EARTHJUSTICE

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Environmental Protection Agency
1200 Pennsylvania Avenue, NW Washington, DC 20460

Submitted via https://www.regulations.gov/comment?D=EPA-HQ-OW-2015-0174-0442

RE: Comments of Waterkeepers Washington and Pacific Coast Federation of Fishermen's Associations and Institute of Fisheries Resources on EPA's proposed Withdrawal of Certain Federal Water Quality Standards Applicable to Washington (EPA-HQ-OW-2015-0174)

Dear Ms. Fleisig and EPA Office of Water:

These comments and supporting documents regarding EPA's proposed Withdrawal of Certain Federal Water Quality Standards Applicable to Washington, EPA-HQ-OW-2015-0174-0442, are submitted by Earthjustice on behalf of Waterkeepers Washington (Columbia Riverkeeper, Puget Soundkeeper Alliance, Spokane Riverkeeper, and North Sound Baykeeper), the Pacific Coast Federation of Fishermen's Associations, and Institute for Fisheries Resources (collectively "Waterkeepers Washington"). The commenters are all non-profit organizations dedicated to protecting the environment and natural resources of Washington State and the Pacific Northwest region; ensuring that all communities of Washington and the Pacific Northwest have fishable and swimmable water; protecting the family-wage jobs that depend on fishing in Washington waters through scientifically sound policy; and seeking positive solutions to the challenge of water pollution and its human health implications. These joint comments supplement, and are in addition to, any individual comment letters submitted by each group.

In 2016, EPA largely rejected Washington's submission of water quality standards that depend on dubious math and arbitrary choices to essentially leave old standards in place, while simultaneously providing new avenues for polluters to avoid complying with all water quality standards. Nearly three years later, EPA now contends that this same rule is somehow adequately protective of designated uses and scientifically defensible. EPA's new position cannot be squared with the best available science and the intent and text of the Clean Water Act, and its proposed reversal is arbitrary and capricious and contrary to law. Indeed, even the State of Washington acknowledged that circumstances have changed since 2016, and accordingly asked EPA to leave the federally promulgated standards in place as the State and stakeholders have invested great time and resources into implementing the current standards.

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Waterkeepers Washington submits these comments in opposition to EPA's proposed Withdrawal of Certain Federal Water Quality Criteria Applicable to Washington, 84 Fed. Reg. 38,150 (Aug. 6, 2019) ("Proposed Reversal"). Waterkeepers Washington further adopts and incorporates by this reference the comments submitted by the Northwest Indian Fisheries Commission.[1]

LEGAL BACKGROUND

The overarching commitment of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). To that end, the Clean Water Act sets national goals to eliminate all discharges of pollutants by 1985, to attain water quality which provides for the protection and propagation of fish and shellfish by 1983 (the "fishable" goal), and sets national policy to *prohibit* toxic pollutants in toxic amounts. 33 U.S.C. § 1251(a)(1), (2), and (3). In order to ensure the attainment of these goals and implementation of this policy, the Clean Water Act imposes an obligation on states, with EPA in an oversight role, to develop water quality standards comprised of narrative or numeric water quality criteria sufficient to protect designated uses such as fishing or recreation. 33 U.S.C. § 1313(a) and (b). *See also*, 40 C.F.R. §§ 130.3, 130.10(a)(3), 131.4, 131.5, 131.10 and 131.11.

"Fishability" is shorthand for and encompasses the ability of people to engage in harvest of fish and shellfish and to safely eat the harvested fish and shellfish in quantities that those individuals would normally consume. As stated by EPA in 2016, for Washington's water quality standards, the designated use must recognize and encompass the manner in which tribes use the water. Thus, in Washington, harvesting and eating fish, including for subsistence (sustenance) by tribes, is the designated use of the waterbody that the Clean Water Act requires be protected. *See* Wash. Admin. Code 173-201A-600, -610; *see also* 81 Fed. Reg. 85,417, 85,424 (Nov. 28, 2016).

While states have the first opportunity—indeed the first *obligation*—to promulgate protective and science-based water quality standards, it is up to EPA review and to approve or disapprove a state's efforts and most importantly it is up to EPA to be the backstop should the state fail to promulgate the required standards. 33 U.S.C. § 1313(a), (b), and (c); 40 C.F.R. § 131.21. Moreover, EPA has independent authority to ensure that a state's standards are up to date and adequate to meet the requirements of the Clean Water Act. 33 U.S.C. § 1313(c)(4). At any time, when "the Administrator determines that a revised or new standard is necessary to meet the requirements" of the Clean Water Act, EPA "*shall* promptly prepare and publish proposed [revised] regulations." 33 U.S.C. § 1313(c)(4) (emphasis added). Again, the Clean Water Act structures the relationship such that EPA assumes the role of issuing standards that comply with the Clean Water Act even when the state has failed to do so.

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[1] Waterkeepers Washington also expect EPA to include in the record for this rulemaking the entire docket found at https://www.regulations.gov/docket?D=EPA-HQ-OW-2015-0174 and the certified record in related litigation, *State of Washington v. EPA, et al.*, No. 2:19-cv-00884 (W.D. Wash. 2019).

The Act requires that standards, whether new or revised, *shall* consist of the designated use of the water and the water quality criteria for such water necessary to protect those uses. *Id.* at § 1313(c)(2)(A). Further, the standards *shall* protect the public health or welfare and enhance the quality of the water. *Id.* A state must submit their new or revised standards to EPA for review and approval (or disapproval). Should EPA determine that any state submission or portion of a state submission (or existing standard) does not protect designated uses or otherwise meet the requirements of the Act, EPA is required to disapprove the standard and allow the state time to correct. Should the state fail to do so, again, EPA is required to then promulgate, *not later than 90 days* after disapproving a state submission, a standard that meets the requirements of the Act and protects designated uses. There are no provisions or allowances for EPA to reconsider and promulgate a weaker standard.

Because state and federal regulators have an obligation to set water quality standards to allow individuals and communities to harvest and eat shellfish safely in the quantities they would normally eat, it is incumbent upon the regulators to determine the amount of fish people actually consume when setting the human health water quality criteria for toxic pollutants. In numerous guidance documents, EPA has made clear that states must use locally accurate and protective fish consumption rates to set water quality standards. *See, e.g.*, EPA, *Methodology for Deriving Ambient, Water Quality Criteria for the Protection of Human Health* at 2-13 (Oct. 2000) ("EPA 2000 Guidance"). Accurately determining the fish consumption rate is integral to regulators' ability to set protective human health water quality standards such that the level of toxic pollutants are low enough that fish remain safe to eat, even for people who eat greater amounts of fish than others. *Id.*; *see generally* National Environmental Justice Advisory Council, *Fish Consumption and Environmental Justice* at 30-32 (Dec. 2001). If a state sets the foundational fish consumption rate lower than the amounts actually consumed, the commensurate human health water quality standards will be too lenient and people consuming fish may ingest levels of toxics that will put them at increased and unacceptable risk for adverse health consequences. EPA 2000 Guidance. Failure to adopt human health water quality standards based on an accurate fish consumption rate, including a rate adequate to protect sustenance fishing by tribes and other cultures, is a failure to promulgate water quality standards that meet the requirements of the Clean Water Act.

Other components of the human health water quality standards equation are also critical to ensuring adequately protective standards. As important as the fish consumption rate is the acceptable cancer risk rate, i.e. the risk that a person consuming fish will contract cancer during his or her lifetime because of exposure to toxics that may accumulate in fish. In Washington State, that number has been set at 10^{-6}, a one in one million chance that the average fish consumer would contract cancer from eating fish from the state. A $1x10^{-6}$ risk factor is generally considered protective. 40 C.F.R. § 131.36(b)(1).

Additional components of the equation that affect the outcome are assumptions about a person's body weight, lifespan, the relative amount of toxics from ingestion of fish, as opposed to other sources (the "relative source contribution" number), and the use of bioconcentration or bioaccumulation factors. At every step, the Washington State Department of Ecology's ("Ecology's") 2016 proposed criteria—which, three years later, EPA has now decided to approve—used the less protective option for the equation, often rejecting EPA's best-science instruction and recommendations. As a result, pursuant to its obligation under the Clean Water Act, EPA disapproved 143 of Ecology's human health criteria and promulgated federal standards that would adequately protect Washington's people and waters. *See* 81 Fed. Reg. 85,417 (Nov. 28, 2016).

Finally, for three pollutants, PCBs, mercury, and arsenic, in Ecology's 2016 proposed criteria, criteria that EPA now proposes to approve, Ecology failed to follow even the basic requirements of the equation for determining protective criteria. Rather, Ecology allowed PCB levels to be significantly less protective than dictated by science and factors such as actual fish consumption rates and bioaccumulation; allowed mercury levels to stay at their current harmful levels with no change; and allowed arsenic criteria to actually become less protective by simply relying on drinking water maximum contaminant levels, even though EPA's own guidance cautions against that very thing.

I. EPA'S PROPOSED REVERSAL IS CONTRARY TO THE REQUIREMENTS OF THE CLEAN WATER ACT AND EPA'S REGULATIONS.

Over forty years ago, the Clean Water Act made the promise to rid our nation's waters of toxic pollutants and to restore and protect the "fishable and swimmable" character of those waters. The Clean Water Act also imposed the requirements necessary to fulfill those promises on states and the EPA. Unfortunately, long past the timelines set forth in the Clean Water Act, states and the nation continue to struggle to meet those most basic goals, with outdated standards that are inadequate to protect consumers from toxins like mercury, polychlorinated biphenyls ("PCBs") and arsenic. EPA's 2016 promulgation of human health criteria for a number of toxic pollutants in Washington's waters went some distance to correcting the problem and moved toward meeting the requirements of the Clean Water Act. Now, less than three years later, EPA's Proposed Reversal, seeks to move backward on protecting human health and the state's and nation's waters by implementing water quality criteria that are significantly less stringent than Washington's current criteria. EPA's Proposed Reversal is contrary to the plain requirements of the Clean Water Act, the Administrative Procedure Act, and EPA's regulations.

A. The Clean Water Act and EPA's regulations do not authorize EPA to unilaterally impose weaker standards on Washington

The Clean Water Act dictates what EPA may and may not do with respect to a state's water quality standards. *See* 33 U.S.C. §§ 1313-1315; *see also Louisiana Pub. Serv. Comm'n v. F.C.C.*, 476 U.S. 355, 374 (1986) ("an agency literally has no power to act…unless and until Congress confers power upon it"). When a state submits new or revised standards to EPA, the EPA Administrator has 60 days to approve or 90 days to deny the state's standards. 33 U.S.C. § 1331(c)(3); 40 C.F.R. § 131.21. Under the plain language of the Act, EPA has no authority to revise a state's water quality standards absent a new submission by the state or following a "necessity determination" by the Administrator. *See* 33 U.S.C. § 1313(c)(3)-(4); *see also Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 485 (2001) ("EPA may not construe the statute in a way that completely nullifies textually applicable provisions meant to limit its discretion."). The limit Congress placed on EPA's authority with regard to states' water quality standards stands in stark contrast to other sections of the Clean Water Act in which Congress explicitly authorized EPA to revise previously promulgated rules. *Compare* 33 U.S.C. § 1313(c) (describing limited timeframe and circumstances in which EPA Administrator can act on a state's water quality standards) *with* 33 U.S.C. § 1311(d) (EPA shall review effluent limitations at least every five years and revise if appropriate).

In 2016, within the limited timeframe mandated by the Clean Water Act, EPA disapproved 143 of Washington's proposed criteria and promulgated criteria that protect designated uses and otherwise meet the requirements of the Act. 81 Fed. Reg. 85,417; 40 C.F.R. § 131.45 (Washington's current water quality standards). Washington has been working to implement those standards for nearly three years. There has been no new submission of criteria from the state—to the contrary, the state has asked EPA to keep the current standards in place—and the EPA Administrator has not made a determination that a new standard is necessary to meet the requirements of the Act. *See* 84 Fed. Reg. at 38,152. As such, there is no statutory authority for EPA to unilaterally modify Washington's current water quality standards, particularly when the result will undermine the Clean Water Act's goal to restore and maintain "the chemical, physical, and biological integrity of the Nation's waters." *See* 33 U.S.C. § 1251(a).

Moreover, EPA possesses no inherent authority to revise its regulations to make Washington's water quality standards weaker. While it is well established that "administrative agencies are assumed to possess at least some inherent authority to revisit their prior decisions, at least if done in a timely fashion," *Ivy Sports Med., LLC v. Burwell*, 767 F.3d 81, 86 (D.C. Cir. 2014), EPA's Proposed Reversal cannot reasonably be considered timely under the circumstances. Indeed, one of the cases that EPA cites in support of its about-face notes that a reasonable time for agency reconsideration is measured in weeks, not years. *Belville Mining Co. v. U.S.*, 999 F.2d 989, 1000 (6th Cir. 1993). Here, EPA waited three years to reverse course on standards that states must review *triennially*. *See* 33 U.S.C. § 1331(c)(1). EPA has acknowledged that Washington is currently in the process of its next triennial review, 2019 EPA TSD at 9, and that "Washington opposes the EPA withdrawing the 2016 federal human health criteria," 84 Fed. Reg. at 38,152. However, EPA dismisses Washington's request that EPA respect the current state process, and the three years of work that Washington has put into implementing the current standards, by saying that "the State remains free to promulgate the federal standards into state law if it so chooses." Not only does EPA's Proposed Reversal fly in the face of the statutory scheme, it also makes no practical sense. To be clear, what EPA is suggesting through its Proposed Reversal—and what Washington is trying to avoid—is an unnecessary regulatory rollercoaster.[2]

Additionally, any "inherent reconsideration authority" that an agency might possess "does not apply in cases where Congress has spoken." *Ivy Sports*, 767 F.3d at 86. As discussed above, Congress has clearly spoken as to the circumstances and timeline in which EPA must approve, deny, or revise state water quality standards. EPA has no power to act outside of those limits as it seeks to do with the Proposed Reversal.

[2] *See* Bellon letter to EPA (June 12, 2019), EPA-HQ-OW-2015-0174-0451.

B. <u>EPA's attempts to weaken Washington's current water quality standards violate the Administrative Procedure Act</u>

EPA must provide a reasoned explanation for its departure from its earlier decision—it has not done so. *See FCC v. Fox Television Stations, Inc.*, 556 U.S. 502, 515 (2009). Moreover, in explaining its changed position, "an agency must also be cognizant that longstanding policies may have engendered serious reliance interests that must be taken into account." *Id.* The state of Washington accepted and relied upon the 2016 EPA-promulgated criteria in moving forward with its regulatory duties, and has since invested substantial time and resources to implement those standards. EPA has provided no explanation—much less a reasoned one—for ignoring the state's repeated requests to leave Washington's current standards in place.[3] Instead, EPA merely notes that Washington can adopt the more stringent federally promulgated standards at some point in the future through a separate state administrative process. "In such cases it is not that further justification is demanded by the mere fact of policy change; but that a reasoned explanation is needed for disregarding facts and circumstances that underlay or were engendered by the prior policy." *Fox Television*, at 515–516. As in the circumstances presented here, "an unexplained inconsistency in agency policy is a reason for holding an interpretation to be an arbitrary and capricious change from agency practice." *Encino Motorcars, LLC v. Navarro*, 136 S. Ct. 2117, 2125–26 (2016) (internal quotation omitted).

Additionally, as explained below, the water quality standards that EPA now purports to approve were arbitrarily arrived at by Ecology. Moving forward with the Proposed Reversal would not only be arbitrary agency action in and of itself, it would also result in arbitrary and scientifically indefensible human health criteria for Washington's waters. There is no reasonable justification for EPA's Proposed Reversal and EPA must leave Washington's current, adequately protective water quality standards in place.

