattle.

For example, infant mortality rates and life expectancy at birth are disparate for the Beacon HPA compared to other King County HPAs. The Beacon HPA infant mortality rate is 1.4 deaths per 1,000 live births greater than the rate for King County, and 2.0 deaths per 1,000 live births greater than that of the Ballard and Northeast Seattle HPAs (Queen Anne had too few infant deaths to be statistically significant). Life expectancy in the Beacon HPA is 79.5 years on average.

[23]As defined by the Healthy Food Financing Initiative, a partnership of between the Treasury Department, Health and Human Services, and the Agriculture Department, as a "low-income census tract where a substantial number or share of residents has low access to a supermarket or large grocery store". Low-income is defined as 1) a poverty rate of 20 percent or higher, OR 2) a median income at or below 80% of the area's median family income, and "low-access" is defined as a community of at least 500 people and/or at least 33 percent of the census tract's population must reside more than one mile from a supermarket or large grocery store (for rural tracts, the distance is more than 10 miles).

[24] The term brownfields site means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

[25] See e.g., *Pediatric Environmental Health*, 3rd Ed. American Academy of Pediatrics. 890 pp. October 15, 2011. ISBN-10: 1581103131.

[26](http://www.kingcounty.gov/healthservices/health/data/chi2009/HealthOutcomesLifeExpBirth/HPA.aspx)

This is 1.5 years less than the King County average, and 3.7, 4.7, and 5.8 years lower than the average life expectancies for Queen Anne, Ballard, and Northeast Seattle HPAs, respectively[27].

An additional analysis by Public Health Seattle and King County has compared the trend in life expectancies by census tract for King County to the trend in life expectancies found for the ten longest lived countries, “ten-countries”. Although there were too few data to do the comparison between Georgetown and the “ten-countries” dataset, for the South Park census tract, the life expectancy trend is approximately 24 to 57 calendar years behind that of the “ten-countries” life expectancy trend[28] (if trends continue, it will take 24 to 57 years for the populations in these census tracts to reach the life expectancy currently attainable in the “10-countries” dataset).

The child and adult asthma hospitalization rates are also disproportionately higher in the Beacon HPA than for King County. Asthma hospitalization rates within many Seattle HPAs are statistically significantly higher than the rate for many other areas in King County (Figure 4). The Beacon HPA childhood asthma hospitalization rate stands out at 306 per 100,000 individuals under the age of 18, and, at over twice the rate of the average within King County is the highest rate of all HPAs. The adult asthma hospitalization rate from 2003-2007 was almost twice as high in Beacon HPA as in King County on average, and it is approximately 10% higher for the neighboring Delridge/West Seattle HPA than the King County average. Other chronic diseases are significantly higher in the Beacon HPA, including the rate of death by stroke, and diabetes rates, on average, compared to the average rate for King County. 14.6% and 14.2% of the Beacon HPA and West Delridge HPA populations, respectively, are characterized by “Poor or Ill Health” according to the King County Indicators, in comparison to 10.5% of the population for King County on average, and 6.7% and 8.8% for Queen Anne and Ballard, respectively.

A more recent analysis based upon U.S. Census tract (2005-2009 U.S. Census Bureau) and WA State Dept. of Health Center for Statistics data for the Duwamish Valley (DV) (Appendix A; Health indicators Duwamish area and King County), which includes South Park and Georgetown and other South-Central Seattle neighborhoods, similarly revealed significant differences between the socioeconomic and health characteristics of the DV[29] area and King County (KC)[30].

For example:

- the average poverty level for the DV (17.6% v. 9.7% for KC);
- 31.9% of the DV is foreign born v. 19.0% for KC;
- 20.1% of the DV lack a high school degree v. 8.2% for KC;
- 75.4% lack a bachelor’s degree v. 55.2% for KC;
- life expectancy in the DV is lower than in KC (79.4 v. 81.3 years for KC);
- lung cancer and asthma hospitalization rates for children and adults were higher for the DV compared to KC (2005-2009 WA Dept. of Health data). Asthma hospitalization rates are 67% higher for children and 60% higher for adults in the DV than for KC.

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[27] All life expectancies are significantly different

[28] 2005-2009 data – As presented by D. Fleming: *Health of King County Focus: Health Inequities*. http://www.kingcounty.gov/healthservices/health/healthofficer/~/media/health/publichealth/documents/data/HealthofKingCounty2012.ashx, accessed October 18, 2012. Example – an outcome of 81.8 years for the 10 countries’ life expectancy in 2009, when U.S. life expectancy was only 78.2 years, means that U.S. life expectancy is the same now as the 10 countries were 16 years ago.

[29] Mortality, life expectancy and low birth weight data use census tracts within the Lower Duwamish Waterway to define the area. Hospitalization and risk factor data use zip codes (98106, 98108, and 98134). See Appendix A.

[30] In this case, for statistical reasons, health data were aggregated for the Duwamish Valley, instead of individual tracts for South Park and Georgetown, and census data were similarly aggregated to enable a direct comparison.

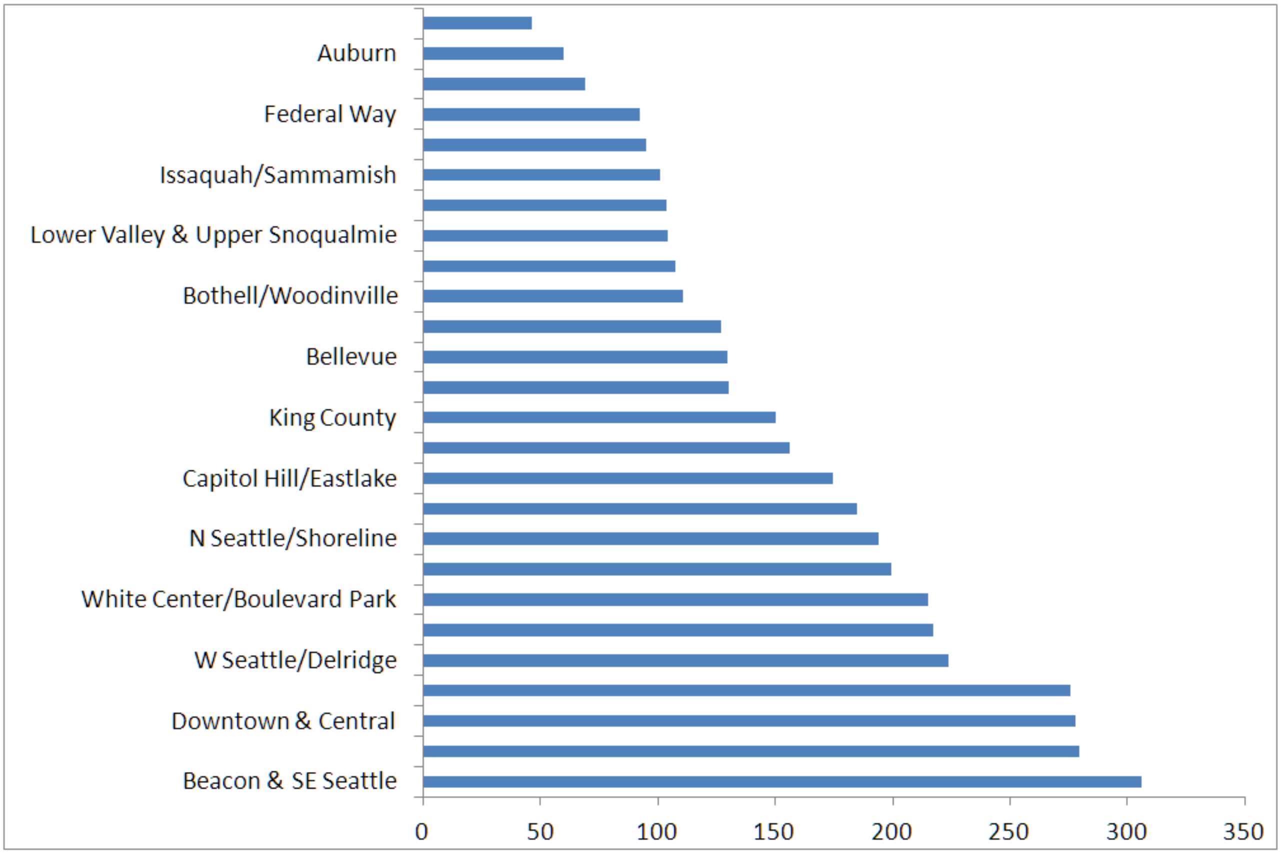

***Figure 4** – King County comparative asthma hospitalization rates by HPA, 2003-2007*

Public Health Seattle & King County also has created an independent social vulnerability index particular to Seattle, which uses factors including the health status of the population. In the most recent King County/City of Seattle social vulnerability index, the Georgetown and South Park neighborhoods ranked medium to high risk (Seattle Hazard Identification and Vulnerability Analysis, City of Seattle May 14, 2010[31]:).

Within King County, racial and ethnic disparities exist for several health indicators. Because there is higher diversity in South Seattle neighborhoods within a 1 mile radius of the LDW, these disparities are important to consider. Obesity prevalence, mortality rates due to stroke, and diabetes rates, for example, are much higher for African Americans, American Indians, and Hispanics/Latinos, than for Whites or Asian/Pacific Islanders, as defined in the 2010 Washington State Department of Health Behavioral Risk Factors Surveillance System.

For example, based upon 2006-2010 data, the obesity prevalences for African Americans and American Indians were 68%, 66% for Hispanics/Latinos, 56% for Whites, and 37% for Asians/Pacific Islanders. Adult rates of asthma are much higher for American Indians than for any other race or ethnicity surveyed[32].

31 http://www.seattle.gov/emergency/publications/documents/SHIVA.pdf

32 Accessed from http://www.kingcounty.gov/healthservices/health/data/chi2009.aspx, 2012.

Cumulative Exposures and Disparities in Access to Environmental Benefits

Several indicators of the burden of pollution in the Georgetown and South Park neighborhoods are stronger than in surrounding neighborhoods in Seattle, and King County. The South Park and Georgetown neighborhoods and the other areas adjacent to the LDW are a mix of industrial, commercial, and residential uses, and the neighborhoods are located near hubs for transportation, including major roadways (Highways 99, 509, and I5), rail spurs, and the Port of Seattle (Figure 5), the King County International Airport and its flight-paths, and are on the flight-paths from the Seattle-Tacoma International Airport. The assessment below identifies disparities in access to environmental benefits and burdens that can be considered in mitigating impacts from the cleanup. It is focused on the environmental issues that have a potential connection to the cleanup impacts.

However, King County is at the forefront in a movement to assess and implement equity impacts analyses in their decision-making. The King County Equity Initiative is a new one, and it has first systematically documented some burdens and benefits disparities within King County (king County 2012). Although it is difficult to define metrics and “total burdens” and “total benefits” such that the disparity or lack of disparity is clear, definitions are transparent, and tradeoffs are clearly stated, it is a phenomenal effort to tie decision-making to an understanding of what leads to healthier lives.

In their documentation (Appendix A), King County has shown that, for example, there are libraries and plentiful public transportation routes in or near the LDW, and that these benefits provide more livability for residents in the neighborhoods here. For one metric, access to a trailhead within one quarter mile of a residence, South Park also ranked as relatively dense in trailheads at a county level.

Although these metrics may not reflect access as well as presence (for example, Sammamish and Issaquah also ranked as relatively low in trailhead presence, along with Georgetown, despite possessing more access to parks in terms of area per person), they are important to acknowledge. It should be emphasized that the cumulative exposures to pollutants and disparities in benefits outlined here are only a snapshot of current conditions, given the best or most recent available data in hand.

As the King County Equity Initiative is put into place throughout the work of the county agencies, the analysis and recommendations should be updated to reflect any changes or enhanced information that can be gleaned from the County’s work.

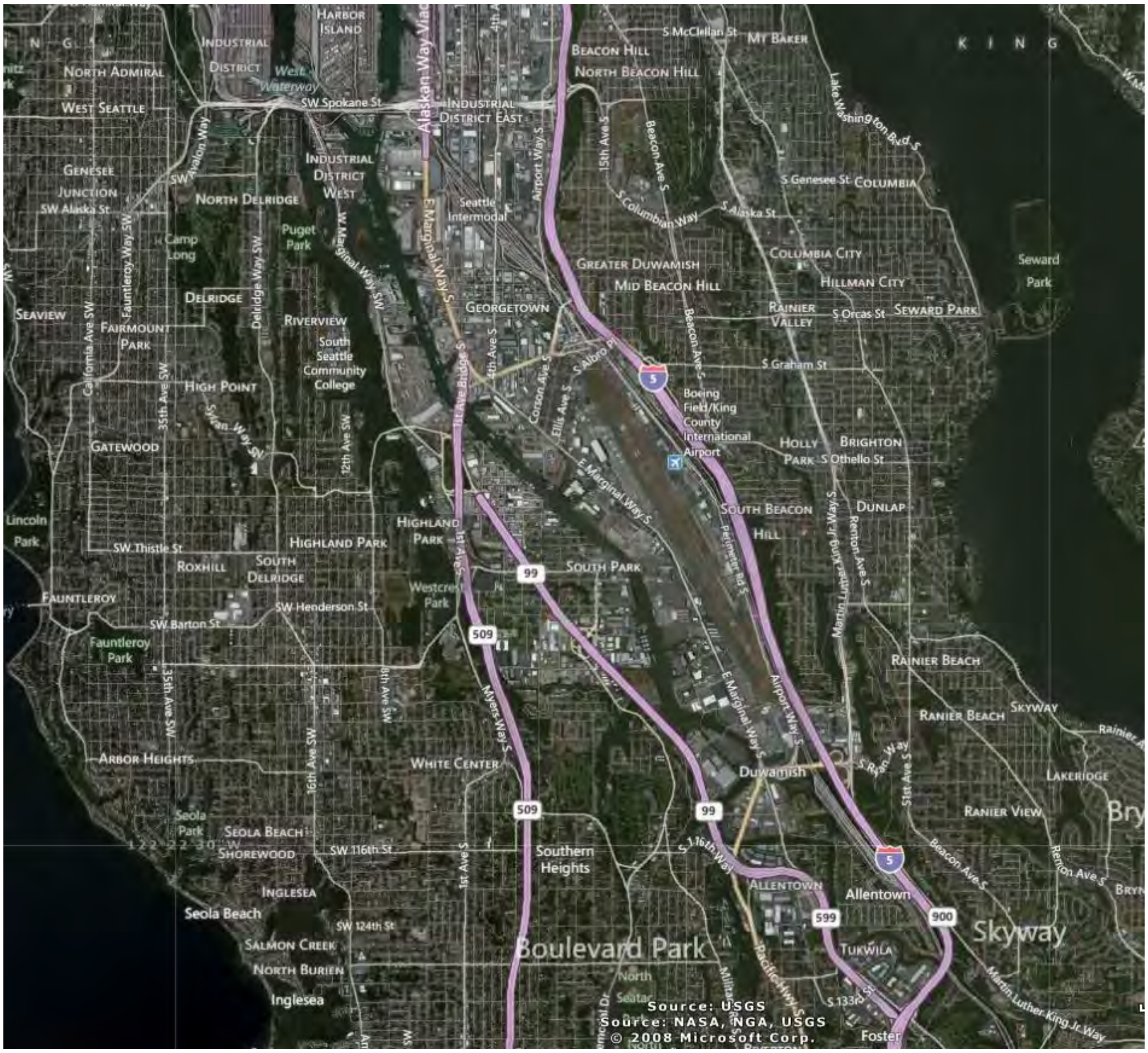

Figure 5 *– Duwamish infrastructure, including major highways and Boeing Field/King County Airport*

Proximity to Pollution

Hazardous Waste and Facility Density

Hazardous waste facilities and other pollution point sources[33] in the City of Seattle tend to be more concentrated along industrial corridors including the Duwamish Valley and around the LDW, and concentrations of hazardous waste sites were found to be higher neighborhoods with higher proportions of minority and low-income residents in the King County[34] The facilities also correlate with low income and areas with large minority population

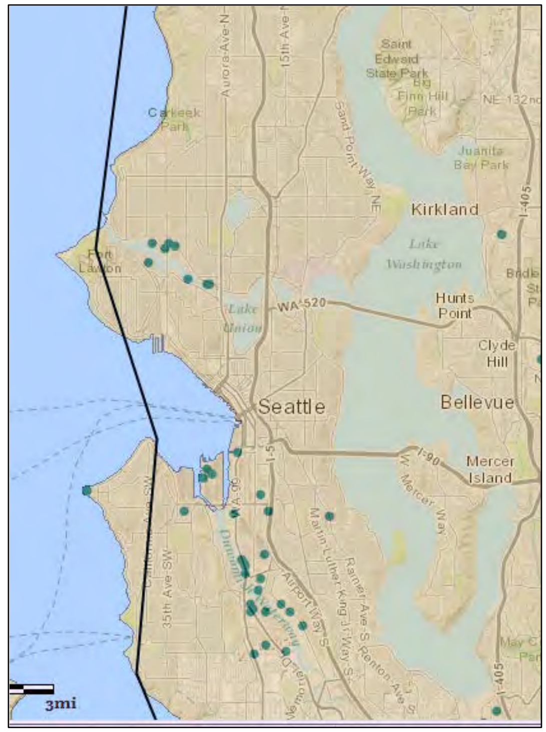

***Figure 6** – TRI Facilities in Seattle, WA*

From King County's "Communities Count" website[35]: "[Between 2003 and 2007] the percent of people living near hazardous waste storage treatment and disposal facilities increased for people living in areas with incomes below the County median household income and for those living in areas with racial diversity greater than the County average." EPA maintains a Toxics Release Inventory Database that tracks self reporting facilities that store or use hazardous substances. In the city of Seattle, the majority of these facilities are concentrated along the Duwamish waterway[36] Figure 6 shows TRI facilities' locations in Seattle, WA. Each green dot represents a facility that reports to the TRI program.

