February 5, 2024

Via Online Submission
Washington State Department of Ecology
Attn: Sean Smith
P.O. Box 330316
Shoreline, WA 98133

Re: Aqueous Film-Forming Foam Collection and Disposal Program: Draft Programmatic Environmental Impact Statement

Dear Mr. Smith:

The Sierra Club and Earthjustice respectfully submit these comments on the Washington State Department of Ecology's ("Ecology") Draft Programmatic Environmental Impact Statement ("DEIS") for the planned collection and disposal of Aqueous Film-Forming Foam ("AFFF") from fire stations across the state.

To begin, we support the state's AFFF collection and disposal efforts. For much of the last century, fire stations, airports, military bases, and other facilities used AFFF made from toxic per- and polyfluoroalkyl substances ("PFAS"), a large class of dangerously persistent chemicals. The PFAS in AFFF are associated with an increased risk of cancer, developmental and reproductive harm, immune system toxicity, and other severe health effects. In 2018, the state legislature passed a law to restrict AFFF due to the dangers it poses to firefighter health and because it had contaminated drinking water across the state. Fire stations now have stockpiles of highly toxic PFAS foams. Moreover, because of PFAS' "extreme persistence … [and] mobility,"[1] many treatment and disposal technologies fail to destroy or permanently contain PFAS, but rather continue the cycle of contamination by releasing additional PFAS to the air and water. Washington's AFFF collection and disposal program allows the state to make coordinated and informed decisions about the best methods of PFAS disposal, while relieving individual fire departments of the logistical and financial burdens associated with such disposal.

We also strongly support Ecology's decision to prepare an EIS for its AFFF disposal program. As the Environmental Protection Agency has acknowledged, "significant uncertainties remain" with respect to the effectiveness and environmental impact of traditional waste disposal methods – landfilling, incineration, and deep-well injection – when applied to PFAS-containing wastes.[2] AFFF disposal presents substantial environmental and health risks, and the EIS process

[1] Carol F. Kwiatkowski et al., *Scientific Basis for Managing PFAS as a Chemical Class*, 7 Env't Sci. & Tech. Letters 532-543 (2020), DOI: 10.1021/acs.estlett.0c00255.
[2] EPA, *Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances* at 4 (Dec. 2020), https://www.epa.gov/system/files/documents/2021-11/epa-hq-olem-2020-0527-0002_content.pdf.

offers an opportunity to carefully evaluate those impacts and to identify the safest and most effective disposal option.

However, Ecology's DEIS fails to provide the "impartial discussion of significant environmental impacts and … reasonable alternatives" that the State Environmental Policy Act ("SEPA") requires.[3] Ecology selected a private contractor with close ties to the hazardous waste incineration industry to prepare the EIS, a conflict that raises serious questions about the objectivity of the underlying analysis. The DEIS understates the harms associated with PFAS landfilling and incineration, declaring those impacts to be minimal based on a misapplication of industry test data while ignoring substantial evidence of data gaps and health risks. Ecology also understates the impacts of PFAS disposal on environmental justice communities, focusing exclusively on communities in the immediate vicinity of disposal sites even though PFAS are highly mobile and are known to cause disproportionate harms to lower income communities, Indigenous communities, and communities of color nationwide. Finally, Ecology fails to seriously consider several advanced PFAS destruction alternatives that have the potential to eliminate or reduce the impacts associated with traditional disposal technologies, such as super critical water oxidation ("SCWO") – which has been used to treat AFFF in other locations – and closed-loop Hydrothermal Alkaline Treatment ("HALT") technology developed by Washington-based Aquagga, the winner of EPA's Innovative Ways to Destroy PFAS Challenge.[4]

The impacts of Ecology's PFAS disposal decisions extend far beyond the 59,000 gallons of AFFF covered by the current collection and disposal program. In addition to fire stations, AFFF is also stored at ferry terminals, airports, refineries, and other industrial facilities across the state, and Ecology has acknowledged the potential for expanded collection and disposal efforts in the future. More broadly, other states, municipalities, and private parties are struggling with similar issues concerning PFAS disposal and are searching for better solutions. Ecology has a statutory obligation to carefully evaluate the environmental and health impacts of its PFAS disposal program, and its analysis and selection of alternatives has the potential to inform future decisions and move the nation towards more protective PFAS disposal technologies. In its final EIS, we urge Ecology to fully account for the risks associated with PFAS incineration as well as the potential benefits of alternative destruction technologies.

I. SEPA Requires Ecology to Carefully Evaluate the Environmental Impacts of Its AFFF Collection and Disposal Program, Including Alternative Disposal Options

SEPA "sets forth a state policy of protection, restoration and enhancement of the environment."[5] "The most important aspect of SEPA is full consideration of environmental values … and this policy is carried out by the EIS procedure."[6] The preparation of an EIS

---

[3] Wash. Admin. Code § 197-11-400.
[4] EPA, Innovative Ways to Destroy PFAS Challenge: Winners, https://www.epa.gov/innovation/innovative-ways-destroy-pfas-challenge#Winners.
[5] *Polygon Corp. v. City of Seattle*, 578 P.2d 1309, 1312 (1978); *see also* Wash. Rev. Code § 43.21C.010; *Leschi Imp. Council v. Wash. State Highway Comm'n*, 525 P.2d 774, 781 (1974) (SEPA "indicates in the strongest possible terms the basic importance of environmental concerns to the people of this state.")
[6] *Sisley v. San Juan County*, 569 P. 2d 712, 718 (1977) (citation omitted).