II. THE PROPOSED REVERSAL WILL RESULT IN WATER QUALITY STANDARDS THAT ARE NOT SUFFICIENTLY PROTECTIVE OF DESIGNATED USES, FAIL TO CONFORM TO THE REQUIREMENTS OF THE LAW, AND ARE ARBITRARY.

The water quality standards at issue here must protect the designated use of catching and eating fish from Washington waters. That is, the standards must protect public health and welfare. That includes protection from toxins that bioaccummulate in fish and shellfish. The public health and welfare that must be protected is that of all citizens of Washington for the actual amount of fish that they would normally consume. EPA's Proposed Reversal does not meet these most basic requirements of the Act for protection of water quality and public health.

EPA acknowledges that its Proposed Reversal will result in water quality standards that are less stringent—that is, less protective of human health—than Washington's current criteria. 84 Fed. Reg. at 38,153. This is because Ecology's 2016 proposal fudged the math, or failed to engage in using the proper equation at all, to reach a predetermined end-result. *See* EPA's May 10, 2019 Technical Support Document ("2019 EPA TSD") at 16-18 (describing Ecology's

[3] *See* Bellon letter to EPA (July 22, 2019) (EPA-HQ-OW-2015-0174-0581); Bellon letter to EPA (June 12, 2019) (EPA-HQ-OW-2015-0174-0451); Bellon letter to EPA (May 7, 2019) (EPA-HQ-OW-2015-0174-0446); Bellon letter to EPA (Aug. 7, 2018) (EPA-HQ-OW-2015-0174-435).

process of offsetting protective inputs with other inputs that are less stringent than EPA's guidance) (EPA-HQ-OW-2015-0174-0455). Despite rejecting 143 of Ecology's proposed criteria in 2016 as not protective of designated uses, EPA now contends that Ecology's outcome-oriented approach to arithmetic is scientifically sound and adequately protective. *See* 2019 EPA TSD ("the protectiveness of the criteria must be evaluated based on the suite of risk-management decisions, the totality of the inputs into the equations, and the resulting numeric criteria"). EPA's new position does not square with the law or its own regulations—the use of arbitrary inputs necessarily results in arbitrary criteria. *See Dep't of Commerce v. New York*, 139 S.Ct. 2551, 2577-78 (2019) ("the APA requires courts to 'hold unlawful and set aside' agency action that is 'arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law'") (quoting 5 U.S.C. §706(2)(A)); *see also* 40 C.F.R. § 131.5(a)(2) (EPA must determine that state-adopted criteria "protect the designated water uses based on sound scientific rationale").

A. <u>A Fish Consumption Rate of 175g/day is more protective than the former National Toxics Rule, but also on the low end of actual consumption rates</u>.

Surveys of Washington communities show fish consumption rates far higher than 175 g/day, even without considering suppressed consumption due to severely reduced stocks of salmon, shellfish, and other fish relied upon by many Washington residents. In its earlier determination that Washington's water quality standards are inadequate, EPA noted consumption survey data as high as 1,600 g/day and a Suquamish 95th percentile fish consumption rate of 767 g/day. *See* 80 Fed. Reg. 55,063, 55,066 n.18 (Sept. 14, 2015). Another recent EPA document noted survey data showing adult Suquamish tribal members have a fish consumption rate totaling 584.2 g/day. EPA, Record of Decision: Lower Duwamish Waterway Superfund Site App'x B at 33 & n.46 (Nov. 2014). EPA also highlighted that the Muckleshoot and Suquamish Tribes have raised the issue of their fish consumption rates being suppressed as a result of fishing conditions. *Id.*; 80 Fed. Reg. at 55,066 n.18 ("Extensively researched historical average FCRs for the Columbia River Basin Tribes range from 401 to 995 g/day . . . ."); *see also* Comment Letters from Confederated Tribes and Bands of the Yakama Nation, March 25, 2014 (noting Yakama has higher consumption rates and never "agreed" to 175 g/day); The Tulalip Tribes, March 28, 2014; Puyallup Tribe of Indians, April 9, 2014; Stillaguamish Tribe of Indians, April 2, 2014 (noting that consumption has been suppressed due to efforts to build up salmon runs decimated by non-Indian actions); and Northwest Indian Fisheries Commission ("NWIFC"), September 5, 2014, including table showing surveys in NWIFC previous comments.

The 175 g/day fish consumption rate is the result of years of process and negotiation between the State and several tribes; but it must be (and has been) acknowledged that many Washington residents eat fish in excess of that rate. Survey data supports even higher rates (requiring stronger protections) based on actual amounts of fish consumed by many members of the community affected by this rule. *See also* Expert Report of Allan Chartrand ("Chartrand Report"), attached, discussing fish consumption rate surveys and the interworking of protecting actual consumption rates and the development of human health criteria. This is doubly important because of the substantial environmental justice concern the fish consumption rate presents as its effects are most acutely felt by people of color such as Tribes, certain immigrant groups, and subsistence fishers.

Moreover, as explained below, the fish consumption rate does not exist in a vacuum and must be considered simultaneously with the other components of the human health water quality standards. *See* Chartrand Report at 3-7. Tinkering with various components of the human health criteria equation negates much or all of the progress that may have occurred as a result of finally using a fish consumption rate that moves toward a more accurate reflection of what Washington's residents actually eat.

B. The $1x10^{-6}$ Cancer Risk Rate is a necessary component of the water quality standards equation.

Washington's cancer risk rate for human health criteria water quality standards has always been one in one million, or $1x10^{-6}$, as part of the National Toxics Rule ("NTR"). 40 C.F.R. § 131.36. Indeed, Washington approved of the $1x10^{-6}$ cancer risk rate when the NTR was put into effect. In its official comments, Washington asked EPA to use a 10^{-6} cancer risk level. 80 Fed. Reg. at 55,068 (citing 57 Fed. Reg. 60,848 (Dec. 22, 1992)). EPA, in its 2016 rule, maintained the one in one million rate. 81 Fed. Reg. at 85,427. EPA found that that rate was consistent with its 2000 Methodology, tribal treaty rights, and proper given Oregon's 175 g/day fish consumption rate and 10^{-6} risk rate, as many of Washington's rivers are upstream of Oregon. *Id.* EPA's use of the 10^{-6} cancer risk rate is further consistent with general agreement overall in the scientific and regulatory community. Chartrand Report at 6. The strong scientific and regulatory bases for using this rate are in part to ensure that most of the population is protected, including more vulnerable persons, and to address the potential of additive or even synergistic toxicity from exposure to multiple toxins, often the situation with consumption of fish. *Id.*

The cancer risk rate is crucial to determining in-water protections. The very point of protecting fish consumers under the Clean Water Act would be compromised by a rate of less than one in one million, because those who eat the most fish make up the exact population for whom these numbers matter most and the group for which EPA must not compromise protections. A greater risk tolerance would mean that cancer risk for one segment of the population, high fish consumers, can be ten to 100 times higher than for the general population. Valuing the health of one group of people differently from another is unacceptable, a violation of the express direction in the Clean Water Act, and a likely violation of state and federal civil rights law. Use of a $1x10^{-6}$ cancer risk rate is appropriate and indeed necessary to ensure protection of designated uses of catching and eating fish over a lifetime.

C. EPA's Proposed Reversal would allow arbitrary, selective, and unscientific tinkering with components of the water quality standards equation contrary to the Clean Water Act and the APA.

In 2016, Ecology adjusted some, but not all, components of the human health water quality standards equation in reference to EPA's Exposure Factors Handbook ("EFH").[4] *See also,* Chartrand Report at 13. In so doing, Ecology picked only EPA recommendations that would weaken water quality standards while rejecting those that would strengthen the standards. Ecology's actions appeared to be results driven and are not based on the best science or what will

[4] EPA's Exposure Factors Handbook 2011, *available at* EPA-HQ-OW-2015-0174-0091.

be most protective of the most residents of Washington. This is the hallmark of arbitrary agency action.

In the state administrative process, Waterkeepers Washington commented that Ecology engineered its standards equation adjusting body weight, life expectancy, relative source contribution, and the use of bioconcentration as opposed to bioaccumulation factors to arrive at significantly less protective criteria than would be the result if Ecology had followed EPA's Handbook. Each of these components affects the outcome of the human health criteria equation and the amount of concentrations allowed in Washington's waters. Chartrand Report at 3-7, 10, and 13. Moreover, each of these components is based upon EPA's long work in developing the science that supports use of particular factors in order to protect designated uses, and EPA has provided the results of that science in its recommendations to states. Yet Ecology ignored the science, and EPA recommendations based on that science, in favor of a one-sided results-driven approach. For body weight, Ecology chose to adopt EPA's recommendation, a choice that would drive the standard downward or in a less-protective direction. For life expectancy and source contribution however, Ecology rejected EPA's recommendations, on thin "states-rights" grounds, because those factors would strengthen the standards. On the bioconcentration as opposed to bioaccumulation issue, it appears from Ecology's Overview document that Ecology was confused about the science and the difference between these two factors as its discussion is muddled and inconsistent with the science and the Clean Water Act. *See* Ecology, *Overview of key decisions in rule amendment* at 23-24 (Jan. 2016) ("Overview"), *available at* https://perma.cc/SX88-PU2W; *see also*, Chartrand Report at 6. Nonetheless, Ecology's choice again drove the resulting standard away from EPA's recommended approach and in a less-protective direction. Overall, as EPA found in 2016, Ecology's justifications in how it calculated the standards were unscientific, unclear, and unsound.

1. Ecology selected a higher body weight which resulted in a less protective standard and failed to consider implications for subsistence communities and the relationship between increased weights, related health effects and access to traditional foods.

While both EPA and Ecology used a national default of 80 kg (176.37 lbs.) body weight in promulgating Washington's current criteria, (moving away from a 70 kg (154.32 lbs.) body weight assumption), that change too resulted in standards that are less protective for consumers of fish and shellfish. *See* Ecology Overview at 23-24. By assuming that people consuming fish weigh more than EPA assumed in the 1992 National Toxics Rule, which set the 70 kg standard in Washington, concentrations of toxics were permitted to be as much as 10% to 15% less protective. Catherine O'Neill, *Washington State's Weakened Water Quality Standards Will Keep Fish Off the Table, Undermine Tribal Health*, Center for Progressive Reform Blog (Mar. 4, 2014), *available at* http://goo.gl/7R04n3.

This component of the equation is also important for considering discriminatory impacts of weakening the standards equation in this and similar ways. Traditional foods are crucial to the health of native people and to tribes. Reduced access to traditional foods has resulted in myriad health problems in tribal areas, *including increased body weights*. A study commissioned by the Karuk Tribe found that "[t]he loss of traditional food sources is now recognized as being directly responsible for a host of diet-related illnesses among Native Americans, including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney troubles, and strokes." Kari Marie Norgaard, *The Effects of Altered Diet on the Health of the Karuk People* at 5 (2004). The United States Centers for Disease Control & Prevention has also recognized the importance of traditional foods in fighting diseases in American Indian communities. *See* Native Diabetes Wellness Program, Centers for Disease Control & Prevention, Traditional Foods in Native America: A Compendium of Stories from the Indigenous Food Sovereignty Movement in American Indian and Alaska Native Communities (2013). This effort is of crucial importance because the rate of diabetes for American Indians and Alaska Natives is two to three times that of other groups in the U.S. Centers for Disease Control & Prevention, MMRW Weekly Summary (Aug. 1, 2003). For the Yakama Nation, the rate of diabetes is twice that of other populations in Washington. *See* O'Neill, *Washington State's Weakened Water Quality Standards*. It is unjust and discriminatory to use one of the results of taking away healthy subsistence foods for native communities—increased body weight—as a reason to then further weaken water quality health protections for eating those foods.

Moreover, there is evidence that Ecology's 2016 decision to use a higher body weight assumption came at the urging of industry polluters, not due to some scientific assessment. *See* Email from Nancy Judd, Wind Ward Environmental Consulting, to Cheryl Niemi, Washington Dept. of Ecology (Dec. 16, 2013) ("The result of using [a higher] average body weight is HH WQC that are still protective but are 10-15% higher"), *available at* EPA-HQ-OW-2015-0174-0289, Attachment 52; *see also* O'Neill, *Washington State's Weakened Water Quality Standards*.

As for other communities that consume high amounts of fish and shellfish, use of an 80 kg body weight significantly overstates weight, particularly for those in Asian American and Pacific Islander communities, again resulting in reduced protections for those communities. A study of fish consumption by ten such communities in King County indicated an average body weight of 62 kg for men and women. Ruth Sechena, et al., *Asian and Pacific Islander Seafood Consumption Study* at 62 (May 27, 1999), *available at* http://goo.gl/ptLiZZ. A dietary survey assessing fish consumption of Japanese and Korean women found similar body weight results to the King County study of the Asian and Pacific Islander community for women (57 kg, according to a presentation by one of the study's co-authors). Ami Tsuchiya, et al., *Fish intake guidelines: incorporating n-3 fatty acid intake and contaminant exposure in the Korean and Japanese communities*, 87 Am. J. Clinical Nutrition 1867-75 (2008), *available at* http://ajcn.nutrition.org/content/87/6/1867.long. The mean weight of the participants in the Tsuchiya et al. study was 55 kg for the Japanese women and 59 kg for the Korean women. *Id.* There is simply no support for the contention that 80 kg body weight results in a protective standard for all consumers of fish in Washington.

The use of an 80 kg body weight assumption cherry-picked the one component of the standards equation that would lower protections from among the relevant recent default values found in EPA's 2011 Exposure Factors Handbook. While body weight assumptions may increase, the 2011 EFH contains other values that would be more protective, such as those for life expectancy, drinking water intake, and relative source contribution. Instead of simply adopting all of EPA's recommended values along with body weight, or adopting EPA's 2015 national 304(a) human health criteria, Ecology instead chose only to modify the one default (body weight) that is less protective of human health. This decision was (and remains) arbitrary and not supported by science.

2. *Use of a relative source contribution of 1.0 is arbitrary and not based on scientifically sound rationale.*

As EPA has correctly noted, people's burden of toxics, and relative risk, come from a variety of sources. EPA therefore recommends that, absent scientific data about relative contributions of sources of toxics to the populations that are to be protected by the water quality standards, states should use a default value of 20 percent (.20) in the water quality standards equation to account for the obvious fact that not all toxics a person ingests will necessarily come from fish. EPA, Human Health Ambient Water Quality Criteria and Fish Consumption Rates: Frequently Asked Questions, *available at* http://water.epa.gov/scitech/swguidance/standards/criteria/health/methodology/upload/hhfaqs.pdf. EPA further states that if the sources of exposure to a chemical are well known and documented, a state may use a calculated relative source contribution but EPA recommends that the value not be greater than 80 percent (.80). *Id. See also*, Chartrand Report at 6-7.

Astoundingly, the standards that EPA wants to impose on Washington assume a relative source contribution value for all its calculations of 1.0—that is, it assumes with no foundation in fact or research, that a person in Washington ingests toxics only from fish or shellfish and not from any other source. This is particularly unsupported in the cases of arsenic and PCBs where it is known that humans ingest these toxins in drinking water. In its 2016 proposal, Ecology admitted that using .20 for the relative source contribution, as opposed to 1.0, would have made the resulting water quality standards more stringent. Overview at 25. Ecology did not, however, provide evidence suggesting that it has good scientific data in Washington about sources of toxics or that sources of exposures are "well-known and documented." Indeed, EPA's Proposed Reversal and accompanying technical support document fail to point to a scientifically sound rationale for this unsupported assumption, but rather defer to Ecology's "risk management decision" and supposed "more conservative inputs" elsewhere in the water quality standards equation. 2019 EPA TSD at 15-18. EPA has not provided a reasoned explanation for departing from its earlier science-based decision to properly account for other routes of exposure. *See* 81 Fed. Reg. at 85,421 (relative source contribution accounts for exposures to pollutants from ocean fish and shellfish (which are not accounted for in the fish consumption rate), non-fish food consumption, dermal exposure, and inhalation exposure).[5] Ecology's use of a relative source contribution of 1.0 was arbitrary three years ago, and it remains arbitrary today.