In a recent paper, Abel and White (2011) reported on a retrospective analysis for Seattle that examined the change in TRI-reporting air emitters and the risk from those emitters using EPA's RSEI (Risk-Screening Environmental Indicators tool). They computed a "gentrification index" from 1990-2007 which included factors related to racial and ethnic diversity and income based upon census block group data. From this index, the neighborhoods in South Central Seattle, including South Park and Georgetown, were among the few clusters of block groups in Seattle to incur a disproportionate burden from air pollution sourced from large industrial emitters while demonstrating few changes in race and income over the time period of study.

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33 Point sources refer to discrete locations (typically confined, such as a pipe) that release pollutants into the environment or are locations where potential pollutants are handled. In contrast, nonpoint sources are sources of pollutants to the environment that comprise many diffuse sources that aggregate into a potentially large source of pollutants.

34 "Communities Count" analysis; 2008, accessed at: www.communitiescount.org/uploads/pdf/archives/2008%20Report/Executive_Summary.pdf. 2012 Assessment is pending.

35 (http://www.kingcounty.gov/healthservices/health/data/chi2009/HealthOutcomesLifeExpBirth/HPA.aspx)

36 2011 mapped TRI data available at: http://www.epa.gov/region10/tri/map.html

The trends indicate that the total burden from large industrial air pollution sources and locations of new industrial sources are of particular concern for South Central Seattle, and they are not evenly distributed throughout Seattle. This is of concern because it indicates an additional risk that may be placed on low income and minority communities in the Duwamish area. Note that there are caveats in using RSEI to infer direct risk from individual emitters and mobile sources of air emissions are not included in the tool.

Air

Recent studies have raised concerns about the impact of mobile sources of air pollution, which are sources such as trucks and cars that are not fixed in one spot, together with fixed sources of air pollution, on the health of the South Park and Georgetown neighborhoods. These studies have included monitoring, GIS-based, and numerical modeling-based research. Due to community concerns about air, the Washington Department of Health conducted a regional modeling and health risk assessment for the Georgetown and South Park neighborhoods (WA DOH 2008). The numerical modeling and monitoring results of that study revealed that cancer risks from point source emissions held particular concern for two areas in the Georgetown neighborhood and South Park. The 2008 WA DOH study also found that woodstoves present a risk in winter months. Non-cancer health risks from point, fixed sources were found to be below levels of concern according to the 2008 study.

The neighborhoods of South Park and Georgetown are located adjacent to several major highways, and thus bear high exposure from on-road sources. The modeled on-road mobile sources from the 2008 WA DOH study found that cancer and non-cancer risks were highest near major highways, including highways 99, 509, and I5. The study found that diesel particulates contributed 74% of the excess cancer risk, while benzene contributed 15% of the excess cancer risk, and 1,3-butadiene contributed 9% of the total excess cancer risk.

The researchers discussed particular concern for childcare facilities and schools within 500 feet of a major highway (children are more vulnerable to presenting with asthma and other air exposure-related health conditions). At the time of the study, there were 13 childcare facilities and 3 schools located within 500 ft of a major roadway in South Park and Georgetown.

In 2004, DOH investigated emissions from a South Park cement plant and assessed monitoring data for trends that could lead to upper-respiratory irritation and difficulty breathing. In the course of the investigation, they found that at the Georgetown monitoring station concentrations of nitrogen oxides were significantly higher than at the neighboring Beacon Hill monitoring site. While the higher concentrations of nitrogen oxide were primarily attributed to vehicle traffic, other sources of nitrogen oxide emissions could have contributed to the high concentrations.

Additional air monitoring data were collected by the U.S. EPA Region 10's Office of Air Waste and Toxics at Concord Elementary School, in South Park from August to November, 2009, as part of a nationwide evaluation of air quality near schools (U.S. EPA, 2011). The 2009 EPA study revealed that the major constituents of concern that were modeled in the previous DOH studies, including hexavalent chromium, benzene, 1,3-butadiene, and lead, were below EPA levels of concern at the school during the sampling period. However, key findings from the study at Concord Elementary and national patterns in the data EPA analyzed suggest the strong influence of mobile sources on air quality in the area.

A modeling and monitoring evaluation of air quality was also conducted by the Puget Sound Clean Air Agency (2010[37]). The 2010 PSCAA study revealed that in the Duwamish area of Seattle, the excess cancer risk calculated from the nine monitored chemicals which contribute the most to health risk (carbon tetrachloride, benzene, 1,2-butadiene, formaldehyde, naphthalene, acetaldehyde, chloroform, and tetrachloroethelene) could be expected to result in risks of a little more than 100 excess cancers per million individuals[38]. This risk is 20% less than the risk calculated for Seattle's Beacon Hill monitoring station, and slightly less than the risk estimated for Tacoma's South L Street sampling location (the only other site reported in the study).

The potential risks contributed from diesel particulates based on modeled results, however, were found to amount to almost 300 excess cancers per million individuals at the Duwamish site, around 20% higher risk than at Seattle's Beacon Hill site, and almost three times higher than at the Tacoma South L Street site. Overall, mobile sources were found to contribute to over 72% of the excess cancer risk at the Duwamish site.

Because all three sites, Tacoma's South L Street Station, Seattle's Beacon Hill site, and the Duwamish location are generally speaking low-income and diverse areas, the data are presented here for informational purposes but only a comparison between the Duwamish location and the average Seattle or King County location would be used to determine whether an existing condition is disproportionate for the LDW, and these data are not widely available except as emissions estimates by PSCAA for the airshed based on commerce and transport and the National Air Toxics Assessment data (see below), based on a few monitored sites and modeled data.

The trends seen in the recently-released 2005 review for the National Air Toxics Assessment (NATA) (2011) agree with the findings of the previously described studies. NATA data, which are based on a combination of modeled and monitored data, have caveats given the national-level analysis of the data, but they provide an indication of where air cancer risks may be highest nationally.

For census tracts located in the Georgetown and South Park neighborhoods, non-cancer risks fell in the 60-80th and 80-100th percentile categories, nationally.

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37 Tacoma and Seattle Area Air Toxics Evaluation. October 29, 2010. The Puget Sound Clean Air Agency and The University of Washington. Accessed at http://www.pscleanair.org/news/library/reports/2010_Tacoma-Seattle_Air_Toxics_Report.pdf.

38 Based on Unit Risk Factors which are a measure of the potential cancer risk of exposure to 1 microgram chemical per cubic meter of air over a 70-year period. PSCAA 2010.

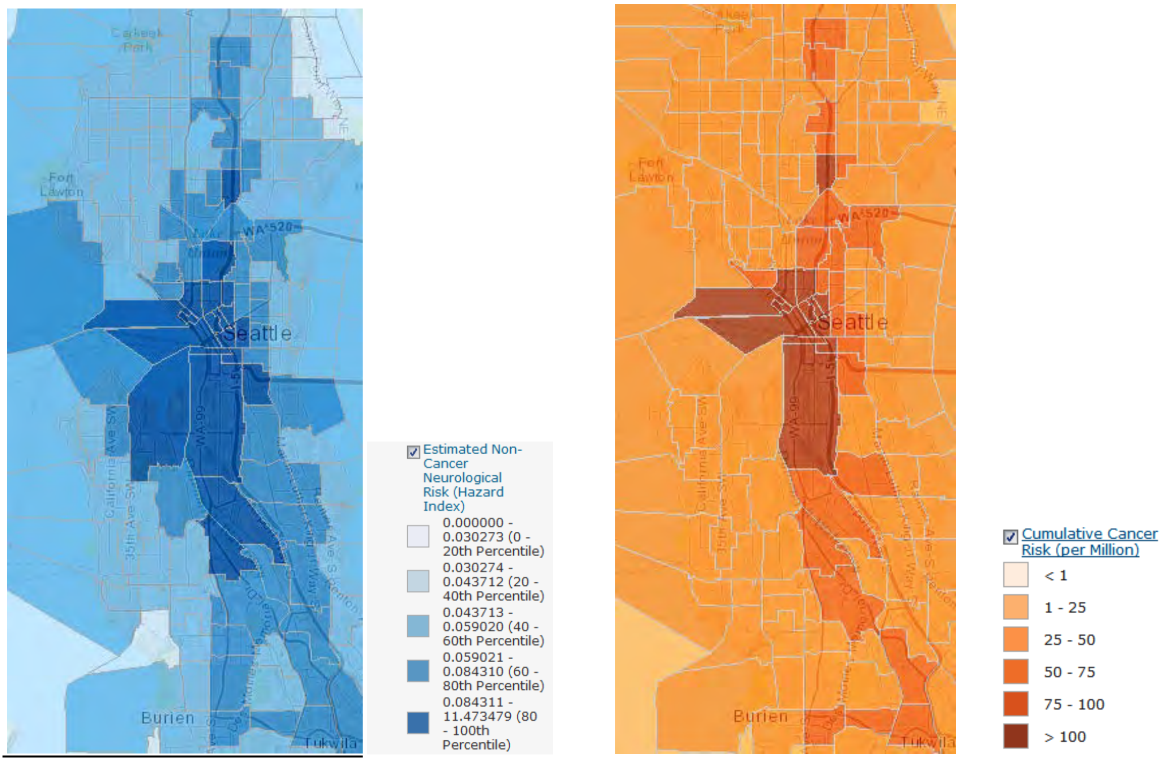

***Figure 7A and B** – Cancer Risks and Noncancer Neurological Risks*

***LEFT (7A)** – Noncancer neurological risk from NATA data. Darkest blue indicates highest percentile (80-100%)*

***RIGHT (7B)**- Cumulative cancer risk from NATA; dark brown is highest (80-100%)*

Non-cancer neurological risks adjacent to Interstate 5 (along the I5 corridor) were comparable to south central Seattle rates and highest in the Seattle metro area, and in the 80-100th percentiles for the NATA dataset. Estimated excess cancer risks are also high, between 75 and greater than 100 excess cancers per million individuals[39], and a pattern of relatively high excess cancer risks again tracked along the Interstate 5 corridor (Figure 7A). While non-cancer respiratory risks were uniformly high throughout the wider Seattle area, non-cancer neurological risks were highest in central and south central Seattle compared to the rest of the city (Figure 7B), together with some neighborhoods in the downtown area adjacent to Interstate 5.

The highest estimates of excess cancer risk for census tracts were found in Seattle's Central District. The NATA data indicate that arsenic concentrations in Georgetown ranked in the 80-100th percentile, and for South Park, 60-80th; for benzene and diesel particulates, similarly 80-100th percentiles, formaldehyde and lead, 60-100th percentiles, and for diesel particulate matter (PM), 80-100th percentiles, nationally.

The Duwamish area is a former non-attainment area for PM_{10} (solid and droplets of particulate matter of 10 microns or less in diameter), and currently in maintenance for PM_{10}, ground-level ozone and carbon monoxide[40]. In order to become a maintenance area, an area formerly in non-attainment must meet air quality standards and have a ten year plan for maintaining air quality.

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39 Cancer unit risk estimate is used, and it is based on 70-year (long-term exposure scenarios. From: An Overview of Methods for EPA's National Scale Air Toxics Assessment. January 31, 2011. EPA. Available at: http://www.epa.gov/ttn/atw/nata2005/05pdf/nata_tmd.pdf

40 WA Dept. Ecology: http://www.ecy.wa.gov/programs/air/other/namaps/Web_Map_Intro.htm

Soil

Contamination of soils from present and past industry is also a concern in South Park and Georgetown. In 2010, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the WA Department of Health reviewed dioxin and PCB contamination data in South Park soils[41], and found that measured concentrations were below levels of concern for non-cancer and cancer health risks for WA DOH's average exposure assumptions.

In discrete samples in South Park in 2008 as part of the Superfund investigation at Terminal 117 (T117), dioxin concentrations of 90 parts per trillion TEQ (toxicity equivalent, a measure of how toxic a contaminant is by relating the various dioxin types to the toxicity of the most toxic form) were found in roadway soils, and other soil samples tested positive for dioxin in the vicinity of the roadway[42] (City of Seattle 2008). These results exceeded the state standard for unrestricted land use, which is 11 parts per trillion TEQ for dioxin under the WA Model Toxics Control Act (MTCA) program. In 2011 Ecology measured soil dioxin and cPAH concentrations in neighborhoods around Seattle[43]. In five of six of those Seattle neighborhoods sampled, which included South Park and Georgetown, the average dioxin concentration in soils was higher than the state MTCA standard but less than the EPA draft cleanup level (72 pptr TEQ). The highest measured dioxin sample concentration, 114.7 pptr TEQ, was found in Georgetown, which also had the highest average concentration, 36 pptr TEQ. The formerly industrialized neighborhood of Ballard had the next highest average concentration, (26 pptr TEQ) while South Park's average level (12 pptr TEQ) fell at the lower end of the range of the six sites sampled. Soil dioxin remediation is part of the activities slated for the Terminal 117 Early Action Area cleanup under the Superfund Program.

Another set of contaminants, PAHs, were measured at the same time during Ecology's 2011 study. The average concentrations in soil samples from four neighborhoods, including Georgetown, were above the MTCA screening level (137 ppb TEQ). In addition, soils from all six neighborhoods exceeded the EPA screening levels of 15 ppb TEQ for cPAHs.

Risks and Disproportionate Adverse Impacts from Consumption of Resident Seafood Caught in the LDW

PCBs, arsenic, cPAHs and dioxins/furans were identified as human health COCs based on an excess lifetime cancer risk greater than 1 in 1,000,000 for carcinogenic chemicals, or a hazard quotient (HQ) greater than 1 for non carcinogens. For any given contaminant, the HQ is the ratio of the exposure concentration or dose to the lowest observed adverse effect level; the hazard index (HI) is the same but for multiple contaminants. Although BEHP, pentachlorophenol, vanadium, tributyltin, and several pesticides were found in the waterway at concentrations that exceeded risk thresholds they were not selected as COCs due to low detection frequency, low contribution to overall risk, or quality assurance concerns with analytical data.