"assures a full disclosure and consideration of environmental information prior to the [commencement] of the project."[7]

SEPA requires an EIS to "provide impartial discussion of significant environmental impacts and … inform decision makers and the public of reasonable alternatives, including mitigation measures, that would avoid or minimize adverse impacts or enhance environmental quality."[8] The test for significance of an environmental impact is "a reasonable likelihood of more than a moderate adverse impact on environmental quality."[9] This fact- and context-specific inquiry "does not lend itself to a formula or quantifiable test,"[10] but rather is "best determined 'on a case-by-case basis guided by all of the policy and factual considerations reasonably related to SEPA's terse directives."[11] Those factors must be considered in light of SEPA's underlying policy of maintenance, enhancement and restoration of the environment.[12]

SEPA also requires an EIS to contain a detailed discussion of reasonable alternatives to the agency's proposed action.[13] SEPA's administrative rules provide that an EIS must consider as alternatives those "actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation."[14] "The required discussion of alternatives to a proposed project is of major importance, because it provides a basis for a reasoned decision among alternatives having differing environmental impacts."[15]

Finally, SEPA "confers substantive authority to the deciding agency to act on the basis of the impacts disclosed."[16] SEPA is not purely an informational or procedural statute; it is intended to inform and promote decisions that further the statute's aims of environmental and health protection.

II. Ecology Must Investigate and Disclose the Potential Conflicts Involving the Contractor It Selected to Prepare the EIS

To prepare the DEIS, Ecology retained TRC Companies ("TRC"), a private consultant with longstanding ties to the hazardous waste incineration industry.[17] By its own account, TRC represents and "produce[s] bottom-line results for our commercial, solid and hazardous waste

---

[7] *Id.; see also Asarco Inc. v. Air Quality Coal.*, 601 P.2d 501, 512 (1979) (SEPA demands a "thoughtful decision-making process").
[8] Wash. Admin. Code § 197-11-400.
[9] *Id.* § 197-11-794.
[10] *Id.*
[11] *Klickitat County Citizens Against Imported Waste v. Klickitat County*, 860 P.2d 390, 398-99 (1993) (citations omitted); *Cheney v. City of Mountlake Terrace*, 552 P.3d 184, 188-89 (1976).
[12] *Polygon Corp*., 576 P.2d at 1312.
[13] Wash. Rev. Code § 43.21C.030(c)(iii).
[14] Wash. Admin. Code § 197-11-440(5)(b).
[15] *Weyerhaeuser v. Pierce County*, 873 P.2d 498, 504-05 (1994).
[16] *Polygon Corp.*, 578 P.2d at 1312.
[17] DEIS at 1-3 ("During the summer of 2021, Ecology completed a Request for Quotes and Qualification bid process and selected TRC to prepare the EIS report.")

clients."[18] For years, TRC has also been an associate member of the Coalition for Responsible Waste Incineration ("CRWI"), a trade association created in the 1980s by Dow, 3M, Monsanto and other hazardous waste generators to promote hazardous waste incineration.[19] CRWI members currently include hazardous waste incineration companies such as Clean Harbors Environmental Services, Heritage Thermal Services, Ross Incineration Services, and Veolia ES Technical Solutions, as well as numerous chemical and pesticide manufacturers.[20] TRC is listed as an "associate member," a membership tier designed for "companies that provide goods and services to the hazardous waste combustion industry."[21]

TRC's close ties to the incineration industry raise serious concerns about the objectivity of the DEIS, and in particular Ecology's assessment of the impacts of incinerating AFFF. The mission statement of CRWI states that "high temperature combustion is an integral part of the solution to the waste management challenge facing hazardous waste generators today" and that "for many wastes … combustion remains the safest, most appropriate treatment method."[22] CRWI has openly lobbied the White House Office of Science and Technology Policy to endorse PFAS incineration, which CRWI erroneously claimed to be the "only … commercially available method for destroying PFAS compounds."[23] TRC's membership in a trade organization that exists to encourage hazardous waste incineration, and that declared has incineration to be the "only" viable option for PFAS destruction, raises serious questions about whether TRC can even-handedly assess the environmental and health impacts of PFAS incineration and other disposal methods, as SEPA requires.

Ecology must immediately disclose the extent of TRC's role in the preparation of the DEIS, as well as any screening that Ecology conducted to evaluate potential conflicts of interest before retaining TRC to work on the EIS. While SEPA authorizes Ecology to use outside consultants to prepare an EIS, Ecology remains responsible for "assur[ing] that the EIS is prepared in a professional manner."[24] Here, Ecology failed to perform that required oversight. As described in greater detail below, the DEIS's assessment of the risks from PFAS incineration rely heavily on a single test conducted by Clean Harbors, a hazardous waste incinerator and CRWI member. The DEIS also identifies two Clean Harbors incinerators as potential disposal locations, without any discussion of the substantial gaps in Clean Harbors' testing or Clean Harbors' relationship to TRC. The public has the right to know whether TRC has any current or past contractual relationship with Clean Harbors or any other hazardous waste management company, and Ecology must ensure the "impartial[ity]" of the EIS by more closely scrutinizing TRC's analysis of incineration and other disposal methods, as set forth in greater detail below.[25]

---

[18] TRC, Solid Waste Management, https://www.trccompanies.com/services/remediation-and-materials-management/solid-waste-management/.
[19] CRWI: Meeting a Vital Need, https://www.crwi.org/textfiles/about.htm; *see also, e.g.,* CRWI Update: December 31, 2023, https://www.crwi.org/textfiles/updec23.pdf (listing TRC as an "associate member" of CRWA).
[20] CRWI Update: December 31, 2023, https://www.crwi.org/textfiles/updec23.pdf.
[21] CRWI, CRWI Membership, https://www.crwi.org/textfiles/why.pdf.
[22] CRWI, Meeting a Vital Need, https://www.crwi.org/textfiles/about.htm.
[23] CRWI, Comments on Request for Information; Identifying Critical Data Gaps and Needs to Inform Federal Strategic Plan for PFAS Research and Development (Aug. 29, 2022), https://www.crwi.org/textfiles/ostp22.pdf; *see also* pp. 4-9 *infra* (describing the risks associated with PFAS incineration).
[24] Wash. Admin. Code § 197-11-420(2).
[25] *Id.* § 197-11-794.