Ecology also rejected EPA's recommendation that life expectancy factors must be increased. Ecology, Proposed Rule Language at 6 (Jan. 2016), *available at* https://perma.cc/645X-WD5M; Overview at 45-46. The 70-year life expectancy relied upon

[5] *See also* EPA's 2016 Partial Approval/Disapproval Technical Support Document (Ecology did not "adequately explain[] why it is appropriate to disregard all other routes of exposure, including air, soil, other marine fish and shellfish, non-fish food, etc. Ecology did not demonstrate how its selection of a RSC value of 1 to derive human health criteria is scientifically defensible and protective of the applicable designated uses."), *available at* EPA-HQ-OW-2015-0174-0428.

by Ecology in its calculations is no longer best science. Rather, EPA recommends an average life expectancy for men and women combined of 78 years. EPA Exposure Factors Handbook at 18-1 (2011), *available at* http://www.epa.gov/ncea/efh/pdfs/efh-complete.pdf. Again, retaining the outdated life expectancy figure results in a less protective water quality standard. Ecology excuses its arbitrary choice by claiming that lifespan is not an "explicit" part of the criteria equations. Overview at 16. While lifespan is not called out explicitly in the equation, it certainly affects the results, and, as Ecology acknowledged, results in changes to the calculated results of the equation. Overview at 44. Likewise, these numbers matter for "discharge limits for episodic discharges." Overview at 46. Yet, instead of using the most current guidance, Ecology used outdated 1994 and 2000 guidance documents, rather than using the updated 2011 guidance.

3. Use of Bioaccumulation Factors Instead of Bioconcentration Factors is Not Scientifically Defensible.

The criteria that EPA now seeks to impose on Washington do not follow EPA's recommendation (and indeed the scientific community's recommendation) to use bioaccumulation instead of bioconcentration figures in the water quality standards equation. And again, the result is a less-protective standard. Since as early as 2000, EPA has made clear that it favors use of the more protective bioaccumulation factors ("BAF") over bioconcentration factors ("BCF"). EPA 2000 Guidance at 1-5. *See also* Chartrand Report at 6-9.

Bioaccumulation reflects how toxics move in the environment and how they ultimately affect people consuming fish and shellfish. It is the accurate figure to use for assessing how much of a toxic a person takes in when eating fish and shellfish and must be the figure used in properly assessing risk and exposure from eating fish. While fish and shellfish may have accumulated toxics in a variety of ways—directly from the water, from contaminated sediments in the water (that became contaminated because of pollution discharges to the water), from eating smaller fish that were contaminated from the water/sediments—the basic fact remains that those toxics got into the fish that people consume because of pollutants getting into the water. The BCF captures only a subset of the BAF because it does not measure all routes through which aquatic organisms are exposed to toxics in aquatic environments. Jon A. Arnot and Frank Gobas, *A review of bioconcentration factor (BCF) and bioaccumulation factor (BAF) assessments for organic chemicals in aquatic organisms*, 14 Environ. Rev. 257, 259-62 (2006), *available at* http://goo.gl/9P1hUO. *See also*, Chartrand Report at 11-12 concerning levels of accumulated toxins in Puget Sound Chinook, forage fish, and bottom fish. These terms are not interchangeable. *Id.* This is because "[f]or some chemicals (particularly those that are highly persistent and hydrophobic), the magnitude of bioaccumulation by aquatic organisms can be substantially greater than the magnitude of bioconcentration. Thus, an assessment of bioconcentration alone would underestimate the extent of accumulation in aquatic biota for these chemicals." EPA 2000 Guidance, at 5-2. Based upon this science, EPA promulgated standards for Washington using BAF, *not* BCF, in their calculations and development of human health water quality criteria. *See* 81 Fed. Reg. at 85,429. The scientific basis for this decision remains unchanged and EPA's newfound justification to weaken current standards is at odds with the Clean Water Act.

Ecology used EPA's outdated 1980 guidance recommending use of BCF, instead of the 2000 EPA Guidance's clear command to use BAFs, and misrepresented (or at least misunderstood) the nature of the Clean Water Act requirements and the relationship between bioconcentration and bioaccumulation. Ecology's attempted justification was that "BCFs are more closely related to the specific environmental media (water) that is regulated under the Clean Water Act." Overview at 43. This is a grossly irrelevant statement and one that does not square with the law. The Clean Water Act requirement to protect designated uses of the water must be met, and if sediment affects the concentrations of pollutants that can be in the water, that must be considered. Water quality standards set the standards for water bodies, regardless of the source of pollutants.

The Clean Water Act regulates water pollution two basic ways—one is regulating point source discharges, but Ecology's statement ignores the entire second half of the Clean Water Act. Congress also directed states and EPA to set water quality standards to protect all uses of water—these standards are set independent of the permitting system—they are standards of cleanliness applicable regardless of pollution sources. *Pronsolino v. Nastri*, 291 F.3d 1123, 1126 (9th Cir. 2002) ("At the same time, Congress decidedly did not in 1972 give up on the broader goal of attaining acceptable water quality. . . . [t]he 1972 statute therefore put in place mechanisms other than direct federal regulation of point sources, designed to 'restore and maintain the chemical, physical, and biological integrity of the Nation's waters.'") (internal citations omitted). These standards then drive the TMDL cleanup process which encompasses all sources of pollutants to water, point and non-point. *Pronsolino*, 291 F.3d at 1131-32.

Similarly, Ecology's justifications for using old, outdated BCFs are not scientifically defensible. The use of BAF relative to BCF has nothing to do with how a pollutant got into a water body. Instead, these distinct factors consider how the pollutant got into fish or other aquatic organisms after getting into the water. The BCF considers only dermal and inhalation exposure of aquatic organisms, whereas BAF considers the BCF plus aquatic organisms' exposure through the food they eat. Arnot and Gobas, 14 Environ. Rev. at 259-62 (2006). How the pollutant got into the water initially before being taken up by the aquatic organism is irrelevant. *See id.* In promulgating an adequately protective rule in 2016, EPA did what Ecology should have done—looked to the clear and scientifically supported recommendation in EPA's 2000 Guidance and used a BAF. Ecology's proposal instead chose, once again and in extremely garbled fashion, to reject EPA's recommendation in favor of a weaker, less-protective approach. EPA's new position is that Ecology's inexplicable use of outdated BCFs is now somehow protective of designated uses when considered alongside Ecology's other inputs—many of which are also significantly less protective than those used in Washington's current water quality standards. *See* 2019 EPA TSD at 15. In this respect, EPA's Proposed Reversal again strains credulity.

III. EPA'S PROPOSED REVERSAL WOULD RESULT IN ARBITRARY AND UNPROTECTIVE STANDARDS FOR SEVERAL DANGEROUS POLLUTANTS.

While EPA's Proposed Reversal would still retain a fish consumption rate of 175 g/day and a 10^{-6} cancer risk rate, much of the protection afforded by those inputs would be undone by changes to other parts of the water quality standards equation as set forth above. Likewise, for some of the most prevalent and harmful pollutants—such as PCBs and dioxin—the Proposed Reversal would result in lower standards than called for in the equation and substantially lower than Washington's current standards.

A. <u>Many Pollutant Concentrations Will *Increase* Under the Proposed Reversal</u>.

The Proposed Reversal would mean dozens of pollutants will have less protective standards than they currently have, and that even before considering the state's generous compliance off-ramps and loopholes are considered. *See* 2019 EPA TSD at 25-29 (table comparing current standards with standards under EPA's Proposed Reversal). *See also*, Chartrand Report at 2-3, and 12-13. Some of the differences between Washington's current water quality standards and the standards EPA is trying to force on Washington are staggering. *See* 2019 EPA TSD at 25-29 (the current allowed concentration for anthracene 100 µg/L, while under EPA's Proposed Reversal it would be 3100 µg/L (31 times higher); flourene is currently 10 µg/L, and would be 420 µg/L under the EPA's proposed reversal (42 times higher); hexachlorocyclopentadiene is currently 1 µg/L for EPA and would be150 µg/L (150 times higher). As noted in the enclosed Chartrand Report, seven polycyclic aromatic hydrocarbons ("PAHs") will be weakened by two orders of magnitude and there is no recognition or accommodate in the Proposed Reversal of the fact that multiples of these PAHs are often consumed together and that they have an additive effect on humans when consumed together. Chartrand at 10-11.

Mercury levels will be allowed to remain at their current unprotective and unhealthy levels under EPA's Proposed Reversal. Mercury is perhaps the most prevalent (along with PCBs) contaminant present in our water and in our fish and shellfish food sources. Chartrand Report at 10. It is a significant health concern for humans, especially vulnerable people such as pregnant and nursing moms and children. Health warnings are routinely issued for mercury in fish tissue with limits on how much people should eat, yet people are also encouraged to choose fish as healthy sources of protein and many people in Washington eat significant amounts of fish and shellfish for health, economic, and cultural and subsistence reasons. Telling people to simply not eat fish is contrary to the very core and purpose of the Clean Water Act and its standards requirements. Allowing mercury to remain at current unhealthy levels does not protect designated uses and is contrary to law. *Id.*

Conversely, Washington's current, EPA-promulgated criteria are based on sound and complete science, are compliant with EPA's own direction and recommendations for calculating protective human health water quality criteria, and they will protect the designated uses of Washington's waters by protecting the health of the fish-consuming public.

B. <u>The Proposed Reversal Would Result in Arbitrary and Extremely Under Protective Standards for PCBs.</u>

PCBs are some of the most dangerous chemicals in Washington's waters. As Ecology has found

> [h]ealth effects that have been associated with exposure to PCBs include acne-like skin conditions in adults, and neurobehavioral and immunological changes in children. PCBs have been shown to cause cancer in animals (EPA 2014). Studies of exposed workers have shown changes in blood and urine that may indicate liver damage.

Overview at 52. Ecology proposed, and EPA now purports to approve, simply keeping the former unprotective and inadequate NTR for PCBs of 0.00017 ug/L. In fact, Ecology's proposal was to use a state-specific risk level exclusively for PCBs placing PCBs entirely outside of the proper equation for determining protective human health criteria and allowing a dramatically higher cancer risk rate for PCBs—rather than one in one million. With its selection of a cancer risk level of 4 x 10^{-5}, Ecology proposed allowing a one in 25,000 cancer risk for PCBs alone. Ecology Proposed Rule at 11-12 & n.E; Ecology Overview of Proposed Rule at 53-54. Ecology then proposed to retain the weak and inadequate NTR because it's 4x 10^{-5} resulted in a standard that would have allowed this very dangerous and toxic chemical to actually increase in Washington waters and fish. Ecology never explained (nor does EPA attempt to do so now) why it would allow a significantly increased cancer risk—forty times more—for fish-consuming residents of Washington for this known and prevalent carcinogen, and produced no scientific evidence to support its decision to allow the public to be at increased risk from PCBs relative to other pollutants. Ecology's approach of proposing to increase toxic chemicals and then purporting to take a protective action of maintaining a standard that does not protect designated uses was and is a smokescreen wholly untethered from the law or science. The entire exercise appeared to be one geared to ensuring the standard ended up where Ecology wanted it to land—at a standard unchanged—and that Ecology tinkered with the math and methodology until it got there.

EPA took the more supportable and protective approach, consistent with its obligations under the Clean Water Act, when it promulgated the human health criteria for PCBs in 2016 of 0.000007 µg/L (0.007 ng/L). EPA must retain this criteria as the scientifically-sound criteria that will protect designated uses, as required by the Clean Water Act. *See* Chartrand Report at 9. Unfortunately, EPA now proposes to adopt Ecology's work and proposal. EPA's Proposed Reversal simply adopts a completely arbitrary and unscientific standard setting process, and it will result in standards that do not protect designated uses in direct contravention of the Clean Water Act's specific requirements.

C. Methylmercury

For methylmercury (a highly toxic metal with neurotoxic effects), applying the updated fish consumption rate and the proper factors from EPA's EFH recommendations would have resulted in a more protective water quality standard. Instead, Ecology proposed to put off any new regulation, leaving the inadequate 1992 NTR mercury standard unchanged. Overview at 63-66. EPA has already found that the mercury standard, as part of the NTR, is inadequate to protect designated uses, necessitating a new, more stringent, standard. To justify its failure to act, Ecology asserted it is simply too difficult to complete a mercury standard. This assertion that "it is too hard" is neither supported, nor supportable. And now EPA proposes to reverse itself and allow this course of action on mercury, contrary to science and law, leaving designated uses unprotected. *See* Waterkeeper Washington Letter, Aug. 10, 2016 (EPA-HQ-OW-2015-0174-0320) and Waterkeeper Washington Comments, Oct. 29, 2015 (EPA-HQ-OW-2015-0174-0228).

D. Arsenic

For arsenic, EPA reaffirmed its November 15, 2016 decision to leave the existing National Toxics Rule values in place. 2019 EPA TSD at 20. Consequently, allowable levels of arsenic will also remain at higher levels in Washington waters and fish and shellfish than would be the case if EPA were to properly apply the equation using proper parameters. Instead of 0.098 ug/L (the standard EPA proposed to retain) application of the proper key exposure parameters in the human health criteria equation results in a more protective standard of 0.0045 ug/L (the same standard EPA originally proposed, but did not finalize, in 2016). *See*, Chartrand Report at 9. Allowing the standard to remain at 0.098 ug/L does not protect designated uses.

E. Dioxins

Ecology's 2016 proposal also proposed human health criteria for dioxins that are less protective than the NTR standards, and 25 times less protective than Oregon's. Ecology reached this result by calculating 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD) only based on its non-cancer health effects. Overview at 30. The current HHC value (listed at 40 CFR 131.45) is 1.3×10^{-7} and 1.4×10^{-7} ug/L, for water + organisms and organisms only, respectively. Ecology's proposed number, to which EPA proposes to revert, represents older, less defensible input parameters for highly toxic TCDD mixtures. Ecology's original proposal is not protective of designated uses. *See,* Chartrand Report at 11.

CONCLUSION

The effect of EPA's Proposed Reversal is to reduce Washington's current health protections for many chemicals—including some of the most dangerous toxins, such as PCBs and dioxins. While maintaining a fish consumption rate of 175 g/day and a one in one million cancer risk rate, the Proposed Reversal otherwise results in a manipulated water quality standards equation and significantly less stringent criteria that do not protect the designated use of fishing and eating fish and shellfish for residents of the state. Protecting designated uses is a basic requirement for setting standards under the Act—a requirement that the Proposed Reversal fails to meet. EPA should rescind its Proposed Reversal and leave in place Washington's current, more protective standards.

Respectfully submitted this 7th day of October, 2019.