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41 Evaluation of Contaminants in Adjacent Streets and Residential Soils in the South Park Site, South Seattle, King County, Washington. 2010. Health Consultation. WA Dept. of Health. July 28, 2010.

42 Fact Sheet released by Chuck Clarke, Director of Seattle Public Utilities. "South Park Streets Fact Sheet" May 2008. Accessed at Yosemite.epa.gov/r10/CLENAUP.NSF/LDW/Fact_Sheets/$FILE/South-Park-Street-FS.pdf

43 Department of Ecology, State of Washington. Urban Seattle Area Soil Dioxin and PAH Concentrations Initial Summary Report. September 2011. Publication no. 11-09—40. Study accessed at: fortress.wa.gov/ecy/publications/1109049.pdf

The human health risk assessment (HHRA; Windward 2010) conducted for the LDW is described in Section 4.1 of the Proposed Plan, and used a range of seafood consumption rates that correspond to a variety of consumption practices by Duwamish community members and local fishers and were selected by EPA and Ecology as the basis for risk estimates in the RI/FS. The information used in the HHRA was derived from EPA's 2007 Tribal Fish and Shellfish Consumption Framework for Puget Sound[44], and the aforementioned Asian Pacific Islander Fish Consumption Study (Sechena et al. 1999). The Tulalip tribal and API data were used as the reasonable maximum exposure (RME) rates in the HHRA[45]. The adult tribal RME seafood consumption rate from Puget Sound, excluding anadromous fish, totaled 97.5 g/day, and comprised pelagic and benthic fish at 15.6 g/day and shellfish at 81.9 g/day. Tribal children RME consumption rates were 39 g/day from all seafood sources, with 6.2 g/day for pelagic and benthic fish, and 32.8 g/day for shellfish).

The Asian and Pacific Islanders' (API) consumption rates were taken from the Sechena et al. collaborative study as reinterpreted for the risk assessment by Kissinger (2005). The overall API RME was 51.5 g/day, with 7.3 g/day for resident species of benthic and pelagic fish and 44.2 g/day of shellfish, respectively. For comparison, the HHRA also considered adult fish consumption at one meal per month (7.5 g/day), and rates for Suquamish adult tribal members[46] based on a Suquamish tribal survey, totaling 584.2 g/day, and comprised of 499.0 g/day for shellfish, 29.2 g/day for benthic fish, and 56.0 g/day for pelagic fish.

Although Suquamish tribal members have fishing rights in the Duwamish River, their total fish consumption rate is dominated by shellfish consumption. However, the LDW does not currently support widespread high quality intertidal shellfisheries (Windward 2010).

The HHRA used the Tulalip rates rather than Suquamish rates to determine the consumption of seafood, as they are more analogous to the resources found in the LDW. The Suquamish Tribe has raised issue with the use of the Tulalip Tribes' rates for the RME scenarios. In addition, the Muckleshoot and Suquamish Tribes have raised the issue that their current consumption rates as recorded in the 2007 framework and in other seafood consumption studies (i.e., Suquamish 2000) are suppressed, reflecting the degraded conditions for fishing, and that with a cleaner river in the future to support safer and robust fisheries, rates would actually be much higher.

Washington State ARARs for human health risks relating to seafood consumption are exceeded for tribal adults and Asian American Pacific Islanders. The standards comprise 1 excess cancer per 100,000 persons for multiple chemical contributions, an individual chemical risk of 1 excess cancer in 1,000,000, or no greater than a noncancer Hazard Index of 1).

Consistent with EPA and Washington risk assessment guidance, the exposure term for calculating human health risks for fish consumption were based on the 95% upper confidence limit on the mean (UCL95) of the concentrations of COC.

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44 Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia. EPA, August 2007.

45 The Tulalip Tribe does not have usual and accustomed fishing rights in the Duwamish; since Muckleshoot Tribal consumption rates were not available, Tulalip Tribal rates were used as a proxy.

46 The Suquamish seafood consumption rate used in the LDW HHRA (Windward 2010) was 583.5 g/day while the value cited in the LDW RI (Windward 2010) was 584.2 g/day. This difference was due to considerations of rounding and significant figures associated with assigning overall seafood consumption to specific seafood categories (e.g. benthic, pelagic, or shellfish). Given the overall uncertainties in the HHRA, the slight differences in consumption rate have an insignificant impact in assessment of overall risks.

Results of the assessment indicate that individuals who use the LDW as a fisheries resource would suffer more health risks than individuals with access to less contaminated resources.

Particularly for the tribal and subsistence fishers and others who consume seafood at a higher rate than the general population, risks from eating contaminated seafood would be even higher, representing a significant environmental justice concern: an existing pre-cleanup adverse disproportionate impact for these groups of individuals.

Hazards from consuming fish from the LDW were also evaluated by DOH coordinating with ATSDR in 2003 and 2005 (WADOH 2005[47]). Based on the findings of the evaluation, the Washington State Department of Health (WA DOH) advisory advocates that fishers "Do Not Eat" the following resident fish and shellfish: perch, flounder, English sole, crabs, and other shellfish. The study found that those who consume large amounts of resident fish (which does not include anadromous fish like salmon) caught in the LDW were at risk for adverse health effects, and that consumption of resident fish represented a public health hazard. Salmon, which spend a limited amount of time in the LDW and are minimally impacted by COCs from it, are not included in the "Do Not Eat" fish advisory. The evaluation found that the effects of mercury and PCBs were of greatest concern, due to the potential for impacts on the development of children after fetal exposure.

The evaluation found that bottom fish like flounder and English sole were of most concern of the fish stocks. There was measurable, although slight, concern raised over the consumption of fish like striped perch. Consumption of red rock and Dungeness crab were also of concern due to high concentrations of PCBs, mercury, and arsenic. Further data compiled during the RI/FS process have been used to calculate relative cancer and noncancer risks from consuming different seafoods in the LDW (Proposed Plan 2013, Figure 7). Because the concentration of contaminants varies within an organism, the WA DOH evaluation identified which portions of target species posed the greatest health concern. For example, fish livers and the crab hepatopancreas (crab butter) concentrate toxins, and should be avoided.

During the study, community members raised concerns over the safety of consuming salmon, the safety of consuming fish at markets, and the lack of adequate warning about consuming seafood from the Duwamish, which are important points to consider in the development of education tools during the Superfund cleanup in the LDW.

Additional seafood risk comparative data are available from the FS 2012. Here, baseline seafood consumption risks are compared to two other measures: a) Preliminary Remediation Goals (PRGs), which are based either on non-urban background or risk-based thresholds, and b) the model-predicted long-term river steady state. PRGs are preliminary cleanup levels used to meet the Remedial Action Objectives in an EPA Proposed Plan. They are finalized to cleanup levels in the Record of Decision after considering public comment. (The Proposed Plan describes the process of selecting PRGs in Section 7.)

Figure 7 of the Proposed Plan shows baseline risks as well as hazard quotients for PCBs (which were the major contributor to non-cancer effects). The combined excess cancer risks for the tribal adult RME scenario based on a diet of perch, flounder, crab or a "market basket" combination of fish are higher than the CERCLA and MTCA thresholds.

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[47] 2005. Lower Duwamish Waterway Site: Updated Fish Consumption Advisory and Evaluation of Marine Tissue Collected from the Lower Duwamish Waterway in August and September 7, 2005. Seattle, Washington. Health Consultation. WA Dept. of Health.

Proposed Plan Figure 17 displays the excess cancer risks from PCBs, which are much higher at LDW baseline than at the PRGs.

The excess cancer risk attributable to PCBs for the tribal adult RME scenario (3 meals per week) is greater than 1 in 1,000 for the Lower Duwamish Waterway baseline (before cleanup) compared to between 1 in 1,000,000 and 1 in 100,000 excess cancer risk at the PRGs. FS model-projections estimate that excess cancer risks due to PCBs would be reduced by 90% after cleanup, but will still be above 1 in 10,000. Should the seafood tissues PRGs be achieved, a 99% reduction in excess cancer risk would result, and risks would be between 1 in 1,000,000 and 1 in 100,000. (These are still above the MTCA risk threshold.)

HQs less than 1 are considered levels where no non-cancer effects are seen, however, it is difficult to compare HQs greater than 1 due to the potential for nonlinearity in responses to a given dose of a particular chemical. Baseline non-cancer hazard quotients attributable to PCBs are shown in Proposed Plan Figure 8, and are as high as 87 (tribal child RME). At the PRG, HQ's would be less than 1 for all adult and child tribal and API scenarios for PCBs and arsenic, so no non-cancer risks would be anticipated from eating fish following achievement of the cleanup goals. However, at the model-predicted steady-state, both child and adult tribal HQs are projected to exceed 1. (The child HQ ranges from 9 with the "market basket" of several species consumed to 31 from eating a diet high in pelagic fish; the adult HQ ranges from 4 in the "market basket" to 14 from eating a pelagic-fish diet.)

Risks from Direct Contact with Sediments or Water

DOH (WA DOH 2005) determined that direct contact with sediments and direct contact with water while swimming in Duwamish waters did not represent a public health hazard. There are risks from ingestion or contact with microbial pathogens (e.g., viruses, bacteria, protozoa) after rain events, resulting in swimming advisories, however, these advisories are not linked to the industrial contamination associated with this cleanup decision. The RI HHRA (Windward 2010) concluded that risks associated with direct contact with water (i.e., swimming) are much lower than those estimated for direct sediment contact, and so did not include them in the FS. The risks from direct contact with sediments include three direct-sediment-contact scenarios, netfishing, clamming, and beach play, and were evaluated in the HHRA (Windward 2010). As shown in Proposed Plan Table 6, excess cancer risks for all human health risk drivers combined for netfishing was 3 in 100,000; for clamming, 1 in 10,000, and for beach play, 4 in 1,000,000 to 6 in 10,000 (all above the MTCA health-based standard for excess cancer risk of 1 in 1,000,000). Beach Play Area 4 at River Mile 2.2W was found to have the greatest excess cancer risk.

The Lower Duwamish Waterway Group also conducted additional sampling at the Duwamish Waterway Park in South Park, which is often used by residents. The calculated excess cancer risk from this additional sampling of the park was 2 cancers in 1,000,000), on the lower end of the range of excess cancer risks compared to other beach play areas studied.

Proposed Plan Table 6 shows the results for noncancer risks associated with direct contact with sediment. HQs from PCB for all netfishing, clamming and beach play did not exceed 1, with one exception, at Beach Play Area 4. When more data were collected by Ecology in 2007, higher concentrations were found in two samples at this area. For this area (Trotsky Inlet), there is an HQ of 187 estimated. However, without these two samples (that is, if the inlet were remediated), the Beach 4 HQ would be less than 1.

Although DOH does not have a public health advisory in place for contact with the site sediments, Seattle/King County Public Health has issued a public health advisory to avoid swimming near combined sewer outfalls (CSOs) in the LDW and elsewhere, due to the potential for contact with enteric pathogen (bacteria and viruses) contamination. There are a number of stormwater/CSOs and locations that contribute loading of contaminants to the LDW identified along the LDW (FS Figure 2-22).

Combined Sewage Overflows play an important role when rain water overwhelms stormwater drains and reduces flooding higher in the watershed. However, this flood reduction comes at a cost, when these episodes result in bursts of combined sewer systems which drain to the LDW (and other waterbodies around Seattle and King County). Lateral loading from CSOs, other nonpoint runoff of contaminants, and upstream loading from the watershed for the Lower Duwamish all add the high background sediment contaminant concentrations from past and current industry local to the watershed. The LDW is listed as a 303(d) contaminated waterbody[48], while serving as a major migration route for Endangered Species Act (ESA)-listed salmonids including Chinook salmon.

Access to Environmental Benefits

Green space and Food Access

Seattle, also called the Emerald City, is known as a green city. There are over 4 million trees in Seattle, with the most in residential areas. That amounts to approximately 7 trees per person, in contrast to other urban cities such as Los Angeles, which has 6 million trees, total, but only approximately 1.5 trees per person[49]. Trees are most numerous in residential areas and natural and developed parks, and they are least numerous in the downtown corridor, commercial/mixed use, and industrial areas. Likewise, in the industrialized and mixed-used neighborhoods surrounding the LDW, particularly in Georgetown, green space is relatively scarce (Figure 8 and 9)

Major roadways must be crossed under or over to reach anything but one large park with playing fields in either the Georgetown or South Park neighborhood, unlike the multi-park access that much of Seattle enjoys (Figure 10). In Georgetown, one playground and one field (sandwiched next to Interstate 5, bordered by train tracks and under the flight path for nearby King County Airport) are the only recreational areas (Figure 9).

South Park (Figure 9) has relatively more green space than Georgetown, comprising the South Park Community Center grounds, the Duwamish Waterway Park and beach, and some other small pocket parks along the Duwamish River. A relatively new bike trail (Duwamish Bikeway) winds along a small part of the western bank of the Duwamish River, and provides recreation linked to the Duwamish, but there is no such path along the eastern bank near Georgetown. South Park's green space also includes the 4-acre Marra Farm, a working farm and community resource, and an important source of produce for local schoolchildren and residents in an area where no large grocery stores are present.

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[48] Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

[49] *Seattle's Forest Ecosystem Values.* Green Cities Research Alliance, August 2012. Report located at: www.itreetools.org/resources/reports.php

South Park and the south end of Georgetown are known as USDA-ranked "food deserts" for the lack of easily accessible grocery stores[50][51]. In combination with obesity statistics and disparities for King County, and with the high diabetes rates for African Americans and Native Americans who live here, lack of access to healthy foods is a significant health issue.

Local residents who fish for and consume Duwamish resident seafood are limited in the choices they can make for acquiring healthy foods from other sources. Innovation is happening around this recognized concern, however. For example, a recent start-up, Stockbox Grocers[52][53], is looking to fill the gap in access to healthy foods, and recently started operating a small grocery store in South Park.

