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DUWAMISH RIVER CLEANUP COALITION
Technical Advisory Group

Health Impact Assessment

Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

Technical Report

June 13, 2013

Assessment and Recommendations

Effects of the proposed cleanup plan on Tribes

Technical report

This technical report supports our overall HIA reports, produced in three stages: *Advance HIA Report* (May 2013), *HIA Public Comment Report* (June 13, 2013), and *Final HIA Report* (due July 2013).

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

1. Introduction

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

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

2. Information Resources

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

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

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

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

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

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

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

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

3. Tribal Baseline Community Profile

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

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

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

Duwamish Tribe

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

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

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

Muckleshoot Tribe

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

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

Suquamish Tribe

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

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

4. Health of the Affected Tribes

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

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

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

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

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

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

General population health models

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

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

Tribal health model

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

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

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

6. How do contaminated sites affect Tribal health?

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

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

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

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

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

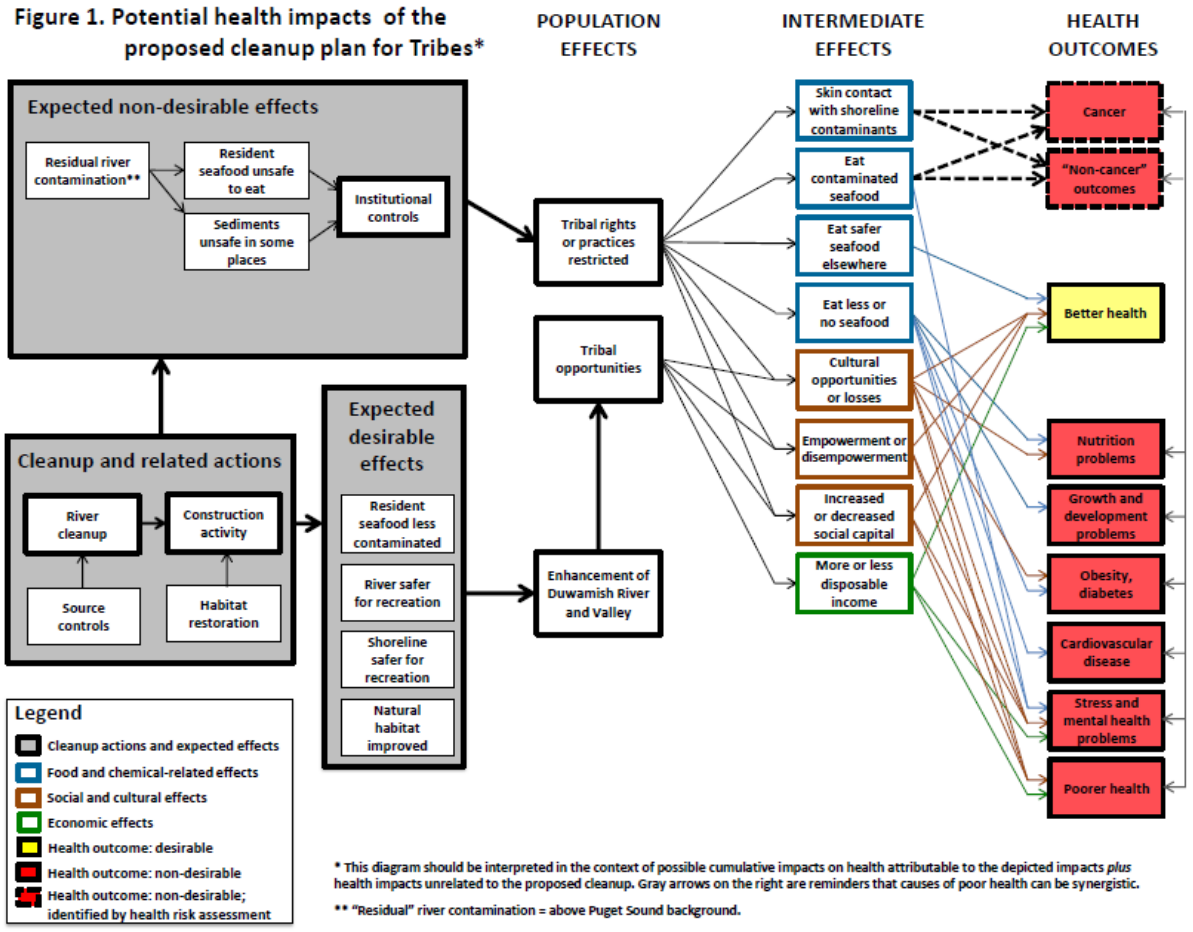
7. How will the Duwamish Superfund proposed plan affect health?

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

Effects of contaminant exposure on health

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

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



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

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

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

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

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

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

Limitations of the conventional risk assessment approach

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

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

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

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

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

Tribal concerns about the Duwamish Superfund cleanup plan

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

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

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

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

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

Alternative way of evaluating risk: Indigenous Health Indicators

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

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

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

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

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

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

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

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

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

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

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

9. Recommendations:

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

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

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

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

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

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

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

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

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

10. Limitations

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

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

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

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

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