Earthjustice
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On behalf of:
Puget Soundkeeper Alliance
Columbia Riverkeeper
Spokane Riverkeeper
North Sound Baykeeper
Pacific Coast Federation of Fishermen's Associations
Institute for Fisheries Resources

Chartrand Expert Report –

EPA-Proposed Water Quality Human Health Criteria Revisions

October 2019

1 Introduction and Overview

The US Environmental Protection Agency (EPA) proposes to withdraw human health water quality criteria (HHC) in Washington State (Fed. Reg. 2019), related to 97 specific EPA Priority Pollutants (under WAC 173-201A-240). In November 2016, EPA had partially approved and partially disapproved HHC submitted by Ecology to EPA for review in August 2016. Also in 2016, EPA promulgated HHC for Washington State in place of the Ecology submission that EPA had disapproved.

The action proposed here follows EPA proposal in May 2019, wherein EPA reconsidered and reversed its partial disapproval of a 2016 Washington State criteria submission under Clean Water Act Section 303c. See Technical Support Document submitted in May 2019 (EPA 2019a). EPA instead approved water quality HHC submitted by Washington State Department of Ecology (Ecology) in August 2016, and determined that "Ecology's HHC are protective of designated uses and based upon sound science". In its proposed reversal, EPA now proposes to withdraw the HHC it had promulgated to replace Ecology's HHC.

I have read through and reviewed EPA's proposed reversal and withdrawal, as well as Ecology's 2016 proposal, and believe that Ecology's proposed HHC values, which EPA is now proposing to partially approve and to allow to become fully effective with EPA's withdrawal of its HHC promulgated for Washington State, clearly do *not* protect designated uses of catching and consuming fish and shellfish and are *not* based on, or supported by, sound science. My expert report was prepared to discuss and explain the specific scientific assumptions used to derive the Ecology HHC values which with the action here proposed by EPA will become the effective criteria for Washington, and to offer recommendations on promulgating more protective HHC for these contaminants moving forward.

2 The Proposed HHC Values are Underprotective of Human Health

The proposed HHC values[1] do not adequately protect consumption of fish and shellfish because the proposed HHC are based on inadequately protective assumptions and input parameters that govern both exposure and toxicity aspects of risk-based water quality criteria derivations. These parameters include a wide variety of values, many of which are discussed and explained below. Among the most important of these exposure parameters are the seafood (fish) consumption rates (FCRs) that have been carefully studied and shown to be underprotective, especially for subsistence fishers and high seafood consumption ethnic and/or Native Americans (e.g. some Northwest tribes as well as sensitive Asian, Pacific Island and

[1] Hereafter, this report will refer to the "proposed HHC values" meaning the values originally proposed by Ecology which would take full effect with EPA's action here. EPA earlier reversed its disapproval of the values proposed by Ecology in 2016 and those values would take full effect once EPA withdraws the HHC EPA promulgated in November 2016.

other groups). Proposed HHC values would also be underprotective of safe consumption of fish and shellfish consistent with Native American tribes' historic fish-based culture and treaty-protected rights.

Table 1 of Fed. Reg. (2019) shows 99 EPA Priority Pollutant compounds (two of which are unaffected, reducing the total to 97) that have largely been weakened by EPA as a result of the water quality HHC revisions and withdrawal discussed above. The net effect of EPA's proposed actions will be HHC values that are *less* protective, in many cases much less protective, than those protective HHC promulgated by EPA at 40 CFR 131.45. These less safe, less protective proposed values would be based on older, indefensible, and less protective science and input/exposure/toxicity data and parameters as proposed by both Ecology (2016) and EPA (2019a and b), *which is unacceptable.* This discussion does not specifically address each of the 97 compounds affected, but focuses the discussion on a few of the most prominent, bioaccumulative, toxic, and problematic of the compounds.

For example, numerous (12) individual polynuclear aromatic hydrocarbons (PAH) homologs, especially high molecular weight PAHs, many of which are believed to be carcinogenic (cPAHs), are on EPA's proposed list for withdrawal and for reversion to Washington state's earlier, less protective HHC. This revision will produce cPAH criteria that that are far less protective than those promulgated by EPA when it disapproved Ecology's HHC submission in 2016. This list of PAHs include less toxic and less bioaccumulative homologs (i.e. isomers), but seven (7) more toxic, potentially carcinogenic cPAHs will be significantly affected by EPA's proposed withdrawal, and acceptance of these proposed HHC values will produce HHC that are far less protective. The more toxic, potentially carcinogenic cPAHs specifically include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno (1,2,3-cd) pyrene. In each of the cases of these individual homologs, which tend to occur together as a result of combustion or other processes, the level of protection for human consumption will be lessened by *about two orders of magnitude or more per homolog.*

For example, the federally promulgated HHC at 40 CFR 131.45 for benzo(a)pyrene, a well-recognized cPAH homolog, would be weakened from 1.6×10^{-5} µg/L for both water + organisms and organisms only, to much less stringent values of 0.0014 ug/L and 0.0021 ug/L, respectively. These older values are based on older, indefensible, scientific data. This is significant because when a person ingests one or more of these homologs, which often occurs together as a mixture, they will be receiving an additive dose for each one of these compounds, each of which operates through a similar mode of action, is toxicologically analogous, and therefore exposure to each of these homologs is cumulative.

PCBs are another group of compounds for which the revised criteria will have a powerful weakening effect. PCBs are a wide-ranging group of 209 individual congeners (similar to PAHs), with some congeners being more toxic, bioaccumulative, and carcinogenic than others. It is therefore important to note that weakening the currently federally promulgated HHC (at 40 CFR 131.45) of 0.000007 µg/L (0.002 ng/L) and replacing this value with that proposed by EPA in May 2019 to 0.00017 µg/L, (and earlier proposed by the Department of Ecology in 2016) is a *weakening of approximately two orders of magnitude*. This revision will be underprotective for human consumers against potential carcinogenic effects, especially for persons with high fish and shellfish consumption rates or for more vulnerable individuals such as children. Therefore the designated use of fish consumption would not be protected using the weakened HHC values.

Moreover, PCBs act through an analogous mode of action, and numerous congeners tend to occur in the environment together rather than as individual congeners. Input parameters supporting the stronger HHC value such as the PCB cancer potency factor (CPF) and bioaccumulation factor (BAF) were reassessed to distinguish among mixtures of specific congeners and different exposure pathways, so the currently promulgated HHC value more scientifically defensible and protective.

It is noted that derivation of HHC values for the other of the 97 compounds other than those discussed above are also affected with respect to using of less protective input parameters (e.g. body weight, relative site factor, BAF values, etc.) that also result in values that are less protective. The discussion below provides more detail on some of these exposure-related issues.

3 Fish and Seafood Consumption Rates and Other Key Exposure Parameters

The discussion and critique in this section focuses on key input parameters used in water quality HHC regulation to address toxic or adverse exposures to fish and shellfish consumers. These key parameters include seafood consumption rates, relative source contributions, bioaccumulation factors (BAF), body weight, and a number of other parameters. All of these parameters are important to ensuring that HHC ensure protection of designated uses. Because Ecology's 2016 proposal and EPA's current proposal fail to employ the proper scientific parameters, EPA's current proposed HHC do not protect designated uses of consuming fish. Among the most prominent and potentially problematic of these is fish consumption rate (FCR), and much of the discussion below focuses on the controversy surrounding FCR values.

Several nationwide studies on FCRs have been done during recent years and are part of generalized EPA risk and exposure assessment guidance (e.g. EPA (2000), EPA (2014a)), but these generic studies have frequently not considered people that consume high levels of fish and shellfish in Washington state such as Native Americans, Asians, and Pacific Islanders.

Regarding Native Americans' exposure to fish and shellfish, numerous toxic exposures, including from PCBs, mercury, and other contaminants, the route of exposure occurs through fish consumption in numerous populations, including tribes and Alaskan Native fishing people (Harper and Walker 2015). EPA recommends that in order to protect subsistence and high consumption citizens, states or tribes should base numeric water quality criteria on actual fish consumption practices rather than simply using default EPA national FCR values. Although larger, nationwide-scale data sets are often useful in the scientific literature, in the case of setting actual criteria to protect actual consumers, especially people who consume high levels of fish and shellfish, the lack of specific consumption data dictates a need for research into tribal customs and habits. (Harper *et al.* 2007, 2012, Harper and Walker 2015).

Harper and Walker report statistical inconsistencies, for example, between reporting average vs. upper-bound or upper percentiles of data distributions for "contemporary" fish consumption, the lack of separation between contemporary and heritage rates, and other factors can lead to under- or -over-reporting actual fish consumption in specific subsistence fish groups or other subpopulations (Harper and Walker 2015, Shilling et al. 2014). Under-reporting can lead to lower FCRs, especially with tribal groups ingesting fishing treaty-rights based or heritage based FCRs (Harper and Walker 2015). For example, heritage rates have been verified as "treaty-reserved rate" for some federally recognized Oregon and Washington tribes (e.g. Ulrich 1999, O'Neill 2013; Harper and Walker 2015).

Heritage rates are not always regarded as historic rates, as the term "historic" suggests that Native populations no longer consume or intend to consume fish at those earlier or traditional rates (Harper and Walker 2015). Similarly, current contemporary rates are deemed as suppressed for many Native Americans due to a variety of factors. There is a general consensus that tribes frequently consume more fish than the general population; however, the amount of fish that would be consumed if fish were clean, available, and accessible is different than the current contemporary rate that does not take this into account (Harper 2007). Destruction of fisheries, lost access to aboriginal lands and fishing sites, awareness of contamination (advisories, hence eating less fish), habitat degradation causing reduced fish availability, dams, and land development, among numerous other issues, cause suppression of the true contemporary fish consumption rate (Harper 2007, Donatuto and Harper 2008, O'Neill 2000, O'Neill 2013). Thus, surveys addressing contemporary fish consumption rates may not include "full" fish consumption rate information and may provide suppressed instead (Harper 2007). For example, the Ecology (2013) technical document, reporting on a Lummi Nation FCR study, emphasized suppression as an issue (quoted from Lummi Natural Resources Department (2012)):

> *"The environmental baseline chosen for the Lummi Seafood Consumption Study was 1985, as this was the peak fish harvest year for the Lummi Nation in recent history and a goal of the Lummi Natural Resources Department is to restore fish habitat so that at least the 1985 harvest levels can be sustained. As a result, the Tribal Advisory Committee determined that fish consumption rates from 1985 should be used to develop water quality standards and to support risk assessments of clean-up options for contaminated sites along Bellingham Bay. While not at Treaty-time levels, seafood abundance and availability was less of a limiting factor for seafood consumption during 1985 than in 2012. Consequently, the seafood consumption rate would be less suppressed due to environmental degradation or the lack of available fish. A literature review showed that appropriate data could be elicited in recall studies that reach back 25 years."*

When developing tribal consumption rates, both heritage and contemporary, it is important to consider that misappropriation and misuse of data have created a rift in relationships between some tribes and the government (Campbell 2003, Smith-Morris 2007). Distrust of outside entities, including research and/or government agencies, makes it difficult to compile questionnaire data from many tribes (Campbell 2003, Smith-Morris 2007). Following is a compilation of some of the FCR rates developed through a variety of studies:

Amount consumed (g/day)	**Reference**	**Notes**
4	Westat (2013)	estimated average
6.5	EPA guidance (past)	
17.5	EPA water quality guidance (2002)	
48.6	FDA and EPA advisories	12 oz of fish per week, recommendation
53	Mayfield *et al.* (2007)	Puget Sound recreational anglers

54	Harper *et al.* (2007)	MTCA and EPA OSWER
63	Columbia River Tribes (1994)	freshwater fish
63.7	CRITFC (2004)	4-tribe average
72	Toy et al. (1996)	Tulalip Tribe
73	Toy et al. (1996)	Squaxin Tribe
95	Ecology (2013)	re-analyzed Sechena *et al.* (2003) data
117	Sechena *et al.* 2003	Asian and Pacific Islanders
142.4	EPA subsistence fishing estimate	
175	Nicole (2013)	Used to support Oregon water quality standards
214	Suquamish Tribe (2000)	all fish, including marine
260	Ecology (2013)	Swinomish Tribal Community
383	Lummi Nation (2013)	fish & shellfish
389	CRITFC (2004)	CTUIR water quality 99th percentile
454	Harper and Walker (2015)	response as cutoff between contemporary and heritage rates
499	Ecology (2013)	shellfish only; Port Gamble S'Klallam
545	Harper *et al.* (2007)	Anecdotal based on estimate
540	Harris and Harper (1997)	average from survey
620	Harper *et al.* (2007)	CTUIR (2006)
620	Boldt decision	Boldt: United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974)
650	Walker and Pritchard (1999)	1950s and 60s rate interviews
725	Walker (1985)	estimate of average heritage rate
865	Spokane Tribe WQ standards	heritage rate
1,000	Walker (1985); comments from Billy Frank, Nisqually Tribe	pre-dam rates Columbia Plateau Tribes

In summary, based on the preponderance of available evidence, it is recommended to use a fish consumption rate of *at least* 175 g/day (and preferably higher given the data shown above of the amount of fish and shellfish that people in the State of Washington actually consume).[2] Further, 175 g/day is the

[2] NWIFC (2012) believes that 175 g/day is a low, unacceptable rate of seafood consumption rate, and describes contemporary consumption rates at several hundred grams per day, up to about 500 g/day, with legacy rates approaching approximately 1,000 g/day (NWIFC 2012).

value adopted by Oregon state for its water quality standards, combined with a 10^{-6} (one per million) cancer risk level for carcinogens (see discussion on cancer risk levels below).

Cancer risk level. Regarding the level of cancer risk levels that should be addressed, EPA's CWA Section 304(a) national recommended human health criteria generally assume that carcinogenicity is a "non-threshold phenomenon," signifying no "safe" or "no-effect" levels because even the smallest doses are assumed to potentially cause an increase in cancer incidence. Therefore, EPA calculates 304(a) human health criteria for carcinogenic effects as pollutant concentrations corresponding to lifetime increases in the risk of developing cancer. EPA calculates these human health criteria values at a 10^{-6} (one per million) cancer risk level and recommends cancer risk levels of 10^{-6} or 10^{-5} (one per one hundred thousand) for the general population. EPA also notes that states and authorized tribes can also choose a more stringent risk such as 10^{-7} (one per ten million).

Although several cancer risk levels have been considered for protection against carcinogenic risk (ranging as low as 10^{-4} [one per ten-thousand], for example, in industrial sites, based on the preponderance of evidence it is generally agreed in the scientific and regulatory community that 10^{-6} is *necessary* in order to address the overall risk associated with a wide range of ubiquitous, carcinogenic compounds, especially associated with the consumption of fish and shellfish. This is due in part to protect against the additive (or even potential synergistic) toxicity from multiple chemical carcinogenic mixtures of contaminants. When multiple chemicals induce the same effect by similar modes of action (e.g. multiple PAHs, each of which may be potentially carcinogenic), EPA guidance recommends that chemicals would contribute additively to overall cancer risk; this additivity needs to be incorporated into the established water quality HHC values. Further, EPA has established that certain categories of contaminants, in particular persistent organic pollutants that occur in complex mixtures (e.g. PCBs, dioxins/furans, or PAHs), share common modes of action and/or target organs or tissues, and are of elevated concern when they co-occur in fish and drinking water. It is also noted that anadromous fish (e.g. salmon or steelhead), may transit multiple inland, nearshore and marine waters throughout their migratory life cycle, potentially exposing them to numerous chemical contaminants. To protect humans from carcinogenic exposures, a risk level of 10^{-6} is necessary to calculate individual chemical criteria and to address likely additive or even potentially synergistic effects of carcinogenic compounds.

Compound-specific bioaccumulation factors. Compound-specific bioaccumulation factors (BAFs) are an important component of the risk assessment algorithms use to estimate dietary exposure to human fish and shellfish consumers. BAFs incorporate known bioaccumulation and partitioning dynamics to make these estimates for key bioaccumulative constituents (e.g. PCBs, PBDEs, dioxins, mercury, PAHs), and they are incorporated into water quality HHC developments to address the process of chemical bioaccumulation via the diet into aquatic organisms such as edible fish and shellfish.