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[50] USDA food desert mapping tool: http://www.ers.usda.gov/data/fooddesert/fooddesert.html

[51] "Communities Count" food desert data: http://www.communitiescount.org/index.php?page=farm-desert-map

[52] http://stockboxgrocers.com/south-park/

[53] http://boss.blogs.nytimes.com/2011/11/01/a-start-up-tries-to-eliminate-food-deserts/

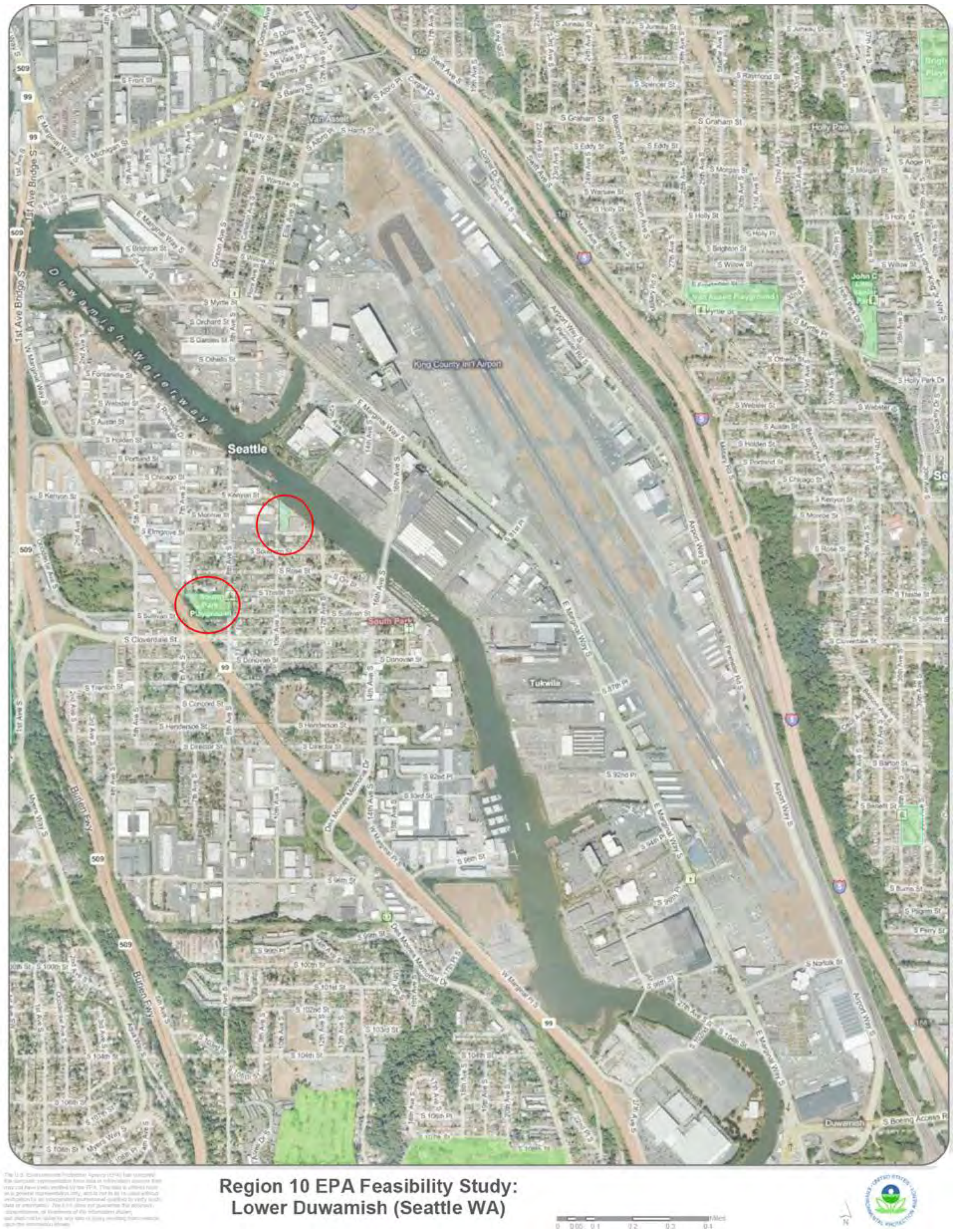

Figure 8 *– Green space and parks in the South Park neighborhood, Seattle (two parks circled in red*

Figure 9 *–- Green space and parks in the Georgetown neighborhood, Seattle (one park circled in red)*

Figure 10 – *Park density throughout Seattle*

Community Assets

Statistics of course do not provide a full view of life in the community surrounding the LDW Superfund site, and many of the impacts above belie strong communities that are working together in an unprecedented way toward achieving environmental justice in their neighborhoods. Many issues raised here are related to historical development of the city, infrastructure, timing, and policies that took place over a long period of time. Therefore, they will take time to resolve and will require that communities, industry, businesses, and multiple agencies move forward together to acknowledge and address the underlying causes and solutions for the disparities and concerns.

The Georgetown and South Park communities each have strong community neighborhood associations (South Park Neighborhood Association and Georgetown Community Council) which are actively tackling issues that face their communities together with the City of Seattle and King County. For Georgetown, a Georgetown Neighborhood Plan was created in the community in the late 1990's, and additionally, the community has done visioning for the future of Airport Way and the Duwamish River. Industry provides thousands of diverse jobs in the area with varying levels of experience and education needed to fill them, and the neighborhoods flanking the Duwamish also provide a way to work close to home.

This work has resulted in the development of Oxbow Park, neighborhood P-Patches, and better community space in the neighborhood. The community has also worked together to save historical public art, the "Hat 'N' Boots" icons from the 1950s that are now located at Oxbow Park. South Park has created the "South Park Action Agenda" which targets five areas for improvement, including,

- Environmental and physical
- Business and transportation
- Community engagement
- Youth development, and
- Public safety.

Both neighborhoods are cohesive and many activities involve neighbors helping neighbors. The community activities bridge diverse cultures, languages, and socioeconomic barriers. For example, Marra Farm, an icon in South Park, supplies organic produce to neighboring schools and is a source of outdoor recreation, food, and environmental education in the area.

South Park Arts, is an organization that works to bring art to the South Park neighborhood and hosts monthly events. Recently, the group developed a neighborhood-wide mini-golf course, with South Park-inspired mini-golf holes throughout the neighborhood.

The 17-member South Park Citizens Advisory Group formed in 2002 to provide community input on the new South Park Bridge that is scheduled to be finished in 2013, and the group gave suggestions on the design which changed the design chosen, retained the artistry of the original landmark bridge, and reduced impacts on local neighborhoods.

Community artwork and art venues along with historical buildings figure prominently in South Park and Georgetown, and around the LDW, including the Duwamish Tribe's Longhouse and Cultural Center and Art Gallery and exhibit area, the new fish schooner sculpture at Terminal-107 Park that was just finished along the Duwamish trail on land owned by the Port of Seattle, and the historic Old City Hall and original Rainier Brewery (now the Georgetown Brewhouse).

Duwamish River Festival

The neighborhoods flanking the LDW also have a resource – the LDW, Seattle's only river, and environmental and economic benefits from that river. Local industry and businesses participate in and support the many festivals that are located in neighborhoods flanking the LDW. The annual Duwamish River Festival includes music, cultural, and river-based activities to South Park and LDW. South Park Cinco de Mayo, Fiestas Patrias, and Dia de los Muertos events happen annually. Youth Development programs such as "Project Wild" (video here: http://www.youtube.com/watch?v=iKH6wgRcutk), for example, have enabled youth from diverse communities around the LDW to interview and learn from those who use the river for fishing about why they fish, how they fish, and the importance of the river to them. Another source of community involvement around the environment is the "Green Jobs" program at Georgetown Community College (funded in part by a grant from the U.S. EPA), which serves as a resource for communities surrounding the LDW to learn how to be involved in action for the future of the environment they live in.

Evaluation of Impacts from this Decision on Minority and Low-Income Populations including Tribes and Tribal Resources

Impacts Considered for Suite of Remedial Alternatives

In its Superfund Feasibility Study (AECOM, 2012), the Lower Duwamish Waterway Group presented a range of remedial alternatives for reducing risk to human health and ecological targets (benthic invertebrates and river otter). The published alternatives ranged from "Alternative 1" - no further cleanup after completing cleanup of the early action areas, to Alternative 6R which requires a large area of the waterway to be dredged. In between these endpoint alternatives, the other variant alternatives included 2R, 2R-CAD, 3C/3R, 4C/4R, 5C/5R, and 6C. They represent a range of dredging, capping, enhanced natural recovery (ENR; stabilization of sediments with a thin cap of clean sediment), and monitored natural recovery (MNR; monitoring of sediment contaminant concentrations to ensure that cleaner sediments from upstream are gradually deposited naturally over currently contaminated sediments).

Factors and Data Considered

"The purpose of a CERCLA FS is to evaluate remedial alternatives in nine categories (called the "nine criteria" analysis)." The criteria evaluated include: overall protection of human health[54] and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. The "Nine Criteria Analysis" outcomes for the LDW FS 2012 are presented in FS 2012 Table 10-1. It should be noted that the Proposed Plan remedial alternative, 5C plus, is not included in the table, as it was not part of the FS, but the information is similar to that of alternative 5C from the FS 2012. The elements of the nine criteria analysis that are most relevant to environmental justice, including whether or not the threshold criteria overall protection of human health; long-term effectiveness and permanence; short term effectiveness, which includes overall human health impacts, plus community-related impacts due to the length of construction; and community acceptance, are excerpted here (in Table 2.1).

The disproportionate adverse environmental impacts on those who subsist on, work and play in the LDW can be derived from the nine criteria analysis and interpreted together with risk reduction data from Sections 4, 9, and 10 of the FS 2012 to determine the environmental justice implications of the cleanup alternatives

[54] From an EJ and Tribal perspective, traditional risk assessment is considered inadequate and insufficient to resolve the true burdens on a population (EPA 2002 NEJAC report)

Table 2-1 – Comparative Evaluation and Relative Ranking of Remedial Alternatives[a]

Evaluation Criteria				Remedial Alternative: 1	2R	2R-CAD	3C	3R	4C	4R	5C	5R	5R-T	6C	6R
Overall Protection of Human Health and the Environment	Long-term Effectiveness and Permanence	Magnitude and Type of Residual Risk	RAO 1: Residual seafood consumption risk from total PCBs – Adult and Child Tribal RME[b,c]	All alternatives are predicted to achieve excess cancer risks of 2×10^{-4} and 3×10^{-5} for the Adult Tribal and Child Tribal RMEs, respectively. They are also predicted to achieve non-cancer risk of HQ = 4 to 5 and HQ = 9 to 10 for the Adult Tribal and Child Tribal RMEs, respectively. For the API RME scenario, total PCB risks are predicted to be 5×10^{-5} excess cancer risk and HQ = 3 for non-cancer risk. Times required to reach lowest predicted surface sediment concentrations vary, as does the degree of uncertainty inherent in these model predictions. Model uncertainty decreases as alternatives rely less on natural recovery. No alternative is predicted to achieve 1×10^{-5} total excess cancer risk, 1×10^{-6} individual carcinogen risk, or HI of 1 as required by MTCA.											
			RAO 2: Residual direct contact excess cancer risk[d]	May not achieve RAO 2 cleanup objectives because no active remediation in clamming and beach play areas	Following 63, Alternatives 2 through 6 are predicted to achieve: 1) a total excess cancer risk of < 1×10^{-5}; 2) excess cancer risks for total PCBs, cPAHs, and dioxins/furans considered individually less than or equal to 1×10^{-6}, 3) arsenic reaches the long-term model-predicted concentration range (associated with an excess cancer risk range between 1×10^{-5} and 1×10^{-6}), and 4) non-cancer hazard quotients for each risk-driver are less than or equal to 1.0 in netfishing, clamming, and beach play areas.										
			Types of engineering controls used to achieve cleanup objectives (numeric values are in units of acres)	Uses no engineering controls outside of EAAs.	Least use of dredging (29) and capping (3) and most MNR. No ENR/*in situ*.	Same as Alt 2R, but adds long-term management of in-waterway CAD.	Same use of dredging (29) and more capping (19) than Alt 2. Less MNR. 10 acres ENR/*in situ*.	More dredging (50) and less capping (8) than Alt 3C. Same MNR as Alt 3C. No ENR/*in situ*.	More dredging (50) and capping (41) than Alt 3C. Less MNR. 16 acres ENR/*in situ*.	More dredging (93) and less capping (14) than Alt 4C. Same MNR as Alt 4C. No ENR/*in situ*.	More dredging (57) and capping (47) than Alt 4C. No MNR. 53 acres ENR/*in situ.*	More dredging (143) and less capping (14) than Alt 5C. No ENR/*in situ* or MNR.	Same as Alt 5R. Adds *ex situ* treatment.	More dredging (108) and capping (93) than Alt 5C. No MNR.101 acres ENR/*in situ*.	Most dredging (274). 28 acres of capping. No ENR/*in situ* or MNR.
			Institutional Controls	No proprietary controls, education, outreach or waterway user notification programs	Seafood consumption advisories are required to manage residual seafood consumption risks. Proprietary controls (e.g., environmental covenants) are also needed to manage residual contamination left in place. The number and importance of these proprietary controls progressively diminishes as the amount of dredging increases because the amount of contamination left in place is correspondingly diminished.										

Evaluation Criteria			Remedial Alternative											
			1	2R	2R-CAD	3C	3R	4C	4R	5C	5R	5R-T	6C	6R
	Short-term Effectiveness		No short-term impacts because no construction. Longest time to achieve cleanup objectives. Highest natural recovery prediction uncertainty.	Low short-term impacts during construction. Long time to achieve cleanup objectives. High natural recovery prediction uncertainty.		Low short-term impacts during construction and moderate time to achieve cleanup objectives. Moderate natural recovery prediction uncertainty.		Moderate short-term impacts during construction and moderate time to achieve cleanup objectives. Low natural recovery prediction uncertainty.	High short-term impacts during construction and moderate time to achieve cleanup objectives. Low natural recovery prediction uncertainty.	Moderate short-term impacts during construction and moderate time to achieve cleanup objectives. Very low natural recovery prediction uncertainty.	High short-term impacts during construction and long time to achieve cleanup objectives. Very low natural recovery prediction uncertainty.		High short-term impacts during construction and long time to achieve cleanup objectives. Very low natural recovery prediction uncertainty.	
	Summary of Overall Protection of Human Health and the Environment		Does not provide adequate overall protection to human health and the environment.	All alternatives achieve overall protection of human health and the environment in varying time frames and degrees of certainty based on varying reliance on natural recovery. All require institutional controls to varying degrees to fully achieve protectiveness. Longer construction periods result in proportionately greater short-term impacts. Dredging or capping a larger surface area has a lower potential for subsurface contamination to be exposed by natural or mechanical disturbances (e.g., scour, earthquakes). The potential for subsurface contaminated sediment to be exposed diminishes as more contaminated sediment is dredged. Exposure of subsurface contaminated sediment is less of a concern for maintaining PRGs based on SWACs than for maintaining PRGs that are based on point concentrations (e.g., the SMS COCs for RAO 3).										
Achieve Threshold Requirements			No	Alternatives likely require one or more ARAR waivers to meet threshold criteria.										
Long-term Effectiveness and Permanence		Potential for Exposing Remaining Subsurface Contamination	Largest amount of subsurface contamination and greatest potential for increases in long-term SWACs.	Moderate potential for exposure and high potential for increases in long-term SWACs.	Same as for Alt 2R plus: majority of contaminated sediment remains on site in CAD.	Moderate potential for exposure and moderate potential to affect long-term SWACs.	Same as for Alt 3C but lower amount of residual subsurface contamination than Alt 3C.	Lower potential for exposure than Alt 3C and 3R and moderate potential to affect long-term SWACs	Lower amount of residual subsurface contamination than Alt 4C and low potential to affect long-term SWACs.	Lower potential for exposure than Alt 4C or 4R, and low potential to affect long-term SWACs.	Lower amount of residual subsurface contamination than Alt 5C and low potential to affect long-term SWACs.	Same as for Alt 5R.	Low potential for exposure and low potential to affect long-term SWACs.	Least amount of residual subsurface contamination. Very low potential for exposure and very low potential to affect long-term SWACs.
Long-term Effectiveness and Permanence	Adequacy and Reliability of Controls[h]	Relative amount of monitoring and maintenance required (based on total cap, ENR/*in situ* and MNR area).	Low – only EAAs monitored	Large area (128 acres)	Large area (128 + 23 acres of CAD)	Large area (128 acres)	Large area (107 acres)	Large area (107 acres)	Moderate area (64 acres)	Large area (100 acres)	Small area (14 acres)		Large area (194 acres)[i]	Small area (28 acres)

