

Revive Environmental Technology, LLC

REVIVE ENVIRONMENTAL TECHNOLOGY, LLC'S PUBLIC COMMENT IN RESPONSE TO THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT REGARDING AQUEOUS FILM-FORMING FOAM COLLECTION AND DISPOSAL PROGRAM

INTRODUCTION

On December 22, 2023, the Washington Department of Ecology ("DoE") issued a draft Environmental Impact Statement ("EIS") regarding the State's proposed collection and disposal program for aqueous film-forming foam ("AFFF"). AFFF is a fire suppressant containing high concentrations of per- and polyfluoroalkyl Substances ("PFAS"), chemical compounds often known as "forever chemicals" due to the extremely strong carbon and fluorine bond.

Most notably, the EIS proposed four separate potential actions that could be used to implement the proposed AFFF collection and disposal program : (1) Approved Hold in Place; (2) Incineration; (3) Solidification and Landfilling; and (4) Deep Well Injection. DoE also recognized that it could take no action at this time.

In addition to those listed actions, the EIS refers to "emerging technologies" that were considered in the process. DoE stated, however, "[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. However, if one or more of these emerging treatments is further developed and becomes technically and commercially viable, the technology could be implemented under Alternative 1 in the future."

As detailed further below, Revive respectfully submits that supercritical water oxidation ("SCWO"), one of the listed emerging technologies, has been technically ready and commercially available since May 2023 and should be given additional and further consideration as one of the listed Alternatives. Pending that addition, we believe Alternative #1 ("Approved Hold in Place") in the EIS to be the only responsible action for DoE .

SUPERCritical WATER OXIDATION AND PER- AND POLYFLUOROALKYL SUBSTANCES

SCWO is an advanced technology which destroys PFAS by leveraging the distinctive attributes of supercritical water to mineralize PFAS compounds. This "special phase" is achieved at temperatures above 374°C and pressures surpassing 22.1 MPa. These elevated pressures and temperatures allow for the broad and complete mineralization of PFAS within seconds. That has two implications:

- SCWO completely destroys all types of PFAS (long and short chain compounds), often to non-detect levels.
- SCWO only produces non-toxic byproducts - carbon dioxide, water, and brine.

SCWO treats all types of PFAS waste, including AFFF, landfill leachate, industrial wastewater, and contaminated groundwater.

There are multiple companies, in various stages of development, currently using SCWO-based technology systems to destroy PFAS compounds.

REVIVE ENVIRONMENTAL TECHNOLOGY IS COMMERCIALY AVAILABLE; RESULTS

Revive is a clean technology spinout of Battelle, a nonprofit and the largest independent applied science and technology organization in the world, which has decades of environmental remediation technology experience. Revive was conceived six years ago to target the permanent destruction of PFAS in multiple applications, was formally established in December 2022, in financial partnership with Viking Global Investors, and operates as its own commercial entity today.

As a fully capitalized and independent firm, Revive became the first commercially available, fully permitted, complete PFAS destruction solution available in the U.S. Revive has successfully partnered with multiple state and local regulators to secure the necessary air and water discharge permits. Revive rapidly scaled its capability and has seven operational PFAS Annihilators®, which have a combined ability to treat 700,000,000 gallons of PFAS-laden waste annually, when combined with other pre-treatment technologies.

In the first-ever deployments of a PFAS destruction technology in North America, Revive's PFAS Annihilators® are currently operating and destroying PFAS around the country, including over 55,000,000 gallons combined of landfill leachate, AFFF, industrial wastewater, and groundwater.

Importantly, because SCWO (and the PFAS Annihilator®) is a chemical process, its efficacy can be measured and verified to a far greater extent than landfilling, incineration, or deep well injection ("Incumbent Disposal Options"). Revive can produce batch-by-batch analytical evidence of the complete PFAS destruction and zero harmful byproducts, thus providing a higher level of transparency and certainty. To date, all deployments of the PFAS Annihilator® have destroyed PFAS molecules below the U.S. EPA's proposed 4 parts per trillion drinking water standards.