III. Ecology Overlooks Significant Environmental and Health Risks Associated With PFAS Incineration

The DEIS badly understates the concerns regarding the safety of incineration as a disposal option for PFAS. Ecology fails to critically assess industry data effectiveness of PFAS incineration, overlooks potentially harmful byproducts of incineration, and presents an unrealistic view of the ability of compliance-plagued hazardous waste incinerators to operate at ideal conditions when incinerating PFAS stockpiles.

Ecology erroneously asserts that "[i]ncineration is one of only a few technologies that can potentially destroy PFAS … reducing future risks to public health and adverse effects on the environment."[26] The only cited support for that claim is a study conducted by a hazardous waste incinerator, without any government oversight, that purportedly found "destruction of 99.9999 percent of common legacy PFAS compounds."[27] But that study did not, and could not, establish the safety of PFAS incineration, since it did not measure the PFAS and other byproducts that are most likely to be produced during the incineration process.

Destruction and removal efficiency ("DRE") compares the levels of certain target PFAS in the feedstock waste with the levels of those chemicals in stack emissions following incineration. But it doesn't account for the formation of harmful byproducts that may be generated as result. The incineration of PFAS releases highly reactive fluorine molecules that can form a variety of harmful fluorinated compounds, including but not limited to new PFAS. As the Department of Energy and U.S. Environmental Protection have acknowledged, "incineration can result in the formation of other PFAS compounds in [stack] emissions," as well as other harmful products of incomplete combustion ("PICs") "which may become problematic in their own right."[28] A "destruction" method that merely converts one PFAS to another or generates toxic PICs does not "reduc[e] future risks to public health and adverse effects on the environment."[29]

A. The EIS Relies Exclusively on an Industry-Funded Study That Didn't Examine Harmful Byproducts of Incineration

The incineration destruction figure cited by Ecology comes from a single test conducted at Clean Harbors' Aragonite, Utah incinerator in July 2021.[30] This study measured PFAS emissions using EPA Other Test Method 45 ("OTM-45") for air, which is capable of detecting

---

[26] DEIS at 2-21.
[27] *Id.*
[28] *See* Dep't of Energy, DOE Commercial Potential Evaluation (CPE) Report: PFAS in Wastewater at 30 (Aug. 2023), https://science.osti.gov/-/media/sbir/pdf/Application_Resources/2023/CPE-PFAS-Final-Report.pdf; EPA, Technical Brief: Per- and Polyfluoroalkyl Substances (PFAS) Incineration to Manage PFAS Waste Streams (Feb. 2020), https://www.epa.gov/sites/default/files/2019-09/documents/technical_brief_pfas_incineration_ioaa_approved_final_july_2019.pdf (findings that PFAS "can result in the formation of smaller PFAS products, or products of incomplete combustion (PICs), which may not have been researched and thus could be a potential chemical of concern.")
[29] DEIS at 2-21.
[30] *See* EA Eng'g, Sci. & Tech. and Montrose Envt'l Gr., *Report on PFAS Destruction Testing Results at Clean Harbors' Aragonite, Utah Hazardous Waste Incinerator* (Nov. 2021) ("Clean Harbors Test Report").

approximately 50 semi-volatile and polar PFAS, less than 1% of the PFAS class.[31] But PFAS incineration is also expected to produce a variety of volatile, nonpolar PFAS, which are not detected by OTM-45.[32] Clean Harbors thus cannot say whether its alleged destruction of PFOA and PFOS is actually creating new PFAS that it failed to measure its pilot study.[33]

Notably, while Washington presents the data on PFAS incineration as clear cut, a PFAS incineration scientist commissioned by Clean Harbors to review its study data raised concerns about the formation of breakdown products and the low recovery of fluorine in the form of hydrofluoric acid.[34] The challenges of documenting the ultimate fate of the fluorine molecules released during incineration led the scientist to conclude, "[i]n summary, development of better analysis methods organic and inorganic fluoride are needed to support PFAS-performance testing at the full scale."[35]

EPA recently released a new draft test method for air, OTM-50, which will capture up to 30 highly volatile, nonpolar PFAS, the very type of breakdown products expected to be produced by PFAS incineration. This method will allow future experimental and observational studies to more fully report products of incomplete combustion of PFAS materials.[36] But it was not used by Clean Harbors or in any of the studies referenced in the DEIS, precluding a full assessment of the effectiveness and impacts of PFAS incineration.

B. A Recent Study by EPA Scientists Confirms the Potential Generation of PFAS and Toxic Byproducts During PFAS Incineration

In July 2023, a publication by EPA scientists ("Shields et al.") reviewed the safety and efficacy of PFAS incineration in a trial study at EPA's Rainbow research combustor.[37] This study also used EPA method OTM-45 to measure the destruction of PFAS from AFFF

---

[31] *See* Suzanne Yohannan, *EPA Eyeing Paired Issuance of PFAS Disposal Guidance, Air Test Method*, Inside PFAS Policy (Dec. 11, 2023) ("OTM-45 … measures approximately 50 semi-volatile per- and polyfluoroalkyl substances (PFAS) and polar PFAS in air emissions"); Nat'l Inst. of Env't Health Sci., *Per- and Polyfluoroalkyl Substances (PFAS)*, https://www.niehs.nih.gov/health/topics/agents/pfc ("PFAS are a group of nearly 15,000 synthetic chemicals").