Evaluation Criteria			1	2R	2R-CAD	3C	3R	4C	4R	5C	5R	5R-T	6C	6R
			Remedial Alternative											
		Summary	No institutional controls	The need for monitoring and maintenance is higher for combined alternatives and less for removal alternatives with the same RALs, and is greater for alternatives that rely more on natural recovery. Similar seafood consumption advisories and public outreach and education programs are required for all alternatives.										
	Summary		Low – only EAAs remediated. Not expected to achieve all RAOs.	Combined-technology alternatives as compared with removal-emphasis alternatives, and lower numbered alternatives leave a greater amount of contaminated subsurface sediment in place. They also have greater monitoring and maintenance requirements. Monitoring, maintenance, and ICs in varying degrees and/or durations are considered adequate and reliable for all alternatives.										
	Relative ranking (★= Lowest for long-term effectiveness and permanence)		★	★★	★	★★★	★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★	★★★★	★★★★★
	Relative ranking based on amount of material managed[i] (★= Lowest for Reduction of Toxicity, Mobility or Volume)		★	★	★	★★	★	★★	★	★★★	★	★★★★	★★★	★
Short-term Effectiveness	Protection during Construction	Period of community exposure (including noise), worker exposure, ecological disturbance and resuspension of contaminated material from dredging (years of construction)[j]	0	4	4	3	6	6	11	7	17	17	16	42
Short-term Effectiveness	Protection during Construction	Air quality impacts (CO_2/PM_{10}; metric tons)	Not estimated – Lowest impact	21,000/ 18* *per year= 4.5 mt PM_{10}	18,000/ 19* *per year= 4.7 mt PM_{10}	20,000/ 16* *per year= 5.3 mt PM_{10}	29,000/ 24* *per year= 4.0 mt PM_{10}	28,000/ 23* *per year= 3.8 mt PM_{10}	44,000/ 36* *per year= 3.3 mt PM_{10}	32,000/ 26* *per year= 3.3 mt PM_{10}	62,000/ 52* *per year= 3.1 mt PM_{10}	54,000/ 45* *per year= 2.6 mt PM_{10}	68,000/ 56* *per year= 3.5 mt PM_{10}	146,000/ 122* *per year= 2.9 mt PM_{10}
Short-term Effectiveness	Time to achieve RAOs or important risk reduction milestones (years)[k]	RAO 1: 10^{-4} magnitude PCB risk (Adult Tribal RME)[l]	5	4	4	3	6	6	11	7	17	17	16	42
Short-term Effectiveness	Time to achieve RAOs or important risk reduction milestones (years)[k]	RAO 1: Predicted time for total PCBs and dioxins/furans to reach long-term model-predicted concentration range in surface sediment[l]	25	24	24	18	21	16	21	17	22	22	16	42

Evaluation Criteria		Remedial Alternative 1	2R	2R-CAD	3C	3R	4C	4R	5C	5R	5R-T	6C	6R
	RAO 2: Total risk $\leq 1 \times 10^{-5}$ (All exposure scenarios)[m]	5	4	4	3	4	3	4	3	4	4	3	4
	RAO 2: Individual risk from cPAHs $\leq 1 \times 10^{-6}$ in all areas except Beach 3	25	19	19	3	6	3	6	3	6	6	3	6
Summary of short-term effectiveness		No short-term impacts because no construction. Longest time to achieve cleanup objectives. Highest natural recovery prediction uncertainty.	Low impacts from construction. Moderate time to reduce contaminant concentrations. High uncertainty (125 acres MNR).	Slightly more impacts from construction than Alt 2R due to CAD. Similar time to reduce contaminant concentrations. High uncertainty (125 acres of MNR).	Similar impacts from construction, shorter time to reduce contaminant concentrations, and less uncertainty than Alt 2 (99 acres MNR).	Higher impacts from construction, longer time to reduce contaminant concentrations, and less uncertainty than Alt 3C (99 acres MNR).	Similar impacts from construction, similar time to reduce contaminant concentrations, and less uncertainty than Alt 3R (50 acres MNR).	Higher impacts from construction, similar time to reduce contaminant concentrations, and similar uncertainty to Alt 4C (50 acres MNR).	Impacts from construction similar to Alt 3R, and higher than Alt 4C. Shorter time to reduce contaminant concentrations. Very low uncertainty (no MNR).	More impacts from construction than Alt 4R and 5C. Longer time to reduce contaminant concentrations. Very low uncertainty (no MNR).		More impacts from construction, similar time to reduce contaminant concentrations, and lower uncertainty than Alt 5R (no MNR).	Highest impacts from construction and longest time to reduce contaminant concentrations with lowest uncertainty (no MNR).
Relative Ranking (★= Lowest for short-term effectiveness)		★	★★	★★	★★★★	★★★	★★★★	★★★	★★★★	★★	★★	★★	★

Notes:

a. Relative ranking compares alternatives to one another using a one star (★= low ranking) to five star (★★★★★= high ranking) system. See specific criteria for guide to interpreting star rankings.

b. Risk estimate is based on use of the total PCB SWAC (using base case [mid input values] BCM output) in the food web model. Total excess cancer risks (all carcinogens combined) are expected to be similar to total PCB risks for the consumption of resident fish and crab. Risks due to clam consumption are largely due to arsenic and cPAHs in clam tissue, and were not calculated due to the poor relationship between sediment and tissue values in the RI dataset).

c. See FS 2012, Table 10-1 for further notes related to the above information.

Several factors are at play in defining a disproportionate and adverse environmental impact in the affected area and impacted populations. First, the disproportionate adverse impacts may be present for segments of the affected community or the community in general at the site. For example, tribes with fishing rights in the LDW who also consume resident seafood at relatively higher rates than the general population such that they are more exposed to environmental contamination could suffer a disproportionate adverse impact compared to the general population.

Similarly, impacted community members may also experience increased disproportionate risk or impacts in the short or long term due to the cleanup methods used. For example, some cleanup methods can resuspend sediment and can cause a short-term increase in contaminants of concern in the water column during construction. Access rights in the long term could be impacted if some cleanup methods are used or more permanent remediation is not in place. Secondly, other impacts during construction are possible.

The cleanup itself has the potential to impact access to subsistence resources, cultural resources, and tribal treaty resources; businesses and the local economy; exacerbate already heavily impacted environmental/health burdens in resident populations; and public access to local green space and the river itself. For example, increased truck traffic during the cleanup could cause traffic and public safety concerns in a heavily impacted transit corridor. It also may have cumulative impacts to environmental media (air, for example), which are already heavily impacted in the Duwamish Valley. The environmental justice implications of the remedial alternatives are further discussed, below.

One thing to note in the risk comparison, below, is that the modeled risk outcomes are difficult to interpret due to the levels of uncertainty in the assumptions and calculations used in the numerical modeling. Although the FS natural recovery model predicts similar cancer risk reduction for all alternatives, it is achieved in varying timeframes with varying levels of uncertainty at varying costs. Model projections for alternatives that rely more on natural recovery are more uncertain than for those that rely more on engineered technologies such as dredging. In particular, model projected sediment and fish tissue contaminant concentrations and risk outcomes are approximations because of "uncertainties in Green/Duwamish River inputs, the effectiveness of source control, natural recovery beyond the construction period, and the potential for contaminated subsurface sediments left in place to be exposed in the future" (FS-AECOM 2012).

The permanence of each remedial alternative in maintaining a cleaner LDW varies according to the methods employed. From the FS (2012), Chapter 9:

> *Areas that are dredged yield permanent risk reduction by removing contamination from the LDW waterway. Areas that are capped yield more permanent risk reduction than those addressed by ENR or MNR. Dredged areas require the least long-term monitoring and maintenance. Capped and ENR areas require moderate amounts of long-term monitoring and maintenance to ensure that buried subsurface contamination remains in place. MNR requires a longer period of intensive monitoring to track surface sediment conditions over time until results indicate that contaminant concentrations have reached acceptable levels (e.g., PRGs or long-term values below which further reduction is formally found to be impracticable by EPA*)."

The institutional controls (ICs) that are put in place to further reduce exposure in the short and long term could also vary with the cleanup alternatives presented. These ICs may have further implications for inhibiting access and rights, and they may place burdens on community members that preclude important cultural practices. In this analysis, the cleanup alternatives are compared qualitatively for their:

- long term and short term residual excess cancer and non-cancer risks for different populations
- the time to achieve human health targets
- the permanence of the methods used to conduct the cleanup
- the dependence upon institutional controls
- and the immediate ancillary benefits of each alternative for the affected community, such as jobs created

These factors have implications for environmental justice on behalf of the affected community. The information presented here is taken from Chapters 9 and 10 and Appendix L of the Feasibility Study (AECOM 2012) with some additional calculations derived from Appendix L.

Seafood Consumption

Cancer Risk

As noted in Table 2.1 above, no remedial alternative presented in FS (AECOM 2012) is expected to meet MTCA health-based standards for excess cancer risk for tribal adults, tribal children, or API populations. Despite this, in the predicted long-term steady-state of the waterway following remediation, all active cleanup alternatives that are presented in the FS 2012, are predicted to significantly reduce risk for populations who consume resident seafood out of the LDW, by approximately 90% from the baseline estimates. Institutional controls will also be required to protect human health, as the predicted steady-state is above the PRGs. However, the duration of the construction phase of the remedy, time to reach steady-state, and the potential exposure to short-term increases in risk from resident seafood consumption for each alternative varies.

In this section, each alternative is compared to see if and how the alternatives reduce the known disproportionate adverse impacts to local populations who consume resident fish, crabs, and clams from the LDW. Baseline excess cancer risks and non-cancer risks (as a hazard quotient, HQ, or hazard index, HI) are estimated in the FS (AECOM 2012), and shown in Proposed Plan Table 6 and Figure 16. Proposed Plan Baseline and predicted future risks are compared for PCBs only in Proposed Plan Figure 17. Because of uncertainties associated with future predictions of other human health COCs than PCBs, alternatives are compared in the FS Figure 9-7a) and Proposed Plan Figure 17 for PCB only. Only PCBs could be addressed in the RI/FS food-web model, because RI data did not provide sufficient information to develop predictable relationships between sediment and seafood tissue for cPAHs and arsenic, and because of insufficient seafood tissue data for dioxins/furans. The FS assumed that risks and hazards from PCBs would vary similarly to the joint risks from PCBs, arsenic, cPAHs, and dioxins/furans.

For the tribal adult scenario and the “market basket” mixture of species eaten, alternatives 2R, 2R-CAD, 3C, 5C, and 5C Plus are predicted to result in comparable cancer risk reductions (to 1 in 100,000 excess cancer risks, designated in Proposed Plan Figure 15 as milestone 1b) most quickly: within 10 years from the start of construction. The predicted waterway steady-state (milestone 1c) is met most quickly by alternatives 3C, 5C, 5C Plus, and 6C: between 16 and 18 years following start of construction.

At the model-predicted steady state, the FS estimated an adult Tribal RME excess cancer risk of 2 in 10,000 for PCBs. For comparative purposes, the excess cancer risk for PCBs at the baseline Lower Duwamish Waterway concentration is estimated to be 5 in 1,000 (see Proposed Plan Figure 17).

For the tribal child scenario, alternatives 5C and 5C Plus also reach the lowest-calculated excess cancer risk (3 in 100,000, a 90% reduction in excess cancer risk) in the shortest time frames following beginning of construction — 16 years for Alternative 6C and 17 years for 5C and 5C Plus, but these are not likely to actually be different in light of the uncertainties associated with the predictions. Note that the model's convergence on a 90% risk reduction over the long term is driven by the uncertain PCB concentrations in incoming sediments from the Green River. If future water and sediment contaminant concentrations are reduced upstream of the LDW, fish and shellfish tissue concentrations would be reduced to a greater degree than these predictions.

Overall, alternatives 5C, 5C Plus and 6C were found to have the largest decreases in cancer risk for all populations within the shortest time frames as presented in Proposed Plan Figure 15.

Non-Cancer Risks

At the predicted waterway steady-state sediment concentration, the PCB-associated non-cancer risks for the "market basket" mixture of species eaten were reduced from baseline HQs of 40 (tribal adults), 86 (tribal children), and 29 (API), to respectively, HQ of 4 to 5 for tribal adults, 10 and 9 for tribal children, and 3 for API at the end of the simulation periods (45 years). Alternative 6C arrives at the lowest HQ (9) the fastest, with other alternatives reaching the value at the end of construction (6R) or at the end of the simulation (4C, 4R, 5C, 5R). The other alternatives, 1, 2R, 3C, 3R, have higher HQs. For API populations, 4C and 5C reduce HQ fastest, to 4 by 5 years, and all alternatives except for alternatives 1 and 2R reach the lowest calculated HQ, 3, within 15 years.

The FS estimated an adult Tribal RME non-cancer risk of HQ of 4 or 5 for PCBs at the model-predicted steady state. For comparative purposes, non-cancer risks for PCBs at the PRG are estimated to an HQ of less than 1 (see Proposed Plan Figure 17). There are also comparable hazard reductions for predicted future waterway steady-state, and non-cancer HQs for PCBs for both child and adult tribal HQs would continue to exceed 1 for all alternatives. In the Preferred Alternative (Proposed Plan Figure 17), the child tribal HQ ranges from 2.5 (clams only eaten) to 31 (pelagic fish such as surf perch only eaten) with the "market basket" of several species consumed to 8.6. This is a reduction of about 90% from the baseline.

The FS predictions included effects from construction, such as sediment resuspension and releases in the dissolved phase; these cannot be altogether avoided, but can be minimized with specialized equipment, careful dredging and Best Management Practices including incorporating results from water quality monitoring into the implementation. For all action alternatives, the FS (AECOM 2012) assumes a 2-year post-construction window during which contaminant concentrations in fish and shellfish tissue will remain elevated.

Direct Sediment Contact

For netfishing, total baseline direct contact excess cancer risk for tribal adults is estimated to be 3 in 100,00 (see Proposed Plan Table 6) , which is over an order of magnitude less than baseline seafood consumption excess cancer risks (4 in 10,000). For clamming, the baseline risk is 1 in 10,000. For beach play, it is 4 in 1,000,000 to 6 in 10,000.

Following remediation, the FS modeling predicts that for total direct contact (netfishing, clamming, and beach play areas), all action alternatives would result in risks within the CERCLA risk range and the minimum MTCA requirements for risk reduction, with one exception. The natural recovery model predicts arsenic will reach an excess cancer risk range below 1 in 100,000 but above 1 in 1,000,000, above the MTCA risk range. Alternative 1, the no-action alternative, is predicted not to reach a multiple-chemical excess cancer risk of 1 in 100,000 for clamming until 30 years following start of construction. Mitigation for Alternative 1 could include enhanced communication and outreach around contact and exposure minimization.

Summary of Disproportionate Adverse Impacts from Human Health Risks Identified in the Risk Assessment

Without including institutional controls, none of the remedial alternatives in the FS 2012 are predicted by the modeling conducted in the FS to meet the sediment and seafood tissue PRGs that are cleanup goals for Remedial Action Objective 1 (protection of the public for consuming resident seafood). Thus, all alternatives would result in adverse disproportionate impacts for tribal adults, tribal children, and API populations, since the cancer risks and non-cancer risks would remain above MTCA ARARs for these populations, compared to the general population of seafood consumers who consume at a rate of one meal per month or less (general population rates result in projected excess cancer risks at below the MTCA standard for PCBs at PRGs, and between MTCA and CERCLA standards after cleanup). Model predictions indicate significant risk reduction over time for non-cancer and cancer risks for all action alternatives, which is commendable. However, because of these adverse disproportionate impacts, institutional controls and other mitigation steps will be necessary to ensure that exposure is reduced for the affected populations. These mitigations should take into account any additional excess risks identified through monitoring, such as higher construction-related water column resuspension of contaminants. Monitoring will also verify if the model predictions are correct; it is possible that remediation and source control can reduce exposure more than or less than what model results indicate.

The length of time or construction period of the cleanup controls many of the localized adverse impacts of the cleanup on the community (Proposed Plan Figure 15; Table 13; see next sections), which is balanced by the reduction in human health risks achieved by each cleanup alternative. For short-term effectiveness, alternatives 3C, 4C, and 5C ranked highest for all short-term considerations (overall, for all populations).

Institutional controls, mitigation measures, and offsets

Institutional Controls

Institutional controls (ICs) are administrative and legal instruments intended to minimize the potential for human exposure to contamination by limiting land or resource use and influencing human behavior. In addition to protecting human health, they also play an important role in Superfund site cleanup by protecting the integrity of engineered remedies. They are not, however, intended to be primary solutions or to be used to avoid more costly engineered solutions. Because no alternative that has been considered in the FS 2012 will clean up the river enough to lift fish advisories, institutional controls will play a strong role in reducing risks from the site. However, institutional controls are controversial from an environmental justice perspective, and so they warrant further detailed discussion here.

Primary categories of ICs include:

- Proprietary controls - prohibit activities that may compromise the effectiveness of the response action or restrict activities or future resource use that may result in unacceptable risk to human health or the environment.

Examples: easements and covenants

- Governmental controls - restrictions on land use or resource use, using the authority of a government entity.

Examples: zoning; building codes; commercial fishing bans; sports/recreational fishing limits

- Informational devices - provide information or notification to local communities that residual or contained contamination remains on site.