Accordingly, EPA (2000) recommends the use of BAFs to reflect the uptake of contaminants from all sources, including passive accumulation as well as the diet, by fish and shellfish, as opposed to bioconcentration factors (BCFs), which have been used in earlier risk assessments. BCFs only reflect passive accumulation or diffusion from the water column, particulates, and/or from bottom sediment and do not specifically address the dietary route of exposure. The use of a BAF better represents the amount of a contaminants accumulated into an organism because it accounts not only for the organism's exposure within the water column, but also specifically addresses dietary exposure (EPA, 2000, 2014a).

Relative source contribution and other input parameters. When deriving water quality HHCs, a relative source contribution (RSC) factor is included to account for non-water sources of exposure to pollutants. The RSC accounts for exposure from water and fish when there are other possible exposure routes, including non-fish food consumption dermal exposure, and/or respiratory and/or other exposures. The use of an RSC value ensures that individual total exposure from all sources does not exceed a maximum acceptable daily intake (i.e. for non-carcinogens, a reference dose as recommended by EPA (2000)). All sources must be accounted for in establishing human health criteria in order to accurately calculate exposure and set safe standards for the allowable discharge of toxic chemicals to Washington's waters. EPA recommends that the RSC not be greater than 0.8 (80%) for consumption of fish and shellfish. For example, it is well documented that humans are exposed to a wide variety of toxicants (e.g. arsenic, PCBs, PAHs, etc.) via ingestion of other foods, drinking water, and also exposed via alternative routes such as inhalation and dermal exposure. In its proposed reversal, EPA did not provide an explanation for reversing its earlier science-based rationale to appropriately account for other routes of exposure.

In addition to the key input parameters discussed above, other important parameters include body weight, expected duration of human lifetime, water ingestion rates, and a variety of other factors. In deriving HHC values that are protective of designated beneficial uses, it is critical to use the most updated and defensible values, as use of underprotective input parameters lead to underprotective HHC. When less protective input parameters are used by Ecology and are now being approved by EPA, critical HHC values are weakened, rendered less protective, and ultimately the revised HHC value is no longer protective of beneficial uses as required by law. Scientific data is continually being updated, and it is essential that updated, accurate information be used to support HHC derivation.

4 Toxicity Considerations and Discussion on Specific Chemicals

Regarding the current EPA-proposed water quality HHC values in Washington State, there are lingering major concerns about specific chemical compounds, especially bioaccumulative, toxic, and persistent compounds, that have remained listed on various fish health advisories and are frequently found in contaminated sediments and CERCLA/MTCA cleanup sites around the state. These compounds frequently appear in 303(d) water quality impairment listings for specific watersheds around the state. These compounds frequently occur in elevated concentrations in areas, some of which are highly urbanized, that are frequently fished such as tribal Usual and Accustomed fishing areas around the state. Examples of these areas are the Lower Duwamish River in Seattle, the lower Puyallup and Hylebos waterways in Tacoma, the Port Gardner and Lower Snohomish River in Everett, and several others. The most prominent compounds affecting these waterways and fishing areas are PCBs, PBDEs, dioxins/furans, PAHs, and several key toxic metals.

PCBs. Despite a US ban on PCBs since 1979, this highly toxic, persistent, and bioaccumulative chemical continues to be discharged into receiving waters around the state, adding to the burden of PCBs in water, sediment, and biological tissues throughout the Puget Sound region and beyond. In fact, levels of PCBs are not declining in many areas of the Puget Sound, and PCBs in fish and shellfish is an area of continuing concern statewide. The key environmental properties of PCBs, including fate, transport, bioaccumulation and toxic effects, have been well characterized over many years. PCBs are unique from other pollutants in that they exhibit a wide range of both short- and long-term adverse environmental effects (toxicity) to aquatic biota, terrestrial wildlife, and humans (ATSDR 2000, WHO 2000).

PCBs are highly persistent, resistant to weathering and biodegradation (environmental half-lives in sediment and tissue often requiring decades), and highly prone to bioaccumulation in biological tissue. In addition, PCBs are well known to undergo biomagnification throughout a food web, which occurs when PCB residues "magnify" or increase with each successive trophic (i.e. feeding or nutritional) level within a food web, and that a top predator (e.g. bald eagle, seal, orca, or human consumer) would harbor and accumulate PCB tissue concentrations at concentrations much higher than those found in lower trophic levels. Biomagnification is a significant and highly adverse environmental process because it substantially contributes to human health and ecological risks presented by concentrating tissue residues at the highest levels of a food web via trophic transfer.

Partitioning (separating between different phases such as water, sediment, and biological tissue) of PCBs is of paramount importance to the environmental fate and effects of PCBs because partitioning determines which environmental media retain the PCB residues and the exposure pathways for bioavailability and toxicity to various organisms, including humans. Because of their hydrophobic nature, PCBs adsorb to organically enriched (i.e. carbon-containing) substrates such as suspended particulates or bottom sediments, or accumulate within biological tissue of marine biota, terrestrial wildlife, and into human tissue.

PCBs strongly sorb to organically enriched substrates such as organically enriched sediments and biological tissue such as fish, shellfish, and human tissue, especially lipid-rich tissues. PCBs are soluble only in the range of about 30 to 170 µg/L (ppb) concentrations, depending on the degree of chlorination (ATSDR 2000). This range is regarded as low solubility to further underscore the hydrophobic nature of PCBs, which are strongly prone to partition between aqueous phase and solid and organically enriched substrates, even though a relatively low fraction would remain either dissolved or suspended in the water column, or present in the pore water residing between sediment particles.

PCBs are still allowed in products under the 1976 Toxic Substances Control Act (TSCA), which are much higher than those allowed in water under CWA. PCBs are difficult to detect in surface waters, so methods detecting PCBs in fish and shellfish tissues are frequently used to measure PCBs. This tissue data is used to support development of WDOH fish advisories (WDOH 2014) and lists of CWA Section 303(d) impaired water bodies (EPA 2014c).

Because PCBs have been discharged from many sources within the Puget Sound over the course of many years in large quantities, elevated biological tissue concentrations in fish, shellfish, wildlife, and even human consumers of fish and shellfish are prevalent, and adverse environmental effects (toxicity) are known to occur in organisms where such elevated concentrations of PCBs occur. In contrast, due to chemical composition, many other organic contaminants such as volatile organic compounds

(VOCs), polyaromatic hydrocarbons (PAHs), and other contaminants are not nearly as prone to bioaccumulation or biomagnification. This characteristic makes PCBs especially problematic in the aquatic environment, as these compounds can persist for decades and cause a wide range of toxicity associated with prolonged exposure to PCB residues.

Effects of PCBs. In addition to exhibiting properties that are bioaccumulative, prone to biomagnification, and highly environmentally persistent, PCBs are both acutely and chronically toxic to aquatic life, terrestrial wildlife, and humans. Acute and chronic health effects associated with exposure to PCBs include acne-like skin conditions in adults (chloracne), and longer-term neurobehavioral and immunological changes in children. PCBs have been shown to cause cancer in animals (EPA 2014, ATSDR 2000). Studies of exposed workers at low levels have shown changes in blood and urine that may indicate liver damage. Other abundant toxicological research (e.g. summarized in Eisler and Belisle (1996), ATSDR 2000) suggest that in addition to lethality that has been well documented in aquatic organisms, that growth, reproductive function, and other sublethal effects occur as a result of short- and long-term exposure to PCBs in the aquatic environment. In mammals, neurotoxicity, immunotoxicity, endocrine disruption, and developmental (i.e. birth defects initiated in utero) toxicity have been documented, and these effects of PCBs are important to understanding short- and long-term effects in the environment. PCBs are also suspected carcinogens to humans based on mostly animal-based toxicological evidence and have been classified by EPA as “probable human carcinogens”.

Water quality HHC for PCBs. Key environmental regulatory criteria and standards have been developed for PCBs (e.g. EPA 1999) that reflect the acute and chronic toxicity, persistence, and bioaccumulation potential discussed above. Ambient marine water quality criteria (AWQC) for PCBs of 10 µg/L and 0.03 µg/L have been developed and adopted by Ecology (WAC 173-201A-240) for acute and chronic exposure, respectively, for protection of marine aquatic life based on direct acute and chronic toxicity (i.e. as opposed to indirect effects related to bioaccumulation).

Because of the bioaccumulative, highly toxic, potentially carcinogenic nature of PCBs, a water quality HHC value for PCBs has been promulgated by EPA Region 10 (EPA 2016a, 2016b), developed as a human health criterion based on human fish and shellfish consumption, and addressing PCBs as probable human carcinogens. This HHC promulgated by EPA in 2016, 0.000007 µg/L (0.007 ng/L), applies to consumption of both organisms only as well as organisms and consuming the water itself. It is stronger by more than an order of magnitude (and more protective) than the earlier NTR-based HHC value of 0.00017 µg/L (for both water + organisms and organisms only.) It was strengthened in part based on a reassessed PCB cancer potency factor, which was revised to distinguish toxicity among mixtures of specific congeners and different exposure pathways. This water quality HHC is reflective of the strong tendency for PCB residues to partition from seawater into edible fish and shellfish tissues and potentially cause cancer to a human consumer during a lifetime, and was revised to protect highly exposed populations (e.g. Native American consumers, Pacific islanders, subsistence fishers, immigrant populations, etc.) who consume large quantities of fish/shellfish. This value is important and necessary as a water quality HHC for protecting human health from consumption of PCB residues in fish and shellfish.

If EPA decides to withdraw this value and leave the underprotective NTR HHC value in place, it would represent a departure from established EPA protocols for establishing such values. Ecology (2016) proposed to use state-specific risk levels not concordant with the most appropriate algorithm used to calculate HHC values. EPA current proposal to adopt Ecology's outdated approach is both arbitrary and underprotective of human consumers, and therefore does not protect designated beneficial uses as required under the CWA.

Toxic metals. Regarding toxicity of key representative metals commonly found at elevated concentrations in the waters of Puget Sound and elsewhere throughout the state, there is extensive data and information available concerning acute and chronic toxicity, including sublethal and long-term effects, as well as environmental fate characteristics, for many metals, some of which are toxic but do not normally bioaccumulate into fish and shellfish tissues to be eaten by people. Thus, this discussion is confined to bioaccumulative metals for which human consumption is a significant issue. Two such metals are arsenic and methylmercury, the toxic form of mercury.

Arsenic. The current (May 2019) Ecology CLARC table value shows that the arsenic water quality HHC using a cancer endpoint is currently 0.098 µg/L. EPA proposed an alternative criteria in 2016 at a much lower concentration at 0.0045 µg/L (based on standard exposure factors such as 10^{-6} risk level, 175 g/day FCR, body weight = 80 kg, standard cancer potency factor of 1.75 per mg/kg-day, drinking water intake = 2.4 L/day, BCF total As = 44 L/kg). However, this proposed criterion was not approved, and 0.098 µg/L is still in place as the most applicable HHC value for arsenic. This HHC value is only slightly more protective than the 1992 NTR freshwater HHC of 0.14 µg/L (0.018 ug/L for marine water) for inorganic arsenic, and should be updated based on more current and defensible scientific principles, as noted above.

Methylmercury. Mercury is a highly toxic, bioaccumulative metal that is common in aquatic and marine environments both from natural and human processes. Once in the water under the appropriate geochemical conditions, mercury can convert to its most toxic form, methylmercury, which is highly prone to accumulate in fish and shellfish tissue, and can be severely toxic, especially neurotoxic. Human consumers may be exposed to methylmercury and its associated health problems through consumption of contaminated fish, and shellfish, and therefore by 2008 all 50 states issued fish consumption advisories due to mercury contamination (EPA 2010). Washington currently has Clean Water Act Section 303(d) listings based on the current mercury HHC, and the Washington Department of Health has issued statewide fish advisories for mercury for different fish species.

Ecology decided to defer state adoption of HHC for methylmercury (Ecology 2016), and plans to schedule adoption of methylmercury criteria and develop a comprehensive implementation plan after the rulemaking process is completed and has received approval from EPA. Thus, the HHC values for total mercury (0.14 µg/L for organisms + water, 0.15 µg/L for organisms only using a non-carcinogenic endpoint) will remain in the NTR until such time as the new methylmercury criteria are adopted by the state. Prior to 2001, EPA recommended that states adopt mercury HHC values based on total mercury measured in surface waters, but in 2001 EPA published a recommended CWA Section 304(a) HHC for water quality for methylmercury based on fish tissue residues. This new criterion, 0.3 mg/kg wet weight (ww) fish tissue, replaced the older total mercury-based criteria, but was calculated using an older fish consumption rate of 17.5 g fish/day.

In September 2015 EPA proposed a regulatory change that would revise the current federal human health criteria applicable to Washington's waters (NTR; 40 CFR 131.36). EPA's most recent proposal for Washington contains an "organisms-only" water quality HHC for methylmercury of 0.033 mg/kg ww in tissue, which would be much more protective for methylmercury in tissue. If and when EPA approves criteria submitted by the Washington state, the corresponding NTR federal HHC values for inorganic mercury are expected to remain in effect, which are 0.14 µg/L (organisms + water), and 0.15 µg/L, (organisms only); both were calculated using non-carcinogenic endpoints; Ecology 2016).

PAHs. As discussed above, numerous individual PAH homologs, many of which are believed to be carcinogenic (cPAHs), are on EPA's current proposed list of chemicals where EPA will withdraw the criteria it promulgated in 2016 in favor of the less-protective proposal made by Washington state. EPA's proposed action here will produce criteria that that are far less protective than those EPA promulgated in 2016 and will produce criteria that will not protective designated uses of consuming fish and shellfish. This list of PAHs include less toxic and less bioaccumulative homologs (i.e. isomers), but seven (7) more toxic, potentially carcinogenic cPAHs will be strongly affected by this proposed withdrawal, and acceptance of these values will produce human health criteria that are far less protective. In each of the cases of these individual homologs, which tend to occur together as a result of combustion or other processes, the level of protection would be lessened by *about two orders of magnitude or more per homolog.* This is significant because when a person ingests one or more of these homologs, which they often occur together, they will be receiving an additive, cumulative dose for each one of these compounds, each of which operates through a similar mode of action and therefore is toxicologically analogous (EPA 2014b).

As an example of multiple pathway exposure to PAHs, PAH exposure are ubiquitous (Ecology (2012), EPA (2014b)), they are present in food and in air, water, soil, and dust, as a result of numerous combustion and related by-products. Exposures vary from person to person by diet, the use of wood stoves, occupation, and personal habits. Food generally accounts for 80 to 95% of PAH exposure, and for people who consume shellfish, PAH exposure from seafood may constitute 25% or more of dietary exposure (Ecology 2012). They are not as bioaccumulative as PCBs, and they do not biomagnify throughout the food web as do PCBs, dioxins, mercury, and other such compounds, but the higher molecular weight PAHs are persistent, potentially carcinogenic and ecotoxic, and can cause a wide variety of problems in aquatic systems (EPA 2014b). The discussion below provides an overview of the link between PAH concentrations in sediments and concentrations and ecotoxic effects in bottom fish of Puget Sound, using English sole as an indicator species.