[32] Suzanne Yohannan, *EPA Eyeing Paired Issuance of PFAS Disposal Guidance, Air Test Method*, Inside PFAS Policy (Dec. 11, 2023); *see also* Jeff Ryan, EPA Off. of Res. and Dev., Presentation to EPA Region 4 Spring Grants/Planning Meeting at Slide 13 (May 23, 2019), https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=538634&Lab=NRMRL

[33] *See, e.g.,* Clean Harbors Test Report at 7-3 ("Given that laboratory standards enabling targeted analysis exist for only about 50 of the thousands of extant PFAS, other analytical tools such as non-targeted PFAS analysis and Total Organic Fluorine … could be employed in the future to more completely characterize the PFAS profiles in the waste and other process streams, as well as in the stack gas.")

[34] Phil Taylor & Associates, LLC, *Final Report: Assessment of a Report on PFAS Destruction Testing Results at Clean Harbors' Aragonite, Utah Hazardous Waste Incinerator. Prepared for Clean Harbors Environmental Services, Inc.* (Jan 26, 2022) (a copy of this report is attached to these comments as **Exhibit A**).

[35] *Id.*

[36] EPA, Other Test Method 50 (OTM-50): Sampling and Analysis of Volatile Fluorinated Compounds from Stationary Sources Using Passivated Stainless-Steel Canisters (2024), https://www.epa.gov/system/files/documents/2024-01/otm-50-release-1_0.pdf

[37] Erin P Shields et al., *Pilot-Scale Thermal Destruction of Per-and Polyfluoroalkyl Substances in a Legacy Aqueous Film Forming Foam*, 3 Env't Sci. & Tech Eng'g. 1308-1317 (2023), DOI:10.1021/acsestengg.3.c00098 (a copy of this study is attached to these comments as **Exhibit B**).

compounds, while using but nontarget analysis of OTM-45 cannisters to identify about 10 fluorochemicals as breakdown products. These include fluoroform, pentafluoroethane, 1H-hepafluoropropane, and 1H perflouroheptane, which are greenhouse gases with long residency times in the atmosphere. Of particular importance was the observation that PFAS breakdown and byproduct formation is highly temperature dependent, with notable performance declines below experimental temperatures of 1000° C. At 970° C less than 99.99% of two shorter chain PFAS chemicals (PFBA and PFPeA) were destroyed. At 870° C cannisters included at least 15 measurable breakdown products at concentrations ranging from 0.4 to 903 mg/m^3. The authors conclude: "These results suggest that [destruction efficiency] alone may not be the best indication of total PFAS destruction, and additional PIC characterization may be warranted."[38]

The Shields study also focused on steady-state combustor operations, noting that the real-world operating conditions of a hazardous waste incinerator will inevitably include temporary disruptions to oxygen and temperature depressions.[39] The authors state the "time dependent behavior of PFAS in [hazardous waste incinerators] and other batch fed systems will depend on the system's ability to smooth these transients and maintain high temperatures," concluding, "[m]ore research into rotary kiln systems and full-scale incinerators is needed."[40] Multiple studies have detected elevated PFAS concentrations in the vicinity of operating incinerators or thermal oxidizers designed to destroy gaseous PFAS waste, raising further concerns about the impacts of PFAS incineration.[41] Ecology failed to consider those studies or address those potential impacts in its DEIS.

C. Commercial Incinerators, including Clean Harbors Aragonite, Do Not Routinely Operate the Under the Ideal Combustion Conditions Tested by Clean Harbors and Shield

The Shields study highlights the role that temperature and residency time of incinerators play in the effectiveness of thermal destruction of PFAS. Thermal breakdown is dependent on proper residency time, temperature and turbulence inside the incinerator chamber. But neither Shields nor Clean Harbors tested incinerators during their real world, commercial operations. Instead, those tests were conducted under carefully controlled conditions; EPA and Clean Harbors aimed for temperatures and retention times at the upper edge of commercial operating efficiency and manipulated the feedstock and operating conditions to attain desired temperature ranges and retention times. Notably, both of the Clean Harbors incinerators referenced in the EIS

---

[38] *Id.* at 1308.
[39] *Id.* at 1314-15.
[40] *Id.* at 1315.
[41] *See* Kaitlin V. Martin et al., *PFAS Soil Concentrations Surrounding a Hazardous Waste Incinerator in East Liverpool, Ohio, An Environmental Justice Community*, 30 Env't Sci. Pollution Res. Int'l 80643-80654 (June 10, 2023), doi: 10.1007/s11356-023-27880-8 (detecting elevated PFAS levels in the soil surrounding the Heritage Thermal Services incinerator in East Liverpool, OH); Bennington College Press Release, *First in the Nation Testing Reveals Toxic Contamination in Soil and Water Near Norlite Incinerator* (Apr. 27, 2020), https://www.bennington.edu/sites/default/files/sources/docs/Norlite%20News%20Release%20%5Bdb%20final%20updated%5D.pdf (detecting elevated PFAS levels in the soil and groundwater surrounding Norlite incinerator in Cohoes, NY); Jiaqi Zhou et al. *Legacy and Emerging Airborne PFAS Collected on PM2.5 Filters in Close Proximity to a Fluoropolymer Manufacturing Facility.* 12 Env't Sci.: Processes & Impacts 2272-2283 (2022), https://pubs.rsc.org/en/content/articlelanding/2022/em/d2em00358a/unauth (measuring PFAS in the air near the Chemours Fayetteville NC facility, which uses a thermal oxidizer to treat gases containing PFAS)

– in Aragonite, Utah and Kimball, Nebraska – have already received and incinerated large volumes of AFFF and other PFAS-containing waste, but they did not measure their releases of PFAS during those operations.[42]

Ecology states that hazardous waste incinerators have administrative controls like permit conditions, operating and maintenance procedure and trained personnel to ensure incineration happens under carefully controlled conditions.[43] In reality, however, incinerators like Clean Harbors' Aragonite facility routinely violate permit requirements.