Examples: State registries of contaminated sites, notices in deeds, tracking systems, and fish advisories.

- Enforcement tools - legal tools, such as administrative orders that limit certain site activities or require the performance of specific activities

The Government Accountability Office has recognized a trend in Superfund cleanups where institutional controls are being relied upon more heavily as contaminants are left in place and not removed completely. They have strongly suggested that EPA review institutional control recommendations, methodologies, and guidance documents to ensure that institutional controls are effective during the time they are needed, and that appropriate contingencies are in place for the long term (GAO 2005[55]). The report found that remedy decision documents lacked information about: implementation including timing of institutional controls, responsibility for monitoring of effectiveness, and enforcement responsibility.

Institutional Controls in the Feasibility Study

ICs are presented in the Draft Final Feasibility Study (AECOM 2012) as necessary to achieve remedial action objectives (RAOs) in addition to the engineered controls. This is particularly true for RAO 1, which is intended to reduce health risks associated with consumption of resident fish and shellfish.

[55] http://www.gao.gov/assets/250/245140.pdf

Institutional controls are required to adequately protect consumers of resident fish and shellfish, because none of the remedial alternatives are predicted to reduce sediment and water concentrations of contaminants to allow for seafood consumption at high (e.g., tribal and API calculated RME rates from the risk assessment) consumption rates.

The ICs discussed in the FS 2012 are primarily proprietary ICs to preclude damage to caps and other protective cleanup systems in place, and which would be controls on activities such as anchoring, pile driving, dredging, etc., where protective caps are in place. The main ICs for reducing the health risk from consuming resident fish and shellfish at the site over the long term that are mentioned in the FS 2012 comprise informational devices, which include: monitoring, public outreach, education, a public hotline, and a seafood consumption advisory. The FS 2012, in its overview of ICs, mentions that a more detailed implementation plan will be developed to meet specific location and local community needs.

All of the alternatives rely on the use of seafood consumption advisories as an IC to protect consumers of resident fish and shellfish. The more significant differences among the alternatives include the amount of acreage controlled through other types of ICs, including proprietary controls, monitoring and notification of waterway users, enforcement tools, and site registry. These will be more significant for those alternatives that emphasize capping, enhanced natural recovery, and natural recovery. Informational devices, including design, monitoring, and outreach, account for much of the estimated 30-year costs of implementing ICs according to the FS 2012.

Other ICs that may be relied upon at the LDW site include technical engineering controls to ensure the integrity of sediment caps and other devices put in place to contain contamination. ICs could limit the range of activities allowed at the location or materials used in creation of the cap or other sediment device could preclude certain activities.

Likewise, new technologies would need to account for future uses at the site, and site design and preparation should account for tribal rights and fishing resources that coincide with the site. The depths for caps should allow for full depth needed for the range of burrowing organisms found in the LDW. They also should be sufficient to allow for anchoring, clamming, and other tribal treaty activities to take place in the future. Any institutional controls in place that limit access or activities, again, should be temporary to the extent possible.

Institutional Controls: Effectiveness

A report prepared by the National Environmental Justice Advisory Council (NEJAC; US EPA 2002) in 2001 (revised 2002)[56] on fish consumption includes a thorough illustration of how EJ issues related to ICs such as fish advisories. Informational campaigns place the burden of addressing environmental contamination's health effects on those affected, rather than those responsible for the risk. In the case of the LDW, there is anecdotal, photographic, and survey evidence that current fish advisories, which are on prominent signs in multiple languages, are currently ignored[57]. Additionally, fish advisories, in attempting to restrict or influence behaviors, assume that there are accessible substitute food sources for the fish consumers and that changing behavior is appropriate.

[56] EPA's National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.
[57] For example, as reported in: "Reclaiming the Duwamish River", *Seattle Times*, April 16, 2011. http://seattletimes.com/html/pacificnw/2014703392_pacificpduwamish17.html

The use of fish consumption advisories within the LDW is complicated as an environmental justice issue. For example, those who are subsistence or tribal fishers on the LDW may have no viable alternative food sources, particularly if alternate fishing locations are too expensive to access or require new skills and fishing knowledge. Advising fish consumers of the LDW to avoid eating fish may be akin to recommending abandonment of their cultural heritage and identity[58]. Restrictions on fish consumption may also lead to short- and long-term changes in diet with significant health consequences.

At the same time, given the reality of potential exposure to toxic contamination for LDW fish consumers, simply avoiding the use of informational devices may result in the environmental injustice of real harm to people from consuming contaminated fish. A middle ground, as advanced in the NEJAC report, is to adopt fish advisories that are culturally appropriate, informed by community expertise, supported with necessary funding, and managed or co-partnered by those affected.

In addition, ICs must be understood to be temporary measures, as limited in scope and duration as possible, and designed to complement other mitigation measures to prevent and reduce the sources of contamination that necessitate short-term advisories. Promoting alternative fish resources that are healthier through informational institutional controls reduces exposure without providing the erroneous message that all fish should be avoided, which has been an unintended consequence of other educational/advisory programs[59].-

One Superfund example of enhanced community outreach which includes fish advisories as institutional controls is the Palos Verdes Shelf (PV Shelf) Superfund cleanup site. At the PV Shelf site, a large effort went into forming a community advisory group, the Palos Verdes Shelf Fish Contamination Education Collaborative (PVS FCEC[60]). The PVS FCEC conducted outreach with and surveyed the community in order to enhance educational messaging.

A partnership of federal, state, local, and community-based organizations was formed, and the partnership developed and jointly implemented institutional controls. In addition, surveys were targeted to the different fishers, using culturally-relevant and appropriate questioning to assess both how well the fish advisories were working, if the advisories resulted in behavioral changes, and what the changes were. This information could be used to evaluate the full impact of the advisory on culture as well as exposure.

Targeting educational information to the groups with the greatest health risk, such as pregnant women, women of child-bearing age, and children, was found to be important. Follow-up surveys were able to evaluate the effectiveness of previous outreach efforts and enable changes to outreach efforts as the cleanup takes place. Other useful tools employed at PV Shelf included a comprehensive in situ monitoring program that is still used to update the fish advisories. PV Shelf also targeted restaurants that bought contaminated fish for monitoring and education.

It should be mentioned that the PV Shelf case differs from the LDW in that there is some regulation around catching of the target fish in PV Shelf, and in the LDW case no prohibition or regulation is in place to restrict catching of resident seafood (and they are not sold to restaurants

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[58] See, e.g., O'Neill C. 2000. "Variable Justice: Envrionmental Standards, Contaminated Fish, and Acceptable Risk to Native Peoples", 19 Stanford Environmental Law Journal, 3:43-44..

[59] For example, National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

[60] www.pvsfish.org

to our knowledge, and restaurants were a focus of PV Shelf activities). Concerted efforts must be put forth to increase the effectiveness of fish advisories when used, to rely on them as temporarily as possible, and to acknowledge the burdens placed on the individual and the individual's behavior rather than on the cleanup itself.

It is important to place value on the culture of the ethnic groups who fish in the LDW when disseminating information about the human health risks associated with fish consumption. Different ethnic groups rely on different communication methods. For example, showing respect for and including tribal cultural practices such as oral traditions, and allowing for exchange of information orally, likely will be important in the LDW given the presence of tribal fishers and their usual and accustomed and traditional fishing area. Furthermore, different types of media may be used more or less frequently by different ethnic groups; television, radio, newspaper, and electronic media including social media. For some groups, only direct person to person communication will suffice. This is an important consideration as well for reaching intergenerational groups. Allowing for culture in the development of institutional controls can lead to improved long term stewardship of the resource and involvement/empowerment in decision-making.

One outcome to be avoided is overall reduced consumption of fish, as it is a nutritive food source. In some follow-up survey work, advisories have been found to have resulted in mis-messaging, such that all fish sources were seen as corrupt rather than those that were the sole target of the advisories[61].

Community Input on Institutional Controls in the Draft Feasibility Study

Community input was sought throughout the remedial investigation and preparation of the draft feasibility study. Of the more than 300 letters received by community members and other stakeholders during the comment period from October-December, 2010, a number of concerns were raised regarding the effectiveness, appropriateness, and description of ICs recommended in the draft FS. The majority of these remarks mirrored the concerns expressed in the NEJAC report, while some commentators recommended specific ICs and related mitigation measures.

Key comments related to the FS discussion and implementation of ICs included the following:

- Revision of FS to better reflect EPA's site manager guidance on ICs and other best practices.
- Concern that IC cost estimates are underestimated and lack detail.
- Call for additional discussion of ICs, including more detailed descriptions and cost estimates for each alternative, as well consideration of short-term, remedial, and long-term implementation.
- Request for additional measures to mitigate the consequences of relying on behavior change strategies and the additional health, cultural, and EJ impacts of fish advisories and restrictions.
- Greater consideration of source control and more extensive clean-up options rather than relying on ICs. Specific IC measures or processes identified through community input included:
- Establishment of a collaborative body to implement the IC program.

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[61] National Environmental Justice Advisory Council, 2002. Fish Consumption and Environmental Justice: A Report developed from the National Environmental Justice Advisory Council Meeting of December 3-6, 2001.

- Education designed to reach multiple communities in culturally-appropriate and easily accessible locations and formats.
- Tools to educate and empower affected populations to improve the health of seafood resources.
- Concerns about local jobs.
- Community-determined mitigation measures (such as transportation to healthy fishing locations, delivery of healthy seafood, community aquaponics, etc.).
- Community health clinic training, especially about health risks for children and women during pregnancy and breastfeeding.

Of particular concern from an environmental justice perspective is the use and reliance on institutional controls. For options that rely more heavily on in-place containment and less on removal, the dependence on institutional controls is stronger. Institutional controls in practice and as mechanisms to mitigate adverse disproportionate impacts will be discussed in section VI. Another related topic is the use of activated carbon and/or other new technologies as remediation methods. The tribes have raised concerns that the use of the new technologies without adequate testing could result in adverse effects on fisheries and ultimately their treaty fishing rights. Although the new technologies are predicted to reduce contaminant concentrations within the water column, the tribes are concerned about potential impacts to the benthic prey species which their target fish and shellfish rely on. Adequate pilot testing is essential for understanding where such technologies can be applied effectively, and to better understand the impacts to the organisms that live in the LDW.

Potential Findings and Conclusions

- IC design, implementation, monitoring, and evaluation should be driven by community experts, with the funding and expertise necessary so that this does not further burden those affected.
- Outreach, education, and information campaigns cannot be designed to promote behavior change; rather they must be designed to facilitate risk communication, with additional funding and expertise for communities to determine appropriate and effective responses to unavoidable risks. Behavior change may be one strategy but it is not necessarily a recommended or helpful strategy, particularly given the questionable effectiveness of most fish advisories and negative health and cultural impacts of ICs.
- To mitigate the negative consequences of ICs, which are compounded for EJ communities, additional measures are needed to ensure that safer seafood alternatives and information on safer seafood alternatives are available. Without these additional offsets to reduce exposure (and necessary funding and expertise), ICs represent an additional harm to EJ communities, potentially leading to proposed alternative that fail to meet threshold criteria.
- Alternatives that depend on longer-term ICs are not preferred from the perspective of EJ. The results of the FS show that seafood advisories will be permanent over the long term (Appendix I), however, the tenor of the advisories (whether the content of the advisories will change as the cleanup progresses) and education efforts that will be needed around the advisories should be clarified and addressed.

Other ways to mitigate adverse impacts

In the context of the LDW Superfund cleanup, mitigation measures are methods to reduce the impacts of the cleanup techniques and options in order to reduce cumulative impacts during the cleanup. Many successful mitigation measures have been developed during the cleanup of the Early Action Areas, and successfully promoting their use in the full LDW cleanup would similarly improve outcomes for community members.

Offsets

Offsets are mitigations which consist of the temporary substitution of healthier seafoods or bolstering of healthier seafoods as alternatives to consuming contaminated resident seafood from the LDW. In the event that the cleanup alternative chosen leads to higher contamination/unacceptable risks from consuming fish from the waterway in the short term, or local users of the waterway are prevented from accessing a cultural or subsistence resource, offsets may be required to reduce exposure and/or increase access to resources. These offsets could include:

- providing maps of other fishing locations with less contaminated resident species,
- the provision of cleaner seafood (tissue within health-based standards) to local residents in the LDW,
- fish trading where less contaminated seafood such as salmon or vouchers for seafood are substituted for resident fish when caught by local fishers,
- transport of fishers to accessible/cleaner fishing locations,
- direct compensation for loss of fishing rights or access,
- community enhancements or infrastructure projects that can substitute for LDW and LDW resident seafood fisheries access in the interim (including sustainable aquaculture or aquaponics projects), or
- reduction of exposure through indirect methods including enhanced habitat restoration to enhance populations of cleaner LDW fish stocks (salmon), upland source control infrastructure projects, and other ways to reduce the flux and net impact of contaminants on fisheries and human health.

While not ideal, the provision of an alternative source of fish, promotion of healthier alternative fish resources, and/or, the bolstering of anadromous fish resources (salmon) that are a healthier seafood consumption alternative either through habitat or general sustainability improvements upstream and in the LDW, could provide an offset for the short-term increased risk/restrictions from eating resident fish from the LDW during active construction and remediation.

Contingencies and much planning and data gathering would be involved for provision of fish from an alternative source, including monitoring of the alternative fish source and ensuring that the fish source is an appropriate substitute from the perspective of those who consume resident seafood from the LDW. Some challenges that can be foreseen include not knowing who is currently fishing, who relies on fish from the LDW, and more recent data on seafood consumption patterns, including what seafood and parts of seafood are being consumed, and who is consuming the fish (age stratification, diversity, etc.).

Community infrastructure projects could range from enhanced park and recreation access (while the LDW has limited access or parks available), community land-based hydroponics or aquaculture projects, tree planting including free trees and techniques, or green building and infrastructure programs. For tribal members, it may be difficult to find an appropriate offset or

mitigation, and any acceptable offset would have to be developed through government to government consultation. For example, community infrastructure projects, such as local aquaponics projects, depending on the type of project and the tribe's role, could have little relevance to tribes.

However, aquaponics and land-based aquaculture have been used in a reuse context or proposed at Superfund sites such as the AMCO Chemical Superfund site, Oakland, CA, and an aquaponics system is being proposed at the Portland Harbor Superfund site[62]. Tribes also use land-based aquaculture such as fish hatcheries to bolster salmon stocks in rivers around Puget Sound, including the Green-Duwamish.

Improving the quality of the stormwater from the uplands is an important component to improving the water quality of the river. Ecology is preparing a source control program that will coordinate source control plans developed by the local municipalities with the current Ecology water quality program. These source control efforts would help reduce total exposures from the site, and by leveraging the work with Puget Sound restoration efforts, could give a boost to the LDW.

Also, reducing nonpoint source pollution with green infrastructure projects in the Duwamish Valley, while at the same time providing more green space, would greatly benefit the South Park and Georgetown communities, enhance livability, and mitigate cumulative impacts, as well as reduce exposures from lateral source loading.

If such green infrastructure projects include buffers comprising trees and rain gardens within and around transportation corridors, the cumulative impacts to air for local neighborhoods bordering the LDW could be lessened as well, which could offset the air pollution impacts due to construction associated with the river cleanup. Infrastructure programs in the form of financial support or incentives for businesses, residents, and mobile sources (travelers) to reduce contaminant loading to stormwater and particularly air deposition of contaminants through greener methods, control technologies, and infrastructure projects would also be welcome ways community benefits from source control programs.

Construction Air Impacts to Lower Duwamish Waterway Residents

Appendix L in the FS (2012) includes calculations of cumulative impacts to air from the operation of equipment included in the cleanup options. It is anticipated that rail will be the dominant mode of transport for sediment movement to the landfill in the FS 2012. The rail and other equipment air emissions within the FS are based on the use of typical diesel fuels and other (non-green) base technologies. The calculations include estimates for PM_{10}, which is of most concern for impacts to the surrounding community because of its potential as an irritant to lungs, and its role in lung cancer and chronic illness.