TCDD (dioxins). The cancer potency factor (CPF) for dioxin (2,3,7,8-TCDD, or TCDD) is undergoing extensive review, and EPA has stated that no new HHC values for TCDD can be promulgated until these issues have been resolved (Ecology 2016). Thus the current approach to develop HHC values for TCDD is based on non-carcinogenic endpoints (decreased sperm count and motility in exposed men) of 7×10^{-10} mg/kg-day. Given the extensive amount of available evidence that TCDD is carcinogenic, use of these non-carcinogenic endpoints in promulgating HHC is underprotective. The current HHC value (listed at 40 CFR

131.45) is 1.3 x 10^{-7} and 1.4 x 10^{-7} µg/L, for water + organisms and organisms only, respectively. The conditionally approved criteria on 10 May 2019 proposes to incrementally reduce protectiveness of both these HHC values to 6.4 x 10^{-7} µg/L for both water + organisms and organisms only. These changes represent use of older, less defensible and science-based input parameters for highly toxic TCDD mixtures, in addition to using non-carcinogenic endpoints, and it is therefore recommended that the current values remain valid, and that the proposed withdrawal and reversal not take place. Moving forward, it is recommended that HHC should be recalculated based on updated cancer risk factors.

5 Overview of current conditions of toxics in Puget Sound fish species

Numerous monitoring investigations and studies document the uptake of toxic chemicals among salmon at various life stages within the jurisdictional freshwater and marine/estuarine waters of Washington state. Numerous other investigations related to distribution of toxics in Puget Sound, many of them quite extensive and multi-year, have been and continue to be conducted by a wide variety of agencies and investigative entities, including NOAA (National Marine Fisheries Service, Northwest Fisheries Science Center), Washington state agencies (especially Ecology, Department of Health, Department of Fish and Wildlife), and the Puget Sound Ambient/Ecosystem Monitoring Program (PSAMP/PSEMP), University of Washington, King County, and others. Numerous Canadian groups such as Environment Canada, the University of British Columbia, and others have consistently documented elevated chemical contamination in a wide range of fish, shellfish and marine mammal species in Salish Sea and Puget Sound waters, to include waters of the Puget Sound and Columbia River basin.

PSEMP (2016) and WDFW (2017, 2019) provide abundant data on key contaminant levels in several fish species occupying different ecological roles, including Pacific herring, an important forage fish for salmon, as well as adult and juvenile Chinook salmon and bottom-dwelling fish, using English sole as an indicator species. Following is a brief overview and discussion of this research.

Forage fish (Pacific herring). For Pacific herring, recent and current data for both PCBs and PBDEs show that the levels in herring stocks are not currently meeting 2020 target values, although PBDE levels are declining more rapidly than PCBs, which are not declining. "Critical action levels" for both compounds (2,400 ng/g lipid for PCBs, and 470 ng/g/lipid for PBDEs are not currently being met (West *et al.* 2017, WDFW Biological Observation System 2019).

Juvenile Chinook salmon. Juvenile salmon are critically important to both the health of the Puget Sound and to humans, including subsistence and high consumption indigenous people fishers. They are listed as Endangered under the Endangered Species Act (ESA), and it is important to protect this species in each of its life history stages. Juveniles represent the feeding life stage for migratory salmon and it is therefore imperative to protective the health of these fish (Meador *et al.* (2002), Meador *et al.* (2010)). Recent and current data for PCBs and PDBDEs for juvenile Chinook salmon, using whole body chemical analysis, show that PCBs are currently above the "critical action level" of 2,400 ng/g, and that in Puget Sound they exceed these levels in the Duwamish Waterway, Hylebos/Puyallup waterways in Tacoma, the Snohomish estuary in Everett, in Lake Washington and the Nisqually delta. Overall, PCBs exceeded "critical tissue levels" in four of the 11 river-estuary systems measured as of 2019. Widespread contaminant-related risks to salmon may include reduced growth, increased susceptibility to disease, hormonal effects, and overall reduced survival (Meador *et al.* (2002), Meador *et al.* (2010), WDFW BOS 2019).

Adult Chinook salmon. Adult salmon muscle tissue concentrations of PCBs and PBDEs are a direct indicator of human consumption of these bioaccumulative, toxic contaminants. They are also a direct indicator of exposure to top predator southern resident killer whales (orcas). O'Neill and West (2009) have documented higher levels of persistent organic pollutants in Puget Sound resident Chinook, indicating higher exposure in the inland waters of Puget Sound as compared to those Chinook salmon that migrate to the North Pacific Ocean. Median and mean PCB levels in resident (i.e. non-migratory "blackmouth") Chinook salmon have exceeded and currently exceed Washington Department of Health (DOH) screening levels in edible fillet samples of 40 ng/g in all marine monitoring areas, especially in the central and southern Puget Sound. Fish advisories from DOH were issued to restrict consumption of Puget resident and ocean migrant Chinook based on previous sampling, most recently in 2004 (WDFW 2017, WDFW 2019).

Bottom-dwelling fish (English sole). Numerous studies in the Puget Sound have linked hepatic lesions, liver disease, and other ecological effects in bottom-dwelling fish (using English sole as the indicator species) to PAH exposures in particular (e.g. Landahl *et al.* (1990). More current data (e.g. WDFW 2019) indicate that PAH-related liver disease in English sole has declined during recent years, although PAHs are still elevated in these fish, and they are still subject to these adverse exposures and effects. Levels are still 3 to 5 times higher in contaminated parts of the Puget Sound, for example at the Seattle waterfront, Duwamish River and Tacoma City waterway monitoring stations.

Levels of PCBs in English sole, however, as with other species, are not declining. PCB concentrations failed to meet the DOH screening level of 8 ng/g for subsistence fishers and high level consumers, and 8 out of 10 monitoring sites are still elevated above these levels. Monitoring data have shown that PCBs have not improved over the past 16 years for these locations (WDFW 2017, WDFW 2019).

6 Summary and Conclusions

I have reviewed the EPA proposal to withdraw water quality HHC in Washington State (Fed. Reg. 2019), related to 97 specific EPA Priority Pollutants under WAC 173-201A-240. Based on this review, I offer the following conclusions:

1) The water quality HHC values that EPA is proposing to withdraw (promulgated at 40 CFR 131.45) are uniformly more scientifically defensible than those originally proposed by Ecology in 2016. The HHC values proposed for reversal and withdrawal are uniformly more protective of human consumers, especially subsistence fishers and high consuming persons (e.g. Native American or other ethnic groups), and are in accordance with the most current scientific understanding with regard to HHC and water quality standards development. Thus, the proposed reversal should be rescinded and leave in place Washington's current, more protective HHC values.
2) Perhaps the most problematic water quality HHC revisions relate to the potentially carcinogenic compounds, especially cPAHs and PCBs. Both types of contaminants represent a wide range of chemical homologs (PAHs) or congeners (PCBs), and both types of compounds tend to occur as complex mixtures in the environment. Because they operate through a similar mode of metabolic action, these compounds are additive and it is therefore important to promulgate protective water quality HHC for these and other such compounds.

3) Other compounds that may be toxic but not carcinogenic are also subject to revision based on non-protective exposure and toxicity-related assumptions, and it is recommended that these revisions not be promulgated as enforceable HHC values.
4) The fish consumption rates (FCR) used to derive the less protective values are too low and not representative of either current or traditional FCR values, especially for Native American or other subsistence, high-consumption fishers.
5) The most defensible and necessary cancer risk level to protect against exposure to numerous chemical carcinogens is 10^{-6}, or one-per-million cancer risk. This is important partly to protect against additive risk from multiple carcinogens with similar modes of action, such as cPAH compounds.
6) Concerning key exposure-related input parameters, it is important to assure that all input parameters are current, updated, and defensible. Use of indefensible or outdated such parameters can lead to underprotective HHC values, which do not safeguard to protect designated beneficial uses under the CWA.
7) I have reviewed and summarized data for several prominent, bioaccumulative and toxic compounds such as PCBs, PBDEs, PAHs, and several toxic metals, and it is clear that concentrations of these chemical contaminants in several indicator species, including forage fish (Pacific herring), bottom-dwelling fish (English sole), and ESA-listed juvenile and adult Chinook salmon, that concentrations continue to consistently exceed the most updated toxicity-based screening levels for these fish. Therefore, it is important that the most updated, scientifically defensible water quality HHC be promulgated, as many of these contamination problems are stable or worsening rather than measurably improving.
8) Among the contaminants discussed in this report, perhaps the most problematic is the continuing problem of PCBs. Although they have been banned in the US since the 1970s, PCBs are widely prevalent throughout the Puget Sound and beyond in water, sediment, and all species of the indicator fish noted above (herring, English sole, juvenile and adult Chinook salmon). In addition, they are widely prevalent in the tissues of southern resident killer whales (orcas), which are also ESA-listed as critically endangered.

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Principal Environmental Scientist

Date: 10/6/2019

Curriculum Vitae

Allan B. Chartrand, DABT | Principal Environmental Scientist

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Expertise

- Recognized expertise in contaminated sediment and water quality ecotoxicology
- Extensive expert witness experience in NRDA, Clean Water Act/NPDES, contaminated sediments/SMS, ecotoxicology
- Ecological and human health risk assessment preparation and background
- Extensive background in pesticide and herbicide toxicology, integrated pest management, and risk assessment
- NEPA/SEPA compliance and EIS/EA preparation
- ESA Section 7 expertise and BA/BE preparation
- Quantitative exposure assessment, fate/transport, and data analysis background
- Over 100 CERCLA/MTCA RI/FS and contaminated site projects, including NRDA projects
- Former water and sediment quality regulatory scientist for State of California
- Environmental regulatory compliance and permitting, specializing in water quality issues
- Laboratory background in toxicology and chemistry
- Site remediation and ecological restoration

Education and Certifications

BS, Biology, University of California Berkeley, CA.

Summary of Experience

Mr. Chartrand has 35 years of experience as a practicing environmental scientist, toxicologist and project manager, with technical expertise in ecotoxicology and risk assessment, regulatory compliance, pesticide toxicology and risk assessment, biological sciences, remediation and restoration of disturbed or contaminated sites, risk-based action and screening level development, water quality and environmental permitting, and remedial design support. His background also includes environmental biology and chemistry, data analysis and QA/QC, bioavailability, bioaccumulation, and fate/transport of contaminants.

Projects performed under CWA, CERCLA/MTCA, contaminated sediment projects under DMMP and related programs. Former regulatory scientist for Los Angeles Regional Water Quality Control Board. Expertise in NRDA planning, injury assessment, ESA compliance, BA/BE's, and Section 7 consultations, NEPA/SEPA, CWA/NPDES, and related expert witness support. Board-certified as Diplomate by American Board of Toxicology (DABT). Experience in EIS and EA preparation, and natural resource management. Extensive field experience in data collection, chemical and toxicological laboratory testing, and field crew supervision. Extensive experience in litigation support, including expert witness testimony, deposition, and preparation of technical declarations and briefs. Life science research and laboratory background in toxicology and

MSPH, Toxicology, University of California Los Angeles, CA. PhD work (incomplete) in Toxicology, Hebrew University, Jerusalem, Israel Diplomate, American Board of Toxicology (currently expired) Awarded the International Rotary Foundation Fellowship for Research HAZWOPER - 40-Hour OSHA 29 CFR 1910.120 Background in scientific diving and field data collection	biochemistry, with extensive international background. Extensive experience in coordination and outreach with clients, regulatory agencies, trustees, stakeholders, subcontractors, and the public.

EXAMPLE PROJECTS

Lead Environmental Scientist and Toxicologist for Co-Designing Environmental Monitoring Program to Support Central Valley Regional Water Quality Control Board (RWQCB) Agricultural Order 4.0, Central Coast, CA. Mr. Chartrand is serving as lead environmental scientist as part of an expert team of environmental specialists to co-design a comprehensive environmental water quality monitoring program in compliance with RWQCB Agricultural Order 4.0 requirements for Central Coast agricultural interests in Central California. Our team developed a science-based program for addressing overuse of nutrients (e.g. nitrates, nitrites, ammonia), insecticides (especially neonicotinoids and rotenoids), and herbicides for a wide variety of crops (strawberries, wine grapes, broccoli, lettuce, etc.). Years of overusing and overapplying these nutrients and pesticides have led to widespread water quality impairments (303(d)) listings in numerous Central Coast watersheds for both surface water and groundwater, and this Agricultural Order 4.0 monitoring program is intended to help restore these watersheds and enable them to meet their designated beneficial uses as specified by the Clean Water Act.

Site-Specific Terrestrial Ecological Evaluation (TEE) for Pacific Park Site, subcontractor to Herrera Inc., King County, WA. Mr. Chartrand is working with Herrera Environmental to produce a site-specific Terrestrial Ecological Evaluation (TEE) to ensure that the Remedial Investigation (RI) and Feasibility Study (FS) prepared under Washington's Model Toxics Control Act (MTCA) requirements provide adequate protection for potentially exposed terrestrial ecological receptors, including threatened or endangered species present at the site. These receptors include soil insects and arthropods, soil-feeding birds, burrowing rodents or herpetofauna, and any wetland animal or plant species included in Washington Department of Fish and Wildlife's (Priority Habitat and Species) PHS database. Contaminants of ecological concern include petroleum derivatives (e.g. PAH, TPH) toxic metals, volatile organics, pesticides, herbicides, and a variety of other contaminants associated with this former landfill site adjoining the White River. Part of this TEE process is to develop ecologically protective numerical benchmarks for each of these potentially exposed receptors to ensure that the proposed site remedies are adequately protective.

Lead Toxicologist and co-project manager for Hanford Natural Resource Trustee Council Toxicity-Based Injury Thresholds, US Department of Energy, Richland, WA. The US Department of Energy (USDOE) Richland office is working with the Hanford Natural Resource Trustee Council (HNRTC) to develop toxicity-based ecological injury thresholds for potential use in the Hanford Natural Resource Damage Assessment (NRDA). Mr. Chartrand is supporting USDOE to provide technical and scientific consistency across methodology and documentation of threshold development. The HNRTC requires toxicity-based thresholds for surface water, river sediments, and soil for use in the Hanford NRDA. These thresholds will be used to assess natural resource service losses associated with Hanford contamination. Key contaminants include metals, radiological constituents, and organic compounds.

Expert Witness and Litigation Support for Revising Health-Protective Water Quality Standards in Compliance with the federal Clean Water Act, City of Miami, FL, Earthjustice, Seattle, WA, and other clients. Mr. Chartrand is currently serving as an expert toxicologist in responding to revised Water Quality Standards issued by the Federal EPA in Seattle, and has been working with the Florida Department of Environmental Protection (FDEP) toward the same purpose. These purpose of these projects is to ensure that water quality standards, especially for bioaccumulative contaminants of concern, are adequately protective of sensitive subpopulations, especially native subsistence fishers that consume fish and shellfish at a much higher rate than non-subsistence fisher populations. These projects address both human health and ecotoxicologic concerns, incorporating a wide variety of exposure parameters (e.g. bioaccumulation, toxicology, fish consumption rate, body weight, types of fish/shellfish consumed, and numerous other considerations). Mr. Chartrand performed detailed data reviews of available environmental data for developing, revising, and supporting these water quality standards, and he is currently preparing expert reports to provide support for revised water quality standards as needed.

Expert Witness Testimony and Litigation Support for PCBs and Clean Water Act Issues Related to Urban Waterway Discharges, Puget Sound, Seattle, WA. Mr. Chartrand served as an expert witness in a confidential case concerning a mixing zone for PCBs into a contaminated urban waterway. The case involves a detailed review of environmental data for PCBs and other contaminants from a wide variety of sources, including wastewater effluent, stormwater, soils and sediment on the facility, receiving water, and bottom sediment, with a focus on bioaccumulation into biological tissue of receptor organisms, including humans. There was a strong focus on PCB toxicity, bioavailability, and bioaccumulation in the Waterway. The project required comprehensive understanding of the Clean Water Act, Sediment Management Standards, NPDES permitting requirements, environmental chemistry/biology, and integrating these information sources into an analysis concerning the appropriateness and applicability of allowing a mixing zone for PCBs into a previously compromised and impaired water body.