The Aragonite facility has a long history of environmental non-compliance, including "incinerating mercury-containing wastes that are prohibited from incineration," "incinerating lead-containing wastes that are prohibited from incineration," "failing to properly categorize wastes and/or document the categorization of wastes," "failing to calibrate monitoring instruments," and dozens of other violations.[44]

The other Clean Harbors incinerator considered by Ecology, in Kimball, Nebraska, has a similarly checkered compliance history, as documented in the accompanying analysis of several hazardous waste incinerators' environmental violations.[45] In 2020, EPA and Clean Harbors reached a settlement agreement resolving alleged violations related to emissions limits and reporting, including "failure to manage and contain hazardous wastes; failure to comply with air emission limits; failure to comply with chemical accident prevention safety requirements; and failure to timely report use of certain toxic chemicals.[46] Our analysis of publicly available records also indicated the facility had at least 105 total violations of emission limits, operating permit limit ("OPLs"), or other permit terms.[47] The facility reported at least 57 instances where it exceeded the emissions standard for total hydrocarbon content ("THC").[48] Of these, two were expressly linked in the facility's reports to problems maintaining adequate minimum temperature for the combustor.[49] There was one additional reported violation during this span where the facility violated its minimum temperature requirement.[50] The facility also documented ten exceedances of the particulate matter standard.[51]

---

[42] According to EPA, Clean Harbors Aragonite burned more than 60,000 kg of PFAS between January 2023 and September 2023, at least 460,000 kg since 2018, while Clean Harbors in Kimball burned at least 237,000 kg of PFAS waste between 2018 and 2023. *See* EPA, PFAS Analytical Tools (2024), https://awsedap.epa.gov/public/extensions/PFAS_Tools/PFAS_Tools.html.

[43] DEIS at 3.1-8.

[44] Utah Dep't of Env't Quality, *Compliance History, for the Clean Harbors Aragonite, LLC Facility* (Aug. 25, 2021), https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/clean-harbors/aragonite/DSHW-2014-018229.pdf.

[45] *See* Sierra Club and Earthjustice, *Incineration is Not a Safe Disposal Method for PFAS* (2022) (a copy of this analysis is attached as **Exhibit C**).

[46] EPA Press Release, *United States and State of Nebraska Reach Settlement with Clean Harbors Environmental Services Inc. for Violations of Multiple Environmental Laws* (Aug. 31, 2020), https://www.epa.gov/newsreleases/united-states-and-state-nebraska-reach-settlement-clean-harbors-environmental-services

[47] Exhibit C at 9.

[48] *Id.*

[49] *Id.*

[50] *Id.*

[51] *Id.*

Those reports may actually underrepresent the facility's compliance problems. A separate report related to leak-detection also included reporting of startup/shutdown events, revealing incidents that are not reflected in the list of OPL and emission limit violations reported for 2019. Summary reports filed by the facility show that, during 2019, the facility was in "upset" mode and reporting excess THC emissions for a total of 45.7 hours. Of this total, 27.25 hours were attributable to "startup/shutdown" events with the remaining being attributable to "process problems." The facility reported an additional 0.4 hours of excess emissions related to O2-related upset conditions. EPA has characterized the Kimball, NE incinerator as a "significant noncomplier" with the Resource Conservation and Recovery Act ("RCRA") in every quarter since 2021.[52]

Those violations are not unique to Clean Harbors; other hazardous waste incinerators have similar number and types of permit violations, including explosions and major malfunctions.[53] It is common for air permits to exempt pollutant limits during periods of Start-up, Shut-down, and Malfunction ("SSM") events.[54] Given the gaps in the available test data, the potential releases of PFAS and other toxic byproducts from hazardous waste incinerators, and the long history of permit violations by Clean Harbors and others, Ecology cannot reasonably conclude that PFAS incineration presents "minimal" impacts on public health and the environment.

IV. Ecology Overlooks Significant Environmental and Health Risks Associated With Landfill Disposal of PFAS

Ecology also understates the impacts associated with the disposal of AFFF at hazardous waste landfills in Idaho and Nevada. Without considering the latest research on potential PFAS releases from landfills, Ecology asserts that "[t]he risk of PFAS release [from landfills] is very low" and "[t]he consequences [of such releases] would be insignificant."[55] These conclusions are not supported by the record.

Due to their volatility and mobility in water, substantial volumes of PFAS are projected to be lost from landfills each year. A recent review paper authored by EPA scientists ("Tolaymat et al") estimated that 1,233 kg of landfills are released annually via leachate and landfill gas, or approximately 15 percent of the quantity of PFAS shipped to U.S. landfills on a given year.[56] More than 130 kg of those PFAS releases are projected to be uncontained and released directly to environment.[57]

---

[52] EPA, Enforcement and Compliance History Online, *Detailed Facility Report*: *Clean Harbors Environmental Services Inc. 2247 S. Highway 71, Kimball, NE*, https://echo.epa.gov/detailed-facility-report?fid=110041638458&ej_type=sup&ej_compare=US (last visited Feb. 4, 2024).

[53] *See* Earthjustice et al., *Vestiges of Environmental Racism* (2021) https://earthjustice.org/wp-content/uploads/earthjustice_ca-incinerator-report_20211108.pdf; EPA, *Complaint and Notice of Opportunity to Request a Hearing*, Docket No. CAA-02-2020-1004 (2020), https://dec.ny.gov/environmental-protection/waste-management/hazardous-waste/norlite-llc/enforcement-history

[54] *See* 40 C.F.R. §§ 60.2918, 60.3025.

[55] DEIS at 3.1-14 to 3.1-15.