The contribution of PM_{10} on annual basis and over the length of construction from site operations for the LDW cleanup alternatives in the FS is small (highest, if distributed equally each year of construction, is 5.3 metric tons per year; Table 2.1) in comparison to background emissions of PM_{10}, which are estimated at 383 tons (347 metric tons) per year for King County maritime operations and 855 tons (776 metric tons) per year estimated by PSCAA for all Puget Sound maritime operations[63] (maritime particulate emissions estimated to be 15% of total

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[62] http://ecotrope.opb.org/2012/07/in-portland-a-csa-on-a-superfund-site/

[63] Starcrest Consulting Group, LLC. April 2007. 2005 estimate. *Puget Sound Maritime Air Forum Air Emissions Inventory.* Accessed at www.pugetsoundmaritimeairforum.org

particulate emissions for all sources in the area regulated by the Puget Sound Clean Air Agency, PSCAA). However, because air pathways are of high concern for impacting human health within this area, ways these impacts can be reduced should be considered further.

Mitigations

First, given the excessive asthma hospitalization rates, excess lung cancers and other impacts to air pathways for residents in the vicinity of the LDW, it is advised to use the cleanest technologies available for equipment associated with air impacts. Particular concern should be given to idling of equipment near residences, schools, childcare facilities, and elders (eldercare, senior housing). Planting trees is another way to mitigate air quality concerns in the long-term and could be leveraged through green space initiatives.

Electric construction equipment, emissions controls, low sulfur fuels, biodiesel, and other environmentally friendly cleanup tools are one way to reduce emissions and local impacts to air. In addition, a primary construction element used in cleanup of the Slip 4 early action area and under consideration for subsequent actions costed out in the Feasibility Study (AECOM 2012) is the use of a direct rail spur (staging-barge-rail) for delivery of sediments out of the LDW neighborhoods. The use of rail would lessen the impact of truck traffic in an area where truck traffic, idling, and diesel emissions are all sources of concern for the neighborhoods from both safety and clean air perspectives.

There are many ways to mitigate the impacts from exposures to diesel PM_{10}. The EPA “National Clean Diesel Emissions Quantifier” can be used to assess the ways that green technologies could reduce impacts from rail, trucks, and other equipment. For example, electric dredges are available, and have been used in cleanups at LDW Early Action Areas.

Furthermore, conversion of dirtier switch locomotives to biodiesel and other cleaner fuel technologies is not unprecedented; EPA has previously funded the conversion of switch locomotives to greener technologies in the San Joaquin Valley. In that instance, it was found that the change in technologies combined with the use of low sulfur diesel, significantly reduced nitrogen oxides and particulate matter concentrations. The West Coast Collaborative (a federal, state, local, and industry partnership) is another mechanism for leveraging resources as they seek out new ways to reduce diesel emissions in transport.

Although rail is not emission-free, the majority of emissions generated would likely be outside of the footprint of the Georgetown and South Park neighborhoods. Rail-based transport would generate fewer emissions overall and have fewer cumulative impacts to the affect community residing near the site (less traffic, idling, etc.). In planning for cleanup work, further EJ concerns should be identified and mitigated as necessary as the routes are planned. Additionally, green rail techniques could be implemented, and community input on timing of rail crossings could be included. Using low sulfur fuels, filter systems, and even biodiesel-based engines are possible, with varying levels of emissions-reductions and cost, but provide significant benefits to air quality. For necessary truck and equipment transport and operation, a community advisory group or other transparent forum for immediate feedback to the site manager would be essential for designing ideal routing and timing, which would maintain low impacts on residents surrounding the LDW.

Cultural and Social Impacts

The LDW cleanup will have restrictions on when in-water construction can occur to protect the migration of juvenile salmon and bull trout through the LDW. The typical in-water work window

will be October 1 to February 15. EPA will consult with the tribes, the National Marine Fisheries Service, and U.S. Fish and Wildlife Service before implementation. In addition, EPA will consult with the Suquamish and Muckleshoot Tribes to ensure that impacts to tribal fishing and cultural events are minimized during remedial activities.

An additional timing concern is the daily operation of equipment in the waterway and transport of dredged materials away from the waterway. Such site operations could impact noise levels and traffic patterns in the surrounding community. Extra traffic could impact local pedestrian access, flow of business in the local area, and commutes. Noise from in-water work and transport of dredged materials may also concern neighbors of the site.

Mitigations

EPA will take these concerns into account and will work with the community regarding hours of operation of equipment at the LDW site and within the surrounding community. Encouraging the routing of trucks and use of equipment outside of residential neighborhoods as much as possible will also mitigate this impact.

Regarding disruption of cultural resources and barriers to access for ceremonial events, a way to inform activities in the LDW and prevent or minimize impacts to such resources would be a cultural resources survey for the LDW. A map or other tool with resource listings and timeframes for resource usage could help to avoid adverse impacts during the cleanup process. Or, alternatively, the use of a shared schedule identifying the resource and timeframe for its use compared to cleanup activities should be generated.

A historical and cultural resources survey will be conducted prior to remediation of the site. However, having such information in hand as soon as possible during cleanup planning would minimize community impacts. A community resources and activities watershed map has been developed by the DRCC for the Duwamish River, including the LDW. Other layers could be added to the DRCC base map with events and timeframes of the resource use, and overlaid with the cleanup site preparation. The map could be provided online to promote clear and quick communication, or be posted in affected communities to provide updated information on the cleanup, and with contacts for questions and concerns. Separately, for federally recognized tribal treaty activities, regular consultation, well in advance of the design, cleanup activities and milestones, must be planned to avoid or offset impacts to fishing activities and other uses of the LDW.

Food Access

The LDW site, as a fishing ground for tribes and residents, is a food resource. Impacts that will further hinder seafood access include increased contamination of seafood in the LDW in the short term during and just after in-water work, and the lack of access to healthy resident seafood resources from the LDW in the long term since fish advisories will remain in place for the foreseeable future. Because none of the cleanup alternatives allow for the safe consumption of resident seafood at current consumption rates for tribes, APIs, and others, this represents a disproportionate adverse impact for people who consume resident seafood, and/or who have a right to harvest resident seafood, from the LDW. The excess cancer and noncancer risks from PCBS (the only direct comparative available between the waterway and background contaminant concentrations) in fish tissue are significantly higher in the Lower Duwamish Waterway than outside of the Lower Duwamish Waterway and although cleanup will reduce the disparity to a large degree, some disproportionate risks will remain.

Mitigations

The lack of access to food resources could be mitigated by similar offsets suggested in the disproportionate impacts from seafood consumption, listed above.

Aesthetics

Since the cleanup alternatives will rely primarily on in-water work, it is not foreseen that aesthetics of the river will be impacted after the cleanup. The cleanup will require restoration of any disturbed areas to at least their previous state, and thus such impacts should be minimal.

Mitigations

The cleanup should be coordinated with the Natural Resources Damages Assessment process and other habitat restoration efforts such that the opportunity to leverage improvement to affected habitat is not wasted, when engineering equipment is already in place.

Green space or Recreation Restrictions and Impacts

It is not anticipated that the cleanup will negatively affect or impact green space in the neighborhoods surrounding the site over the long-term. However, the river remains a source of green space and recreation for those who reside near it, and access to the river may be impacted in the short-term during construction. Many restoration sites are also present with the LDW. Swimming beaches and waters may be impacted during construction. Also, green space is not abundant in these neighborhoods.

Mitigations

Should public access or restoration projects be impacted during the cleanup, they should be restored to at least the original state as soon as possible. Maps to other less impacted swimming locations could be posted on websites or print at the swimming beach locations if their use is restricted.

Further mitigation for these impacts could include improvement of the green spaces in these neighborhoods by planting trees in public right of ways and offering them for free to private landowners, improving landscaping and removing invasive weeds along roads and the LDW, and installation of rain gardens, along with associated maintenance programs. Furthermore, activities within WA ECY’s source control program, or other agency programs, that may be leveraged to improve green space access for residents are encouraged.

Economic Impacts and Jobs

First, the nine-criteria analysis explicitly includes cost as a criterion, and so cost considerations for each alternative are considered in Superfund's decision-making process (PP, Figure 13). Some costs of cleanup may be borne by local ratepayers. Job creation and disruption from waterway cleanup activities have been raised by community members, local government representatives, and the LDWG as major concerns for the LDW cleanup. Community members would like to ensure that local residents are given ample opportunity to apply for jobs created by the cleanup, while others have voiced concern that a longer, more expensive cleanup could inhibit business and reduce the number of jobs available to individuals who reside near the LDW. LDWG has reported that over 100,000 jobs are located in the LDW area and they have expressed concerns that the economic effects of the cleanup's magnitude and scope could negatively affect local businesses and their ability to provide jobs in the LDW region[64]. On the other hand, the cleanup will generate jobs, with the total amount of employment time (number of hours work time over the total length of construction) scaling to the length of the cleanup and the amount of in-water work and volume of sediments handled required for each alternative (Table 2.1).

Table 2.2 – Total Worker Hours Needed

Alt#	1	2R	2R-CAD	3C	3R	4C	4R	5C	5R	5R-Tb	6C	6R
Hours	0	158,728	128,882	139,757	211,345	199,646	320,026	220,648	457,334	381,374	476,867	1,084,682

Total worker hours needed for each remedial alternative. Source: AECOM 2012

Mitigations

Although an analysis of costs to ratepayers has not yet been done (since those responsible for paying for cleanup have not been fully identified), equity impacts will hopefully be considered in distributing any cost impacts from cleanup. Seattle Public Utilities, for example, currently provides low-income assistance for utility payments.

Other sediment remediation sites have created between 500-1000 jobs during construction (e.g., Hudson River PCB dredging). For the cleanup, the King County job training initiative[65], and the Superfund Jobs Training Initiative (SuperJTI[66]) are available for training locals and enabling them to meet the requirements of a particular cleanup and be ready to be hired into the jobs when they are created. Other cleanups have also resulted, on average, with improved economic health for the area affected, post-Superfund, based on real-estate economy and other local economic indicators (Gamper-Rabindran and Timmins, in-press, and 2011)[67].

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64 http://www.ldwg.org/assets/fs/LDWG1102rev_DuwFACTwtd.pdf

65http://www.kingcounty.gov/socialservices/WorkTraining/ServicesAndPrograms/AdultServices/KCJobsInitiative.aspx

66 http://www.epa.gov/superfund/community/sfjti/

67 Gamper-Rabindran and Timmins (2011). "Does Cleanup of Hazardous Waste Sites Raise Housing Values? Evidence of Spatially Localized Benefits." http://econ.duke.edu/~timmins/Gamper_Rabindran_Timmins.pdf

Dependence on institutional controls for and permanence of each alternative

Permanence of the methods used in each alternative and dependence on institutional controls was evaluated through the following factors: total area remediated, construction timeframe, and type of remediation that is conducted. For the suite of alternatives from 1-6R, the long-term effectiveness, permanence, and reliance on institutional controls is shown in Table 2.1. For the alternatives with less dredging, or to a lesser extent, other in-water work, there is stronger reliance on institutional controls in perpetuity, so as not to disturb the underlying sediments and exposure overlying waters to contamination. The options with less in-water work also are less permanent and will rely on more monitoring and evaluation, and re-establishment to ensure that the cleanup methods are working in the future. Overall, the options with more removal rank higher for long term effectiveness and permanence (for all populations), with alternatives 5R, 5-T, and 6R the highest-ranked, and with alternatives 4C, 4R, 5C, and 6C ranking strongly as well (Table 2.1).

Mitigations

Institutional controls, impacts, and limitations are described in detail, above. Limiting their use where possible is the foremost mitigation. Where they are unavoidable, making institutional controls culturally relevant and taking into account the usage of the waterway, those who use the waterway, best communication methods available, and Tribal rights potentially impacted by the engineering or institutional control under consideration is imperative. Advisory groups or input from the federally recognized Muckleshoot and Suquamish tribes and from a community advisory group can help avoid make sure that the cleanup is as effective as possible at achieving the most risk reduction possible for the affected populations.

Affiliated Agency Programs: Source Control

Much of the remaining risk from the site after cleanup with any alternative will be due to the loading of contaminants from upstream sediment sources. The estimated upstream sediment loading to the LDW, which contains low levels of many contaminants of concern, including PCBs, is >100X the volume of sediments compared to the sediments loading from the lateral and bed sources along the waterway. However, control of lateral sources through an effective source control program is an important component to the overall cleanup and will help reduce the chance of recontamination of the sediments following cleanup. To date, Ecology has been evaluating the lateral contribution of potential sources from approximately 250 outfalls within 24 different drainage basins.

Ecology has been charged with identifying and regulating these potential sources to the LDW. EPA and Ecology have agreed to coordinate the sediment cleanup and source control components in an effort to minimize recontamination of the sediments following remediation. Source control will be implemented by a strategic plan prepared by Ecology and several implementation work plans prepared by the agencies and the municipalities responsible for the maintenance of the stormwater systems that discharge to the LDW.

Meaningful Involvement in the Superfund Cleanup Outreach

One provision of EO12898 is to ensure that communities are meaningfully involved in the decision process as much as is practicable. To this end, EPA conducted “A Review of EPA Region 10’s Programmatic Response to the Environmental Justice Concerns of the Georgetown and South Park Neighborhoods of South Seattle” (“Review”) (US EPA 2010b), which served as a screening level analysis of environmental justice issues in these neighborhoods. The analysis is

specific to the development of the remedial alternatives for the Feasibility Study (AECOM 2012).

The primary goal of the Review was to examine how EPA programs and activities delegated to other agencies have identified and responded to environmental justice concerns of the South Park and Georgetown neighborhoods. The Review comprised a series of interviews with community members and EPA staff involved in Duwamish work. The major findings of the report are excerpted on the next page and reflect the major community views on the cleanup:

Major findings of the report

- The Duwamish neighborhoods, including Georgetown and South Park, are environmental justice neighborhoods (see Addington, 2009)
- There are a suite of major concerns on the part of community residents:
    - risks from direct contact with the river
    - eating fish and shellfish
    - tracking contamination into homes
    - controlling on-going upland pollution sources into the river
    - community access and recreation
    - habitat restoration
    - engaging neighborhood youth in environmental projects or internships
    - synergistic health effects of multiple pollution sources
    - air pollution
    - ground water pollution
    - large number of unpermitted dischargers
    - lack of community representation in EPA activities (multicultural and multilingual)
    - underrepresentation of community members in the decision-making process
    - lack of transparency of interactions between agency delegations, especially between EPA, Department of Ecology, and Puget Sound Clean Air Agency and lack of transparency in delegated decisions;
    - Continued siting and permitting of questionable facilities in areas of existing industrial high density and placements that are in close proximity to vulnerable populations
    - There are many concerns on the part of tribes, including the federally recognized Muckleshoot and Suquamish tribes, who have treaty fishing rights to collect shellfish and fish within the Duwamish River. In addition, the Duwamish tribe which, although not federally recognized, historically live along the Duwamish River and maintain cultural ties
      to it.
    - the appropriate incorporation of tribal fish consumption rates, which are higher than the general population in environmental cleanup decisions
    - the ability to exercise treaty rights despite EPA activities
    - the consistency of cleanup actions across all EPA sites along the Duwamish River
    - the consistency of tribal involvement in EPA's actions

- Community input on meaningful involvement
  - The Duwamish River Cleanup Coalition (DRCC) has provided a bridge between EPA and the community, and it has been key in communicating information about EPA actions and how they will impact the community. The Duwamish tribe is a member of the DRCC, and so the Duwamish tribe's views are presented by DRCC at EPA meetings and are represented in DRCC's communications with EPA.
  - There appears to have been a real effort by EPA, Ecology, and other agencies involved with the Duwamish cleanup (with delegated source control programs) to respond to community concerns.
  - EPA has conducted public meetings and provided factsheets and documentation to support the community with translation in multiple languages.
  - Overall, EPA Superfund has done an excellent job of integrating community involvement with Risk Assessment and Sediment and Source Control. This is not to suggest that all community concerns about risk of impacts from the Superfund site have been addressed, addressed adequately or to the community's satisfaction.
  - Tribal consumption rates were incorporated into EPA decisions
  - WA State Department of Health has issued fish consumption advisories and fish preparation instructions in a variety of languages
  - Ecology has implemented a Lower Duwamish Source Control Work Group (SCWG) to better prioritize and control the loading of untreated combined sewer overflows into the Duwamish
  - Superfund Community Involvement, RPMs and the entire Duwamish Team has done an excellent job at involving segments of the community in Superfund processes and decision milestones.