Co-project manager for IDIQ Subcontract with USACE, Walla Walla District, for Diverse ESA, NEPA, and other Environmental Issues in the Lower Snake River Basin, Eastern Washington State, USACE, Walla Walla, WA. Mr. Chartrand recently served as co-project manager for a large IDIQ subcontract encompassing a wide variety of environmental issues, many of them related to USACE Walla Walla District hydropower dams located on the Lower Snake River. Issues include protection of ESA-protected salmonid species, NEPA issues, maintenance dredging and preparing Dredge Material Management Plans (DMMPs), environmental data assessment of facilities adjoining the river throughout the watershed, and working with the Corps in addressing control and management of invasive aquatic plants along the Lower Snake River.

Principal Toxicologist for SEPA Supplemental EIS, Aquatic Herbicides and Noxious Plant Control Agents, WA Dept. of Ecology, Lacey, WA. Currently serving as principal scientist and lead toxicologist in preparing a Supplemental EIS for the Washington Department of Ecology's Water Quality Program. Mr. Chartrand has conducted a SEPA review and programmatic toxicological hazard evaluation of 22 candidate herbicide, algaecide, and chemical treatment methods for control of aquatic plants and noxious weeds throughout Washington State. This SEIS document is being used to support water quality permitting and pesticide registration requirements for use of these compounds and other methods for controlling aquatic plants thro

Expert Witness Testimony and Litigation Support for Arsenic and Other Contaminants Discharging to South Platte River, Denver, CO. Mr. Chartrand served as an expert witness in a confidential Clean Water Act case concerning discharges of arsenic and other metals from a landfill adjoining the South Platte River. Performed detailed data review of environmental data for arsenic and other contaminants to assess toxicity and geochemical characteristics of contaminants discharged to the river. Integrated diverse data sources into an expert report and declaration concerning the potential exposure and toxicological effects to fish, wildlife, and human fish consumers.

Ecological Risk Assessment for Pesticides to support Programmatic EIS (U.S. Department of Agriculture, Denver Wildlife Research Center), CO. Project manager and principal investigator for this ecological risk assessment of 50 chemical pesticides used to control vertebrate pests in fulfillment of NEPA and EIS requirements. This project was conducted as part of a programmatic EIS and focused on potential effects to threatened and endangered aquatic and terrestrial species. The project involved extensive toxicological literature review, derivation of dose-response benchmark values, and quantitative fate and transport modeling for terrestrial, airborne, and aquatic pathways. The approach used for this project was later adopted as a model approach for conducting ecological risk assessment of pesticides by both the USDA and EPA.

Contaminated Sediment Characterization and Remedial Alternative Recommendations for Highly Contaminated Puget Sound Site, Confidential Industrial Client, Port Gardner, Everett, WA. Served as technical lead and principal toxicologist for conducting literature review for available sediment data, designing a supplemental field data collection program for surface and subsurface contaminated sediments data collection, leading the field data collection effort, interpreting the data, and making recommendations concerning the most effective way to dredge, remediate, and remove contaminants from the shallow subtidal sediments in Port Gardner. The project involved toxicological literature review, acute and chronic toxicity testing, and bioaccumulation testing for organics such as dioxins and PCBs in Puget Sound sediments. The reports and other deliverables generated were used to support decision making by Ecology and other agencies for how to remove or eliminate contamination from these sediments.

Expert Opinion and Literature Review for PCB TMDL for Spokane River, WA. Served as technical expert in support of potential third party lawsuit concerning EPA's decision to not develop a TMDL for PCBs in the Spokane River watershed. Performed review of environmental data collected by various investigators, policy documents and white papers developed by the Washington State Department of Ecology and other agencies or stakeholders, and preparing an expert opinion in support of possible legal action relating to this case.

Expert Review of Water Quality Standards in Florida in Support of Rule Revisions, EarthJustice, Tallahassee, FL. Mr. Chartrand provided expert input to a confidential client on revising water quality standards in Florida, including providing updated expertise on a wide variety of organic, metal, and conventional pollutants requiring regulation under State law.

Water Quality and Sediment Quality Standards Development, Keweenah Tribe of Indians, Saginaw, MI. Mr. Chartrand served as regulatory expert in preparing water quality and sediment quality standards for the Keweenah Indian Tribe. This involves comparing proposed standards with other comparable environmental standards developed by the Great Lakes Initiative, USEPA, Great Lakes state regulations, and other Great Lakes tribal regulations to ensure that these standards will be environmentally protective for both water and sediment quality.

NRDA Injury Assessment, Expert Testimony, RI/FS Field Sampling and Support for Montrose Chemical Offshore DDT Contamination Project in Sediment, Palos Verdes Shelf, Los Angeles, CA. Provided technical input to the Palos Verdes Shelf offshore sediments Montrose Chemical DDT project over the course of more than 20 years (intermittently) in various capacities. In 2009-10, Mr. Chartrand served as sediment investigation technical lead and toxicologist for co-designing a Field Sampling Plan for characterizing DDT in surface and subsurface sediments (post-ROD) adjoining the Los Angeles County outfalls and along established monitoring transect isobaths.

- Negotiated with USEPA and USGS to obtain approval for field sampling plan for DDT and PCBs; data used to support pre-remedial design following evaluation of alternatives; technical approach was innovative, cost-effective, and incorporated historical data base developed as part of sediment investigations.

- During an earlier phase of the project, including NRDA injury assessment, Mr. Chartrand led an interdisciplinary team of scientists to design and perform a comprehensive, multi-year investigation of fate and effects of DDT-contaminated sediment and fish/shellfish in Santa Monica Bay.
- Provided expert testimony on behalf of USDOJ and NOAA as part of NOAA's NRDA case against Montrose Chemical for ecological damages to the Southern California Bight associated with DDT and PCB discharges to the marine environment.
- Served as sampling crew leader and principal investigator for multi-year investigation of both sediment and biological sampling in both shallow and deeper basins in Santa Monica Bay (up to 1,000 m in depth) sampling locations. Constituents of concern were DDT and PCBs.

Lower Duwamish River Superfund Site Injury Assessment in Support of NRDA and CERCLA, Seattle, WA. Extensively involved in the investigation and NRDA injury assessment of the Lower Duwamish waterway in Seattle, WA., to develop an injury assessment work plan to investigating injury and potential claims along the waterway associated with extensive sediment contamination of PCBs, PAHs, and numerous other contaminants in waterway sediments and biological tissue. This investigation involved conducting chemical, toxicological, and biological sediment evaluations, characterized fate and effects of sediment-associated contaminants in the waterway, and participating in risk-based cleanup evaluation for sediments. He closely coordinated with other trustee and oversight agencies, especially NOAA, in evaluating resource injury and laying the groundwork for subsequent mitigation and restoration planning. He was also involved in several phases of the ecological risk assessment of contaminated sediments on behalf of King County Department of Natural Resources in the waterway in the vicinity of the Duwamish Diagonal and Norfolk Way CSOs, which was incorporated into the larger context of the subsequent RI/FS and NRDA injury assessment.

Sediment Characterization and Suitability Determination for Dredge Material Placement in Lower Columbia River, Warrenton, OR. Served as the principal investigator in designing, performing comprehensive sediment data collection, analyzing and interpreting the data in light of toxicity and bioaccumulation potential, and providing recommendations regarding placement suitability within the Lower Columbia River.

- Wood debris identified as part of the first phase of sediment characterization, which required a subsequent evaluation of the toxicity of wood debris in sediment using current testing techniques.
- Prepared a draft DMMP for placement options near the mouth and on both the Washington and Oregon sides of the Columbia River. Required numerous interagency meetings and negotiation with multiple stakeholders at local, regional, state and federal levels.

Machado Lake Dredging and Rehabilitation Project, City of Los Angeles, CA. Served as the technical lead for a large multidisciplinary team on a hydraulic dredging project, focusing on surface and subsurface characterization of contaminated freshwater sediment and evaluation of placement options as part of CWA Section 404, Section 10, and TMDL State requirements. Conducted successful negotiations with oversight agencies led to a streamlined, cost-effective sampling and analysis plan for sediment core sampling. Developed nearshore fill as preferred placement option to save the client up to $8M; assisted in selecting appropriate polymer and geotube design for optimizing return water quality after dewatering.

Characterization and Remedial Design of Agent Orange in Soil and Sediment, Da Nang Airport, Vietnam, USAID. Lead scientist in preparing a field sampling plan and evaluating the distribution, fate and potential toxicity of 2,3,7,8-TCDD [dioxin] residues (active ingredient of the phenoxy herbicide defoliant Agent Orange) remaining from the Vietnam War.

- Field sampling plan designed to optimize selection of the most effective of three remedial action alternatives candidate remedies.
- Interpreted existing dioxin database developed through previous investigations to enhance understanding of nature and extent of contamination before collecting new field data.
- Co-designed a streamlined, cost-effective investigation of Agent Orange dioxin and served as field team co-leader in collecting soil, sediment, surface water, and groundwater samples for dioxin and other analyses in Da Nang.

Commencement Bay Nearshore/TideflatsWaterways Superfund Site Injury Assessment in Support of CERCLA, MTCA, NRDA—Tacoma, WA. Represented several private sector PRP clients in providing technical input on injury assessment investigations and planning to investigate resource injury along various waterways within the Commencement Bay Superfund site. Extensive investigation of numerous contaminant mixtures, including PCBs and pesticides, in waterway sediments and biological tissue, including chemical, toxicological, and biological sediment evaluations. Served on a number of work groups tasked with evaluating data in support of injury assessment and risk-based cleanup evaluation for sediments. He closely coordinated with trustee and oversight agency groups in determining the most effective strategies for evaluating resource injury, remediation, and mitigation and restoration planning.

NPDES 301(h) Marine Biomonitoring Program for City of Los Angeles, Hyperion Wastewater Treatment Plant, Los Angeles, CA. Served as regulatory scientist in co-designing extensive marine permitting and biomonitoring requirements for 301(h) and secondary treated wastewater to the Hyperion Treatment Plant. The key emphasis was evaluating the potential short and long-term toxicological effects of contaminants in wastewater effluent on marine organisms as well as biouptake/bioaccumulation and potential effects on human health. Mr. Chartrand was heavily involved in public meetings concerning the environmental implications of implementing these permitting requirements.

Restoration Design and Permitting for Bird Island in Lake Washington, Renton, WA. Lead environmental scientist and permitting specialist for obtaining key federal, state, and local environmental permits for WDNR, supporting restoration design alternatives, preparing a Biological Evaluation for ESA-listed species, and providing technical input on shoreline, critical area studies, and wetland buffering.

Ecological Risk Assessment and Baseline Water Quality Characterization for Copper Concentrate in Marine Sediment (Phelps Dodge Mining Corp.), Copiapo, Chile, South America. Co-investigator/toxicologist for this marine water/sediments study conducted under NEPA requirements, to determine whether a proposed marine transfer facility would cause harmful effects to the marine environment. Baseline benthic biology, sediment toxicity testing, and water column/sediment chemical measurements were taken and a risk assessment for copper developed to establish baseline conditions at the mine tailings site.

Contaminated Sediment and Water Quality Evaluations for Environmental Dredging Project for Docks 14-20, Port of Stockton, CA. Served as project manager and senior scientist for evaluating surface water and sediment quality, toxicity analysis and potential short- and long-term biological effects associated with a long-term environmental dredging project on the San Joaquin River. Project conducted in fulfillment of California CEQA (similar to NEPA) requirements as part of an EIR, in support of the Port's plans to expand this portion of the riverfront and involved detailed sediment, dewatering, water quality, bioaccumulation, and toxicological evaluation of the sediment requiring dredging and monitoring.

Remedial Investigation/Feasibility Study and Baseline Risk Assessment, Contaminated Sediments Operable Unit (U.S. Navy CLEAN II), Long Beach, CA. As principal investigator, negotiated regulatory requirements with oversight agencies, designed and implemented extensive multi-phased field investigations of the Shipyard, authored the Remedial Investigation report, conducted baseline risk assessment focused on toxicity and bioaccumulation, formulated risk-based remedial strategies for Long Beach Naval Station and Shipyard, managed project team, and presented investigation results and conclusions to internal and external agencies.

***Permitting and Mitigation for Tsunami Safe Haven, Long Beach, WA.*.** Served as permitting agent and environmental scientist for obtaining key federal, state, and local environmental permits for the City in compliance with FEMA and other emergency response requirements, supporting development of restoration design alternatives, interacting with permitting agencies, and providing technical input on shoreline, critical area studies, and wetland buffering.

Bunker Hill CERCLA Site Operable Units 2 and 3, USEPA Region 10, Kellogg, ID. Prepared post-remediation guidance for monitoring and post-remedial restoration, for key units within OU2 (the "Box") and the Coeur d'Alene River basin. Reviewed environmental toxicity and chemistry data for riverine sediments, assisted in preparing work plan for pilot study for characterizing and performing a dredging pilot study for contaminated sediments from depositional zones within the Coeur d'Alene River.

Ecological Risk Assessment for the Insecticide Chlorpyrifos for Golf Course Applications, Makhteshim-Agan Co., NJ. Performed detailed ecological risk assessment and served as project manager for project required in support of EPA FIFRA pesticide registration requirements. Project involved bench scale toxicity and fate/transport testing of the organophosphate insecticide chlorpyrifos and derivatives, exposure modeling (e.g. WASP V) for environmental fate and effects in golf course ponds.

Remediation and Ecological Restoration of Mercury-Contaminated Guadalupe Creek (Santa Clara Valley Water District), San Jose, CA. Served as senior scientist in using chemical and toxicological data on mercury contamination in Guadalupe Creek to provide restoration design support for restoring the ecological function of the creek. Prepared Sampling and Analysis Plan, evaluated mercury bioavailability, bioaccumulation potential, and acute and chronic toxicity associated with mercury contamination. Results of this investigation were integrated into mitigation measures required to prevent harmful exposures of fish and wildlife communities and to design restoration of the waterway.

Tributyltin (TBT), Aquatic Ecological Risk Assessment, Puget Sound Sediments (U.S. Army Corps of Engineers, Seattle District), WA. This risk assessment was conducted as part of the PSDDA process of evaluating contaminated sediments within the Puget Sound. TBT was a new contaminant of concern to PSDDA. This report was used to build the database and support development of guidance documents in Puget Sound for toxicity of specific compounds in sediments.

Ecological Risk Assessment for Contaminated Sediments at Mare Island Naval Station (U.S. Navy CLEAN II Program), EFA West, Vallejo, CA. Served as lead toxicologist for designing field investigations and conducting an ecological risk assessment for PAH-contaminated sediment and other units at the former Mare Island Naval Station in Vallejo, California. Used a unique accelerated cleanup strategy approach, which identified 'presumptive remedies' for contaminated areas, including extensive chemical and biological testing, in effect using the FS evaluation process to drive sediment characterization.

Offshore Sampling Survey of Contaminated Sediment and Fish/Shellfish in Southern California Bight (Los Angeles Regional Water Quality Control Board), CA. Served as the lead scientist and principal investigator in conducting a multiyear study of the effects of DDTs and PCBs in the southern California marine environment, as a corollary to the Montrose Chemical NRDA action. Sediment, fish, and shellfish samples were taken from Santa Monica Bay and the Channel Islands to conduct this investigation.