[56] Thabet Tolaymat et al, *A Critical Review of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Landfill Disposal in the United States*, 905 Sci. of the Total Env't 167185 at *1 (2023) DOI: 10.1016/j.scitotenv.2023.167185 (a copy of this study is attached as **Exhibit D**).

[57] *Id.*

While Ecology has considered solidifying AFFF before sending it to a hazardous waste landfill, evidence suggests that PFAS solidification doesn't fully immobilize the chemicals. One study reports that the "[o]verall immobilization of PFAS analytes that were detectable in the leachate from two PFAS contaminated soils ranged from 87.1% to 99.9%"[58] Ecology must evaluate the possibility that some PFAS escape from the solidified AFFF and enter the air, soil, or groundwater.

A. PFAS Leach from Landfills, Creating the Need for Perpetual Management of Liquid Waste and the Likelihood of Uncontained PFAS Releases

Ecology glosses over concerns about PFAS washing out of landfills in the liquid waste or "leachate," stating that "leaching of PFAS compounds would be detected by leak detection system and PFAS compounds would be captured by the leachate collection and recovery system."[59] Ecology further states "the consequences [of landfilling] would be insignificant because, as described above, the partial pressure of PFAS in AFFF in the groundwater would be very low and the resulting ambient PFAS concentrations would be much less than the significance criteria."[60] But studies have estimated a significant amount of uncaptured PFAS leachate, and landfills often fail to destroy or permanently contain the PFAS in the leachate that they do capture.

PFAS are commonly detected in landfill leachate, across many different geographic locations and landfill types. One paper in particular measured PFAS in leachate from a landfill housing only municipal solid waste incinerator ash. The ash was residues of materials that were burned at 950º C, yet the landfill leachate contained more than 2000 ng/L of PFAS.[61] This indicates both that notable amounts of PFAS remained after incineration and were soluble in landfill liquids.

PFAS also leach from hazardous waste landfills. An analysis of 29 leachate samples from two California hazardous waste landfills measured average PFAS concentrations of 68,000 ng/L, with a maximum measured value of 377,000 ng/L.[62] Given this evidence that PFAS will leach from even solidified AFFF waste, Washington must more carefully consider the management and fate of leachate generated from any landfill accepting PFAS waste.

The options for perpetual leachate collection and safe disposal are far more complex than the disposal of a single containerized shipment of AFFF waste. Some landfills send leachate to wastewater treatment plants that are ill-equipped to remove PFAS compounds.[63] Others return

---

[58] E. Barth et al., *Investigation of an Immobilization Process for PFAS Contaminated Soils*, 296 J. Env't Mgmt., 113069 (2021), DOI: 10.1016/j.jenvman.2021.113069.
[59] DEIS at 3.1-14.
[60] *Id.*
[61] Tolaymat, *supra* note 60, at *7 (citing S Liu et al, *Perfluoroalkyl Substances (PFASs) in Leachate, Fly Ash, and Bottom Ash from Waste Incineration Plants: Implications for the Environmental Release Oof PFAS*, 795 Sci. of the Total Env't 148468 (2021)).
[62] *Id.* at *8 (citing California Water Boards's GeoTracker PFAS Map).
[63] *Id.* at *11 ("In the US, most landfill leachate generated from RCRA-permitted landfills is managed off-site … represent[ing] a significant flux of PFAS leaving the landfill.")

leachate into the landfill for perpetual circulation, increasing the likelihood that the PFAS will eventually leach into the environment. We are only aware of one instance in which a landfill is exploring the use of on-site advanced destruction technology to destroy PFAS in leachate liquids.[64] Ecology did not consider that leachate treatment option in the DEIS.

B. PFAS Volatilize From Landfills and are not Destroyed by Methane Gas Flares

The DEIS also failed to adequately account for landfills' potential releases of PFAS to the air. The DEIS describes the possibility of PFAS volatilizing from solidified AFFF as "very low."[65] However, data on the failure rate for PFAS solidification should be also considered in context of new information about PFAS volatilization from landfills. The recent Tolaymat landfill review paper estimated that about 470 kg of PFAS per year up volatilizes into air annually from U.S. landfills.[66] The amount of landfill gas generation depends on the amount of moisture and microbial activity in the landfill. Injecting landfill leachate back into the landfill for circulation would increase both the PFAS and the moisture content of the landfill.

About three quarters of the landfill gas is captured or collected each year, with approximately 25% released to the air as fugitive emissions.[67] For the gas that is captured, even when landfills are equipped with flares to burn landfill gas the flare temperatures of 650-850º C are lower than the temperatures that would be expected to destroy gaseous PFAS. Instead of assuming "low" releases from the volatilization of PFAS from landfills, Ecology must consider the latest research and estimate the potential for air releases over the centuries that landfilled AFFF would remain on site. Moreover, since EPA is still years away from regulating any PFAS as hazardous waste, Ecology cannot assume that existing landfill permits and federal regulations will be sufficient to prevent significant adverse impacts from PFAS in leachate or landfill gas.

V. Ecology Understates the Environmental Justice Impacts Associated with PFAS Landfilling and Disposal

The DEIS also understates the environmental justice impacts associated with PFAS incineration and landfilling, asserting that the risks associated with those disposal options are "low to insignificant."[68] But Ecology underestimates both the likelihood of PFAS releases from those disposal options and the impacts of such releases on environmental justice communities who already bear a disproportionate burden of existing PFAS contamination.