Community and tribal comments and concerns have been received on the draft Feasibility Study (AECOM 2010) during an early, additional comment period from October through December, 2010. This additional comment period was not required by law and was intended to elicit comments early in the process, and in subsequent correspondence. Consultation and discussion with the federally recognized Muckleshoot and Suquamish tribes and tribal representatives has taken place regularly during the FS development and EPA review process. DRCC/TAG, the local Community Advisory Group described a new option, "Alternative 7", which emphasizes source control and where the remedial action level is set to natural background (2 µg/kg dw for PCBs). Similar to the FS alternatives, Alternative 7 would include two variations, with 7C comprising a mixture of technologies, and 7R emphasizing removal/dredging of contaminants and upland source control, with the ultimate goal of negating the use of post construction institutional controls.

Individual comments on the draft FS varied widely, with some emphasizing efforts to reach substantial risk reduction in the quickest way possible, and others emphasizing efforts to reduce contamination in the longer term. Some comments showed a willingness to focus on achieving short-term results and avoid long-term impacts on the surrounding communities. Furthermore, many business and industry groups specifically endorsed alternative 3C.

Tribal comments also supported cleanup alternatives that emphasized permanence/stability while preserving their right to resources available from/at the river. The Muckleshoot Tribe indicated that the FS was not sufficiently detailed to enable the options to be contrasted effectively, while the Suquamish Tribe asserted that those most vulnerable to the health hazards presented by the site should direct the selection of the alternative.

Summary of impacts and recommendations

The EJ analysis has shown that there are many places where EJ concerns exist and mitigation for adverse disproportionate impacts are recommended. Where disproportionate adverse impacts are measured or unavoidable, first consider mitigation for the impacts experienced, and secondly, consider compensation or substitution for any loss of access to fisheries or other resources.

1. First, multiple cumulative impacts are present in the South Park and Georgetown neighborhoods and other areas flanking the LDW, with particular concern around air emissions.
2. Secondly, some local fishers and tribal members may consume more fish than average and may experience disproportionate health impacts from contaminants in fish tissue, compared to the average person.
3. The remedial alternatives may create disproportionate adverse impacts in the short term, as even higher contaminant concentrations may be found in seafood during construction. It should be noted that the existing disproportionate impacts from seafood consumption will not be fully removed by any remedial alternative.
4. From an environmental justice perspective, the focus of the cleanup should be on decreasing health risks from fish consumption as much as possible; minimizing impacts to cultural and recreational uses of the river; while at the same time avoiding or minimizing the use of institutional controls over the long term.
5. Instead of reliance on ICs that are proprietary or put the burden on those who use the waterway, or methods that are vulnerable to stirring/resuspension, the cleanup should ensure the permanence and reliability of the solution in place, and monitoring should provide reassurance that the solution stands the test of time.

Fisheries Impacts

Although offsets and institutional controls to reduce risks are important to reduce short term exposures, they are not meant to be long term solutions to the problem. The cleanup method chosen should reduce the environmental health burden of the contaminated waterway for users of the LDW, tribal treaty fisheries and subsistence/recreation fishers. The cleanup should not rely heavily on making the burdened population change practices and culture over the long term. For many tribal populations, the future outlook for seven generations ahead is traditionally considered in tribal decision making.

Keeping cleanup options open to consider new technologies and improvements in the future, flexibility to meet stricter targets, and employing adaptive management at the site is consistent with that view. Habitat that is disturbed in cleanup should be returned to its prior or improved state as soon as possible as the cleanup progresses and tribal representatives should be consulted on habitat restoration. Only through working closely with community liaisons and consulting separately with the tribal governments the appropriate and acceptable mitigations and offsets can be determined during cleanup.

Communication and Coordination

Enhanced communication and coordination should be a feature of this cleanup. The local communities have been engaged in the process thus far, and outreach should continue to be culturally relevant, targeted and create a space for exchange and discussion to achieve the best cleanup outcome possible. Outreach should make an effort to engage the full diversity of individuals who live, work, and recreate, in the LDW.

Joint community/nonprofit/agency advisory committees for outreach and community involvement and tribal coordination on an institutional controls development program, will be key to the success of such programs and ultimately the cleanup itself.

This coordination is crucial, because of the high volume of activities along the Duwamish, including cleanup of the early action areas, and research projects in the vicinity. Community fatigue is also present and any communication that needs to take place should be as streamlined as possible. Upstream and lateral source control should also be a topic for the enhanced outreach conducted by the institutional controls and enhanced community education groups. Leveraging of source control work (to improve green space quality and provide buffer zones for air and water where possible/practicable) can reduce cumulative impacts to the neighborhoods surrounding the LDW. Joint mapping and scheduling software with continuous information sharing, including areas of progress on the cleanup sites, overlays with significant cultural, ecological, and recreational resources, would allow for more seamless discussions and a level playing field when soliciting community input on tradeoffs in design. For those who do not have internet access, meetings within the community to discuss and solicit input will also be necessary. Furthermore, a comprehensive fish and shellfish-tissue monitoring program that is in place to ensure the reliability of institutional controls and integrity of technologies in place, and also can be used to inform health advisories over the long term, will be a critical data-sharing tool.

Source Control

The continued success of the cleanup for the long-term depends on the ability to control sources via a strong source control program. Although lateral source control is the focus of Ecology's source control program, a joint agency effort to assess how to leverage resources to address sources of contamination upstream, and how to disseminate information to better protect waters and communities downstream, would greatly benefit the people who live, work, and play in the LDW region, and would enable federal agencies to uphold their tribal treaty trust obligations to ensure sustainable resources for tribes in the future. Just such a program, called an Urban Waters Pilot Initiative, has been proposed for the watershed of the Green-Duwamish River, and if it is approved, it will involve numerous local, state, and federal agencies, nonprofits, industry, and other partners.

Addressing Data Gaps

Data gaps in this analysis are many, and new data sources could improve the analysis and recommendations. Data available on background contaminants and health status is a snapshot, and trends are difficult or impossible to infer from the datasets available. Census tract and even blockgroup-based data can leave out patches of impacted communities. The data sets themselves do not provide a fully picture of exposure – only measured, reported sources that are regulated are known. Very limited data are available on local fishers in the LDW (although some data are available for the Duwamish River as a whole). The existing data have revealed some basic fishing and consumption patterns. More detailed data are critical for targeting outreach and

communication, involving the community in a meaningful way, addressing health risks effectively, and designing the institutional controls program.

Understanding environmental health and cumulative risk faced by the population consuming fish caught and shellfish harvested by local anglers in the LDW is complicated by this lack of information. It is possible that some local fishers reside far from the LDW, with different environmental health and burden characteristics than those from the LDW.

Another complication for this analysis is that county health data were not statistically significant at the resolution of the individual neighborhood block and block group levels which would be needed to do more quantitative cumulative health risk comparisons or screenings. Instead, a more general cumulative impacts assessment was provided here, along with relevant studies/information on background sources of pollution to multiple pathways.

However, more epidemiological research would help target with a finer lens the health and related environmental burdens and benefits/improvements that could be made for residents in the area directly surrounding the LDW.

There are several uncertainties with estimating post-cleanup contaminant concentrations and risks. The FS future contaminant concentrations and risk estimates are based upon a natural recovery model and food web model with significant uncertainties, and the uncertainties are difficult to quantify for each population and alternative. Additionally some assumptions, such as reliance on Surface Weighted Average Concentrations (SWACs), rather than the 95th percentile UCL are not conservative. Therefore, these model projections should be viewed carefully, as concentrations and modeled risks could be quite different than those presented here, if modeled instead from the UCL95, or with more complete information included on source control strategies and their impacts on upstream loading. Finally, combined (multi-pollutant) human health risk assessment was not done – only data for PCB-related excess cancer risk was analyzed in the FS, which is an incomplete view of the risks present at the site, where arsenic, cPAHs, and dioxins and furans are also present at levels of concern for human health.

Defining institutional controls timeframes, details, and accountability/responsibility will be critical and will take a multi-agency and group approach, and this should take place as soon as possible. Non-proprietary maps of important local resources and community interviews and engagement, including oral recordings of traditional environmental knowledge, would have been useful in developing this assessment, but are still critical for the development of the proposed plan and design, and in working with affected populations in the future.

Recommendations for the proposed plan

- Emphasize reduction of greatest human health risks as soon as possible while ensuring that cleanup methods used will be effective and last over the long term;
- Form and funding of an advisory group with support for local community outreach experts to meaningfully involve the community in developing the most appropriate mitigations for exposure from eating resident seafood at the site;
- Continue support for tribal consultation, participation, and early involvement;
- Support a local fisher consumption survey specific to the LDW (to find out where, when, and what they are fishing for to provide critical information in the development of institutional controls, offsets, and enhanced education);
- Establish a mechanism to provide offsets in the event of higher short term concentrations in fish tissue in the LDW: fish trading may be most straightforward, but there would be cost savings potentially through a sustainable aquaculture or alternative transportation method; offsets for tribes to be developed in consultation;
- Use green remediation techniques, such as technologies that reduce air impacts, with any cleanup alternative chosen.

Recommendations that would be voluntarily adopted

The recommendations listed below, while not necessarily to be identified within Superfund's LDW proposed plan or record of decision, could be considered through other programs or processes:

- Coordination around source control and environmental justice concerns; buffer zone and green space enhancement where possible;
- Funding training for local workers and local hiring;
- Traffic, health, and safety coordination;
- Health screening.

Future work and vision for Duwamish Valley

Community Visioning

Several visioning efforts have taken place among the communities along the Duwamish River, and can lend insight into how EPA and other involved parties can inform our roles in the cleanup and selection of cleanup options and how our work will ultimately impact the affected communities where environmental justice concerns and disproportionate adverse impacts exist.

The members of the South Park Neighborhood Association conducted a visioning process, where they listed many aspirations including those below that have a nexus to the activities in the LDW:

> *With a thriving retail core surrounded by pedestrian-friendly residential and industrial uses that together create a welcoming and safe environment;*
> *Where children and youth feel safe and enjoy a broad array of recreational and scholastic opportunities, using a variety of public and private facilities;*
> *Where residential, commercial, and industrial interests are considered on an equal basis to create a pleasant living environment, abundant job opportunities, and successful, environmentally responsible community;*
> *That takes pride as Seattle's only riverfront village, practices responsible stewardship of the river, and supports a variety of commercial, industrial, recreational, and wildlife uses along the river;*

Furthermore, in a separate visioning process conducted by DRCC and summarized in the "Duwamish Valley Vision Report" (DRCC 2009), four broad categories were used to define the visioning process, and aspirations were developed based on this scoping:

- Environmental features, including air and water quality, parks, habitat, and open space
- Community amenities, including housing, social services, public art and recreation,
- Transportation, including basic infrastructure, public transport and freight mobility,
- Economic development, including industrial uses, redevelopment and small businesses.

The aspirations that followed the visioning process included:

1. A Duwamish Valley with clean air that no longer poses health risks to area residents.
   Strategies for reducing air pollution that were identified by visioning participants include stricter regulation of industrial air emissions; reducing vehicle traffic, commuting and idling, especially by trucks in residential neighborhoods; and planting more trees to help filter pollutants and improve air quality throughout the Duwamish Valley
2. The need for clean water with a focus for protection of water quality in the Duwamish River and the Valley's streams and creeks.
   Strategies for reducing water quality impacts included stormwater controls such as bioswales and other green infrastructure projects; natural drainage systems; porous sidewalks, driveways and parking lots; and use of wetlands as stormwater treatment ponds
3. Duwamish River Superfund site will be successfully cleaned up and that people will be able to safely play on its beaches, swim in its waters, and harvest and eat fish, clams, crabs and other seafood from the river.
   Strategies include securing a cleanup of the Duwamish River that is "done once and done right", and include controls on sources of contamination.
4. Restored habitat for restoring habitat for fish, birds, wildlife and people.
   Strategies include removing armoring, creating connected restoration and in-water habitat sites as a habitat corridor for juvenile salmon and other organisms, daylighting lost creeks, connecting greenbelt areas, restoring bends and mudflats where possible, and create or restore lakes to encourage diverse wildlife.
5. Creating a livable community with better green space access, particularly in Georgetown.
   Strategies include creating more parks and green space, dog parks, and noise/pollution buffers.
6. Increased public access to the river.
7. Alternative energy and a green economy through green jobs and businesses sourcing.

EPA and other Agencies' Programmatic Efforts in the Duwamish Valley

EPA and other agencies involved in the cleanup share a long term vision for a cleaner river and healthier communities for those who live, work, and play in the LDW. Many of the environmental health concerns mentioned here have causes or are related to issues beyond the scope of the LDW Superfund cleanup. It will take holistic action on the part of all agencies to determine a path forward for addressing these impacts.

For EPA, many programs in the Regional Office in Seattle, WA, have made and will continue to make concerted efforts to address the environmental burdens identified in South Seattle. EPA's work is cross-program, including efforts to improve air and water quality, clean up toxics, improve access to green jobs and remediate brownfields sites. The Region 10 Office of Water and Watersheds is working with the Washington State Department of Ecology to develop a Water Quality Assessment for the Lower Duwamish Waterway.

This Water Quality Assessment will examine the relationship between the pollutant loading in the watershed and the impairments that have been identified in sediment, fish tissue and water quality samples in the LDW.

EPA has funded many grants to do work along the Green and Duwamish Rivers and in the LDW. This works includes grant-making to the Northwest Indian Fisheries Commission and Muckleshoot Tribes to evaluate and improve salmon spawning and migration routes. EPA has provided grants to King County to control sources and implement stormwater-controlling low impact development projects in the Duwamish/Green River watershed. Other EPA grants have funded community groups, including DRCC, to look at Cumulative Health Impacts in South Seattle and a Community Action for a Renewed Environment (CARE) grant is being used to help South Park and Georgetown identify their environmental health priorities. Many agency staff regularly participate in the South Seattle Environmental Justice Interagency Work Group, which is helping coordinate the multitude of activities that agency, industry, and community groups are conducting along the LDW.

EPA has produced GIS frameworks and databases with environmental data and created reports, such as the Toxics Release Inventory Report for Seattle, WA, based upon EPA data sets and other environmental data to distinguish the major environmental and environmental health concerns here. Much compliance and enforcement remediation work has focused on the reduction of PCB contaminated soils and paint. EPA and ECY have targeted further inspection and enforcement activities in the Duwamish watershed, and ECY, in particular, has focused on multimedia inspections along the LDW. EPA has also funded the King County Green Jobs training initiative for several years, as well as brownfields redevelopment initiatives in South Seattle.

Appendix A

[Appendix B Seattle and King County Summary of Social Justice and Equity Initiative Efforts in South Seattle. The following documents can be found in the Proposed Plan Administrative Record (instructions for accessing the Administrative Record can be found in the Proposed Plan):

- Equity_income_foodaccess
- ESJ intent and process per ordinance 6-21-11
- ESJ Ordinance overview Oct 10
- ESJ Ordinance with Sigs
- Forest canopy change and race
- Health indicators Duwamish area and King County
- KingCountyEIRTool Oct 2010
- KingCountyEIRToolExamples[1]
- LDW_ACS_income_library
- LDW_ACS_income_transit
- LDW_minority_canopy
- Translation policy]

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