Porewater and sediment toxicity associated with groundwater discharge for Union Carbide, Columbia Slough, Portland, OR. Designed and implemented porewater survey and toxicity evaluation of groundwater and its potential impacts to the receiving waters of the Slough at a former smelting facility in Portland, OR. Current status of project is to evaluate how groundwater contamination from former sludge ponds can potentially contribute to focused Feasibility Study and assist with designing remedial alternatives for the site.

U.S. Navy Everett Homeport 404/401 Water Quality Certification Program, EFA Northwest, Silverdale, WA. Served as lead scientist in conducting multi-year environmental monitoring program of surface water, sediment, and biological tissue for the purpose of characterizing baseline conditions in the area of the Homeport prior to construction. This report was incorporated into the 401 Water Quality Certification issued to the Navy from the WA Department of Ecology.

Characterization of Contaminated Sediments in Chena River, Fairbanks, AK. As part of a TMDL study and watershed management plan on behalf of USEPA and in collaboration with Alaska Dept. of Environmental Conservation, Mr. Chartrand served as Project Manager and senior scientist in preparing the QAPP and work plans, in leading field sampling operations, in negotiating requirements with EPA and ADEC, and interpreting the resulting data in light of TMDL requirements for this impaired water body.

Ecological Risk Assessment for Columbia Slough Sediments (City of Portland, Bureau of Environmental Services), OR. Served as principal scientist for evaluating existing data and designing a field study for use in human health risk assessment for the site. The focus of this risk assessment was to evaluate the potential for biouptake of petroleum hydrocarbons into edible fish and shellfish organisms in the Columbia Slough. Risk assessment conducted to implement source control and eventual cleanup strategies to protect human health and the environment.

Ecological Risk Assessment of Contaminated Sediments at Castro Creek in Chevron Oil Refinery, Richmond, CA. Served as senior scientist in evaluating data and reviewing ecological and human health risk assessment for large, multi-year risk assessment relating to evaluating the potential effects of petroleum-contaminated sediments on Threatened & Endangered and other species. This risk assessment considered the potential bioaccumulation and food web effect of uncommon organic pesticide and petroleum derivatives, important for the FS and remedial alternative evaluation.

Ecological Risk Assessment of Crude Oil and Drilling Muds/Cuttings on the Tropical Marine Environment (Maxus Oil Corporation), Jakarta, Indonesia. Served as the lead toxicologist for evaluating the potential effects of crude oil and drilling muds/cuttings on marine biota in the Java Sea. These baseline studies were required to determine potential effects associated with oil spillage or other release scenarios, which were part of a larger planning project by the Indonesian government.

Ecological Risk Assessment for Wetland Adjoining Mississippi River (Ilada Energy Corporation), Cape Ghirardeau, IL. Lead scientist and risk assessor for evaluating existing data and designing a field study for use in a risk assessment for this wetland site, which adjoins the Mississippi River. The study was conducted to identify risk-based strategies for cleaning up a contaminated site located in an ecologically sensitive area.

Habitat Conservation Plan for King County Department of Natural Resources, Brightwater Wastewater Treatment Plant, Edmonds, WA. Served as co-author for planning habitat and endangered species protection associated with the wastewater treatment plant. This involved a comprehensive data review, and included an evaluation of the effects of sewage-derived biosolids on human and ecological communities exposed to potentially toxic biosolids applied to crops or other areas.

White Paper and Toxicity Reduction Evaluation Work Plan, Puerto Rico Association of Sewage Authorities (PRASA), San Juan, Puerto Rico. Served as the lead sediment toxicologist in researching and evaluating the most effective way to use whole effluent toxicity (WET) testing data to evaluate the most effective approach to using this data to satisfy the EPA requirement for performing Toxicity Reduction Evaluation (TRE) studies when toxicity does occur when monitoring the effluent.

CERCLA Remedial Investigation and Risk Assessment Work Plan for former Klau-Buena Vista mercury mine, USEPA Region 9, CA. Served as the RI technical lead and ecotoxicologist in preparing a multi-disciplinary field investigation work plan concerning evaluation of mercury discharging from the former mercury mine.

- Emphasis on bioavailability of mercury residues in pore water, tissue, and sediment/soil allowed for streamlining and large-scale reduction in sampling and analysis costs to the client.
- Innovative, screening-based technical approach streamlined the RI and resulted in substantial savings while providing comprehensive data to support the RI and quantitative ecological exposure and risk assessment.

Risk-Based Cleanup Strategy Development for Former U.S. Air Force Airfield (U.S. Army Corps of Engineers, Anchorage District), AK. Served as principal scientist for evaluating existing data and designing field study for use in human health risk assessment of petroleum hydrocarbons and pesticides on Native American populations living in the vicinity of this site, located in Northway, Yukon. Studies were conducted for the purpose of identifying cleanup strategies to protect both human health and the environment.

Characterization and restoration studies of mercury-contaminated waterways in Northern California (Calfed), Sacramento, CA. Served as senior scientist and toxicologist for evaluating the toxicity, environmental fate, and bioavailability of mercury in freshwater riverine sediments of former gold mining districts in the Sacramento and American River systems of Northern California. Results were used to using these results to mitigate contamination and construct a restoration plan for part of the Sacramento River delta system.

TIE/TRE for Evaluating Unidentified Toxicity of Municipal Wastewater Effluent, City of Stockton, Stockton, CA. Served as project manager and toxicologist specializing in evaluating the toxicity of identified agents to algae observed during wastewater effluent testing. Scope included revisions to TIE/TRE work plan as part of permit revision for submittal to Regional Water Quality Control Board in

Sacramento, CA. Also performed evaluation of chemical and toxicological database and compliance with wastewater discharge permit requirements.

Model Toxics Control Act (MTCA) Method A and Method B Human Health and Ecological Risk Assessments, WA. Served as lead scientist and risk assessor in performing numerous small to medium sized human health risk assessments around the State of Washington in compliance with MTCA requirements. These investigations were used to determine the ultimate cleanup or other remedies for various contaminated industrial facilities.

Total Maximum Daily Loads (TMDLs) for Various Water Quality Constituents, EPA National Contract, Washington, D.C. Served as water quality specialist and project manager in developing TMDLs in various EPA regions throughout the U.S. This involves data collection, water quality modeling, and preparing detailed technical reports. Recent TMDL development experience includes:

- Various trace metals in Waltz Creek, PA (EPA Region 3);
- Hardness-dependent metals (e.g. copper) and mercury in the Neosho River watershed in southeastern Kansas (EPA Region 7);
- Fecal coliform in various watersheds of South Carolina (EPA Region 4);
- Trace metals in Illinois River watershed, Arkansas (EPA Region 6).

RI/FS and Risk Assessment for Multiple Operable Units, at Bangor/Silverdale Naval Stations, EFA Northwest, U.S. Navy, Silverdale, WA. Served as project toxicologist and risk assessor in designing field investigations, evaluating environmental data, preparing RI/FS reports for multiple Operable Units (Site A, Site F, Manchester Units), conducting multi-pathway environmental and human health risk assessments for toxicity and bioaccumulation, and evaluating remedial alternatives for each site.

Selected Publications and Presentations

Chartrand, A. B. Sample, and J. Linville. 2018. Methodology for the development of ecological injury thresholds for the Hanford Site. Prep for the Hanford Natural Resource Tree Council by Freestone Environmental Services, Inc. Sept. 2018, draft report, 37 pp. + attachments.

Chartrand, A. 2018. Expert report concerning Seattle Iron & Metals Corp. prep. for Puget Soundkeeper Alliance and Smith & Lowney, PLLC. 49 pp. + attachments. October 2018.

Chartrand, A.B., with TRC Environmental. 2017. Final Supplemental Environmental Impact Statement for Aquatic Plant Management, prep. for WA Dept of Ecology, Water Quality Program, Lacey WA. July 2017.

Chartrand, A. 2014. Expert Declaration Concerning PCBs and Clean Water Act Issues in Discharges to Duwamish Waterway in Seattle, WA. Prepared in Support of Confidential Legal Proceedings to Washington Pollution Control Hearings Board, Lacey WA, December 2014.

Chartrand, A.B. 2011. Toward More Effectively Applying Ecotoxicology to Help Formulate Water Quality Regulations and Policy. Presented at Salish Sea Ecosystem Conference, October 2011, Vancouver BC, Canada.

Chartrand, A.B. 2011. Ecotoxicology, the Endangered Species Act, and Contaminated Sediments in the Northwest. Presented at Society for Military Engineers Chapter Meeting, May 2011, Seattle, WA

Chartrand, A.B. 2010. Final Removal Action Sampling and Analysis Plan, for Environmental Remediation Project: Engineering Design and Planning for Dioxin Containment at Da Nang Airport, Vietnam. Prepared for USAID Vietnam, January 2010.

Chartrand, A.B. 2009-2010. Contaminated Sediments and Dredging: Overview of Environmental Issues. Seminar/webinar presented as Sediment Practice Lead for environmental scientists and engineers at CH2M Hill and Robinson Noble, Seattle and Tacoma, WA.

Chartrand, A.B., D. Holmes, T., Hamaker, J. Chen, and M. Rivera. 2007. Interpreting WET Data from *Arbacia punctulata* using Wastewater Treatment Plant Effluent in Puerto Rico. Presented at 26th Annual Meeting of Society of Environmental Toxicology and Chemistry at Milwaukee, WI.

Chartrand, A.B., J. Chen, J. Stockner, and D. Bos. 2006. A Unique Approach to Defining a Nutrient TMDL for Black Lake, Idaho. Presented at the American Water Resources Association Annual Meeting, Missoula, MT, 27 June 2006.

Chartrand, A.B., J. Chen, J. Stockner, D. Bos, and J. Carlin. 2005. Using Paleolimnology to Define a TMDL Target in a Nutrient-Limited Lake. Presented at 26th Annual Meeting of Society of Environmental Toxicology and Chemistry at Baltimore, MD.

Chen, J., A. Chartrand, J. Stockner, D. Bos, and J. Carlin. 2005. Defining a Nutrient-Based TMDL Target at Black Lake, ID. Presented at Annual Meeting of American Water Resources Association, Seattle, WA, Nov. 2005.

Chartrand, A.B., and J. Chen. 2003. Optimizing WET testing Protocols for More Meaningful Routine Testing and TIEs: the *Selenastrum capricornutum* example. Accepted at Society of Environmental Toxicology and Chemistry for Annual Meeting in Austin, Texas.

Chartrand, A.B., and J. Chen. 2003. Optimizing WET testing Protocols for More Meaningful Routine Testing and TIEs: the *Selenastrum capricornutum* example. Presented at Northwest Toxicity Assessment Meeting in Port Townsend, WA.

Chartrand, A.B., and K. Bergmann. 2001. Have we been missing the true mechanisms of PBT chemical toxicity in protecting rare species? Presented to 22nd Annual Society of Environmental Toxicology and Chemistry, Baltimore, MD, November 2001.

Chartrand, A.B. 2000. Summary briefing on Montrose Chemical DDT Trial and Natural Resource Damage Case. Presented to Northwest Toxicity Assessment Group (NWTAG), December 2000, Seattle, WA.

Chartrand, A.B. (Northwest Toxicity Assessment Group Chair) and S. Singleton (Pacific Northwest SETAC), May 11, 2000. Threatened and Endangered Pacific Northwest Species: Aquatic Toxicity Issues Workshop. Co-sponsored by Northwest Toxicity Assessment Group Chair) and Pacific Northwest SETAC, May 11, 2000.

Chartrand, A.B. 1998. 'Towards More Ecologically Relevant Biological Testing in Contaminated Sediments: (1) Concordance of Benthic Bioassessment with Laboratory Chronic Bioassay Data under Washington's Sediment Management Standards.' Presented at the Nineteenth Annual Meeting of the Society of Environmental Toxicology and Chemistry in Charlotte, NC.

Venkatesan, M.I., G.E. Greene, E. Ruth, and A.B. Chartrand. 1996. 'DDTs and Dumpsites in the Santa Monica Basin, California.' (Institute of Geophysics and Planetary Physics, Contribution No. 3981). The Science of the Total Environment 179: 61-71.

Chartrand, A.B. 1995. 'Defining site-specific sediment quality objectives for contaminated marine sediments.' Presented at Society of Environmental Toxicology and Chemistry, Sixteenth annual meeting in Vancouver, B.C., November.

Chartrand, A.B., V.A. Artman, A.D. Every, J.P. Pecoraro, and G. Connolly. 1995. Invited manuscript for 'Refining the Ecological Risk Assessment of Pesticides,' for EPA Office of Pesticide Programs, Washington, D.C.

Chartrand, A.B.. G.S. Reub, S.L. Shaner, J.L. Cameron, J.L. Dudley, and L. Jollan. 1993. 'Using ecological risk techniques to site a mining transfer facility in a marine embayment.' Presented at Fourteenth Annual meeting of Society of Environmental Toxicology and Chemistry, Houston, Texas.

Chartrand, A.B., V.A. Artman, A.D. Every, J.P. Pecoraro, and G. Connolly. 1993. 'Risk Assessment of Wildlife Damage Control Methods used by the USDA Animal Damage Control Program. Supplement to Draft EIS on the Animal Damage Control Program.' Findings presented at Fourteenth Annual meeting of Society of Environmental Toxicology and Chemistry, Houston, Texas.

Chartrand, A.B., K.P Campbell, and L. Faha. 1991. 'Toxicity Evaluation and Ranking of Columbia Slough Sediments.' Presented at Twelfth Annual meeting of Society of Environmental Toxicology and Chemistry, Seattle, WA.

Venkatesan, M.I., G.E. Greene, and A.B. Chartrand. 1991. 'Transport dynamics of chlorinated pesticides in the Santa Monica Basin, California.' Presented at the 21st International Symposium on Environmental Analytical Chemistry, May 20-22, 1991, Atlanta, Georgia.

Chartrand, A.B. 1989. 'LARWQCB survey of organochlorine contaminants in southern California waters.' Proc. Oceans 89; Seattle, WA, September.

Risebrough, R.W., W.M. Jarman, B.R.T. Simoneit, and A.B. Chartrand. 1989. 'Persistence of DDT and refinery wastes at offshore dumpsites in southern California.' Estuarine, Coastal, and Shelf Sciences 179: 61-71.

Chartrand, A.B., and R.D. Cardwell. 1988. 'Aquatic ecological and human health risk assessment of butyltins in Puget Sound and Lake Washington sediments.' PSDDA report, prepared for the US Army Corps of Engineers, Seattle District.

Chartrand, A.B., H.A. Schaefer, and V.A. Venkatesan. 1987. 'Identification of nonpoint source contaminants in stormwater runoff.' Proceedings of California Water Pollution Control Federation Conference, San Diego, California, April 1987.

Perkins, E.M., A.B. Chartrand, R.W. Risebrough, and D.B. Ebenstein. 1987. 'Fish histopathology and contamination in California's Channel Islands.' Proceedings of Coastal Zone 87, Seattle, WA, May 1987.

Guttman-Bass, N., M.B. Albuquerque, S. Ulitsur, and A.B. Chartrand. 1987. 'Effects of chlorine and chlorine dioxide on mutagenic activity of Lake Kinnereth water.' Environ. Sci. Technol. 21(3): 252-260.

Chartrand, A.B. 1986. 'Montrose Chemical Corporation: Strategies for managing a widespread point source contaminant.' Proc. Managing Inflows Symposium, Monterey, California, November 1986.

Chartrand, A.B., S. Moy, T. Yoshimura, and L.A. Schinazi. 1985. 'Ocean dumping under Los Angeles Regional Water Quality Control Board permit: A review of past practices, potential adverse impacts, and recommendations for future action.' LARWQCB Report No. 235, March 1985.