As Ecology acknowledges, "[t]he first step in an EJ assessment is to identify the study area."[69] The DEIS defines the study area too narrowly, focusing solely on effects within a 10-mile radius of AFFF storage locations or potential disposal sites.[70] While that approach may be appropriate for pollutants with primarily localized impacts, it fails to capture the sweep of highly

---

[64] EPA, Town of Conway Landfill Leachate Treatment Emerging Contaminants Project (2002), https://www.epa.gov/system/files/documents/2022-11/Conway-CWSRF-Emerging-Contaminants.pdf
[65] DEIS at 3.1-13
[66] Tolaymat, *supra* note 60, at 1.
[67] *Id.* at 13.
[68] DEIS at 3.11-20 to 3.11-22.
[69] *Id.* at 3.11-2.
[70] *Id.* at 3.11-20 to 3.11-22.

mobile and persistent chemicals like PFAS. PFAS that are emitted by an incinerator, that volatize from a landfill, or that leach into groundwater do not remain within a 10-mile radius of their release point. They spread long distances through the air, water, and soil, leaving a trail of contamination that extends from the peaks of Mount Everest to the depths of the ocean floor.[71] The communities that face the greatest risks from PFAS releases are not merely those nearest to the release site, but also those who are already exposed to PFAS contamination and are more susceptible to harm from further exposures.

As with many toxic pollutants, PFAS disproportionately harm lower income communities and communities of color. Low income households are 15 percent more likely to live around PFAS-contaminated sites than would be expected based on their share of the population, and African American households are 48 percent more likely to live around PFAS-contaminated sites than would be expected.[72] Another study found that "watersheds serving higher proportions of Hispanic/Latino and non-Hispanic Black populations had significantly greater odds of containing PFAS sources."[73] These inequities must be considered in Ecology's environmental justice analysis, since people who already have elevated levels of PFAS in their bodies are more likely be harmed by any additional releases from Ecology's AFFF disposal. Ecology's finding that there are no "communities of concern" within a 10-mile radius of its proposed landfills or incinerators does not mean that the proposed PFAS disposal will have no significant environmental justice impacts.[74] It just means that Ecology has drawn its study radius too narrowly.

VI. Ecology Prematurely Dismisses Available Alternatives With Lower Environmental Impacts

Washington Ecology's EIS rigidly focused on three traditional methods of hazardous waste disposal, ignoring promising innovations that could be much safer and more effective than incineration, landfilling and deep well injection. Notably both EPA and the Department of Defense have invested time, staff power and research money in honing options for advanced destruction techniques. DOD recently announced a PFAS treatment hub to pilot test PFAS destruction technologies.[75] EPA's PFAS Innovative Treatment Team research project was a limited-duration effort to review alternative destruction tools. It determined that four techniques held promise for achieving high levels of PFAS destruction.[76]

---

[71] Murray Carpenter, *'Forever Chemicals,' Other Pollutants Found Around the Summit of Everest*, Wash. Post (Apr. 17, 2021), https://www.washingtonpost.com/science/mt-everest-pollution/2021/04/16/7b341ff0-909f-11eb-bb49-5cb2a95f4cec_story.html;

[72] Genna Reed, Union of Concerned Scientists, *PFAS Contamination Is an Equity Issue, and President Trump's EPA Is Failing to Fix It* (Oct. 30, 2019), https://blog.ucsusa.org/genna-reed/pfas-contamination-is-an-equity-issue-president-trumps-epa-is-failing-to-fix-it/.

[73] Jahred M. Liddie et al., *Sociodemographic Factors Are Associated with the Abundance of PFAS Sources and Detection in U.S. Community Water Systems*, 57 Env't Sci. & Tech. 7902-7912 (2023), https://pubs.acs.org/doi/pdf/10.1021/acs.est.2c07255.

[74] DEIS at 3.11-20 to 3.11-22.

[75] Megan Quinn, *DOD Taps PFAS Remediation Companies, Including Clean Earth, for Mitigation Research Project*, Waste Dive (Jan. 23, 2024), https://www.wastedive.com/news/pfas-remediation-department-of-defense-clean-earth-arcadis-aquagga/705285/.

[76] EPA, *PFAS Innovative Treatment Team* (2021), https://www.epa.gov/chemical-research/pfas-innovative-treatment-team-pitt

Advocates have long called for more equitable practices for hazardous waste disposal, to ensure the PFAS pollution crisis isn't simply shifted from one community to another.[77] Several key principles are:

(1) The need for tools that can be used onsite, obviating the need to transport waste long distances and keeping the hazardous waste impacts from being concentrated in historically burdened communities;
(2) The need to treat waste in contained systems, which can ensure destruction is complete before wastes are released to the environment.
(3) The need for a very high level of waste destruction efficiency with minimal formation of harmful byproducts.

As described below, significant progress is being made to pilot alternative technologies that live up to these principles. Washington State should be at the forefront of this process.

Two particular destruction technologies hold promise for achieving the key principles for equitable waste destruction. EPA scientists published a test of three commercial services using Super Critical Water Oxidation for AFFF destruction in 2022. It concluded, "as a destructive technology, SCWO may be an alternative to incineration."[78] SCWO is currently being used to treat PFAS in Michigan,[79] and it has been used to destroy other persistent wastes, including chemical weapons, for decades. A second treatment option, Hydrothermal Alkaline Treatment or HALT, has also been used to destroy PFAS in AFFF, with notable reduction of measurable PFAS compounds.[80]

The DEIS acknowledges several emerging PFAS destruction technologies, but states that "[g]iven the uncertainty of when these technologies could be available for commercial use, and the uncertainty of acquiring the receiving state's approval to ship the AFFF, they were eliminated from further consideration as well."[81] That alleged "uncertainty" is not a valid reason for rejecting those alternatives, particularly if they are capable of destroying PFAS with lower environmental and health impacts than traditional disposal options. First, as explained above, technologies like SCWO are readily "available" and have shown promise in treating AFFF. In one place, the DEIS references the potential use of a SCWO treatment facility in Grand Rapids, MI, but Ecology fails to explain why that option was not further pursued.[82]

---

[77] *See* Letter from 65 Community Leaders to Brenda Mallory, White House Council on Environmental Quality (Dec. 6, 2022), https://www.sierraclub.org/sites/www.sierraclub.org/files/2022-12/Biden_CEQ%20Letter-%20PFAS%20clean%20up%20and%20disposal%202022.pdf.
[78] Max J Krause et al., *Supercritical Water Oxidation as an Innovative Technology for PFAS Destruction*, J Env't Eng'g 05021006 (2021), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10428202/pdf/nihms-1786112.pdf; *see also* EPA, Industrial SCWO for the Treatment of PFAS/AFFF Within a Water Matrix (Sept. 2022), https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=546712&Lab=CESER (reporting >99.99% PFAS destruction from SCWO treatment of AFFF).
[79] *See* Isiah Holmes, *System to 'Annihilate' PFAS Chemicals Deployed in Michigan*, Wisc. Examine (June 27, 2023), https://wisconsinexaminer.com/2023/06/27/system-to-annihilate-pfas-chemicals-deployed-in-michigan/.
[80] Aquagga, *Case Studies, AFFF Stockpiles*, https://www.aquagga.com/case-studies.
[81] DEIS at 2-24.
[82] *Id.* at 3.9-9.

Nor does the alleged "uncertainty of acquiring the receiving state's approval" justify Ecology's failure to consider advanced treatment technologies.[83] First, under state law, receiving state approval is not required if dangerous waste is sent to treatment facility that "is operating either: [u]nder a permit issued pursuant to the requirements of this chapter; or, if the TSD facility is located outside of this state, under interim status or a permit issued by United States EPA under 40 C.F.R. Part 270, or under interim status or a permit issued by another state which has been authorized by United States EPA pursuant to 40 C.F.R. Part 271."[84] The DEIS fails to examine whether any advanced treatment technologies could be employed at any facilities that would not require out-of-state authorization. The DEIS also does not state whether Ecology has affirmatively sought authorization from all states with advanced treatment capacity, and what those states' responses have been. If Ecology has done so, it must describe those efforts in greater detail in the final EIS. If Ecology has not, it cannot reject treatment technologies based on its speculation over how other states may respond.[85]

Finally, during a public webinar on the DEIS, Ecology referenced questions over whether other Washington state regulations governing the storage and disposal of "dangerous wastes," including PFAS, may preclude the use of SCWO and other emerging treatment technologies. The DEIS does not specify the nature of those concerns, leaving the public unable to evaluate and respond to them. However, we note that Ecology's dangerous waste regulations permit "treatability studies" to determine "whether the waste is amenable to the treatment process; what pretreatment (if any) is required; the optimal process conditions needed to achieve the desired treatment; the efficiency of a treatment process for a specific waste or wastes; or the characteristics and volumes of residuals from a particular treatment process."[86] At a minimum, we urge Ecology to consider the use of some or all of the collected AFFF in a treatability study to evaluate advanced PFAS treatment technologies and inform future disposal decisions.

Finally, we urge Ecology to consider temporary, off-site storage at a permitted hazardous waste storage facility as a disposal option. The U.S. Environmental Protection Agency and other agencies are currently pursuing a series of short-term and medium term research and development initiatives related to PFAS disposal, which are intended to enable decision-makers "to make informed decisions about the tradeoffs between different risk management solutions, leading to better environmental outcomes."[87] Interim off-site storage would enable Ecology to consider the results of this pending research and to make a more informed choice among disposal options. Moreover, the hazardous waste incinerator that Ecology identified as a potential recipient of the state's AFFF (Clean Harbors' Aragonite facility) is also permitted to store PFAS and hazardous waste. By Clean Harbors' own account, that facility has "ample on-site storage capacity," including "a bulk liquid tank farm (sixteen ~30,000 gallon tanks); container storage areas (~12,000 55-gallon drum capacity); direct burn tanker storage areas (~30,000 gallons total capacity); sludge storage tanks (~38,000 gallon total capacity); and bulk solids storage tanks

[83] *Id.* at 2-24.
[84] Wash. Admin. Code § 173-303-141.
[85] *See King County v. Cent. Puget Sound Bd.*, 979 P.2d 374 (1999) ("An alternative considered for purposes of an EIS need not be certain or uncontested, it must only be reasonable.")
[86] Wash. Admin. Code §§ 173-303-040, 173-303-071(3)(r).
[87] EPA, *Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances* at 93–97.

(~1100 yd3 total capacity)."[88] Moreover, while state regulations require hazardous waste generators to ship dangerous waste off-site within 90 days, they do not foreclose the use of safe off-state (and out-of-state) disposal pending the results of testing that may identify a safer permanent disposal option.

VII. Conclusion

We recognize the time and effort that went into the preparation of the DEIS, and we appreciate Ecology's efforts to ensure the safe and efficient disposal of its AFFF. To inform that decision, however, Ecology must do more to evaluate the adverse impacts of PFAS incineration and landfill disposal, as well as modern disposal technologies that can eliminate or reduce those impacts.

Respectfully submitted,

/s/ Sonya Lunder
Sierra Club
1650 38th Street, Suite 102W
Boulder, CO 80301
Sonya.Lunder@sierraclub.org
Tel: (303) 449-5595 Ext 102

/s/ Jonathan Kalmuss-Katz
Earthjustice
48 Wall Street, 15th Floor
New York, NY 10005
jkalmusskatz@earthjustice.org
Tel: (212) 845-7376

[88] Clean Harbors, *Aragonite Incineration Facility*, https://fr.cleanharbors.com/node/1156 (last visited Feb. 4, 2024); Utah Dep't of Env't Quality, *Aragonite Permit: Clean Harbors, LLC*, https://deq.utah.gov/waste-management-and-radiation-control/aragonite-permit-clean-harbors-llc (last updated December 21, 2023).