Finally, and perhaps most significantly, Revive is already assisting multiple states organize and conduct AFFF Takeback programs. Revive has been working with New Hampshire and Ohio on their respective takeback programs, which are scheduled for 2024. In addition to destroying their respective AFFF stockpiles, we are providing program infrastructure support, including arranging for collection, tracking, storage, destruction, and disposal. Thus, we have real world experience at every stage of the collection and disposal process.

SCWO AND PFAS ANNIHILATOR®'S REDUCED POTENTIAL OF ADVERSE ENVIRONMENTAL IMPACTS

"The intent of [DoE's] DEIS, as detailed in Chapter 1, is to provide sufficient information on the

best options for AFFF disposal that align with the protection of human health and the environment. With this information, [DoE] will make an informed decision on which alternative or alternatives should be selected for implementation." Pursuant to this mission, DoE sought to analyze the "potential adverse environmental impacts" of the available PFAS disposal options on "earth, water, and air quality, and sensitive biological species and communities."

When compared to the Incumbent Disposal Options, the PFAS Annihilator® presents the same or less potential adverse environmental impacts .

- Its air emissions are demonstrably cleaner than those from an incinerator, consisting of only carbon dioxide and no PFAS molecules.
- Likewise, the impact on aquatic resources and terrestrial habitats is near zero due to the destruction of the PFAS molecules. Landfilling and deep well injection only move PFAS around without addressing the core problem.
- Concerns about spills from vehicle accidents or other handling mishaps can be greatly reduced due to PFAS Annihilator's® ability to be deployed on site, significantly decreasing the cumulative transport miles needed to destroy the AFFF.
- Unlike the Incumbent Disposal Options, the PFAS Annihilator® does not have environmental justice concerns. Landfills and incinerators are frequently located in or near environmental justice communities, with harmful effects disproportionately impacting disadvantaged low-income, overburdened communities.

CONCLUSION

Revive strongly recommends the Washington Department of Ecology reconsider the exclusion of SCWO as an approved disposal method in its upcoming AFFF disposal program. SCWO technology not only aligns with the DoE's commitment to protect human health and the environment but also offers a more sustainable and transparent solution compared to Incumbent Disposal Options. By including SCWO, the DoE will benefit from a proven, commercially viable technology that guarantees complete destruction of PFAS with minimal environmental impact. We urge the Department to prioritize innovative, effective solutions like ours in its final decision, ensuring a safer and cleaner future for Washington's communities and natural resources.

Until such time as DoE has completed the additional review needed to include SCWO as a listed Alternative, DoE should proceed with Alternative #1 ("Approved Hold in Place").

Respectfully submitted,

David Trueba
Chief Executive Officer

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EXHIBIT 1
CATEGORY-BY-CATEGORY ANALYSIS OF
PFAS ANNIHILATOR® WITH REGARD TO
POTENTIAL ADVERSE ENVIRONMENTAL IMPACTS

Below is greater detail of the limited potential environmental impacts of the PFAS Annihilator® based on the categories used in the EIS.

Greenhouse Gas Emissions – Revive's PFAS Annihilator® produces a de minimus amount of carbon dioxide during the treatment process. In fact, state regulators in Ohio and Michigan have determined that the amount was so low as to not require any type of permit. Despite the lack of harmful emissions, all exhaust from the PFAS Annihilator® is run through a vapor polishing process to ensure there are no detrimental emissions.

Transportation and Truck Safety – Revive's PFAS Annihilator® is built inside a conex box and designed to be mobile, so it can be delivered to a DoE-selected location to destroy the AFFF. A central collection and storage location would greatly reduce the risk of potential spills from vehicle accidents or other handling mishaps due to PFAS Annihilator's® ability to be deployed on site, significantly decreasing the cumulative transport miles needed to destroy the AFFF.

Earth and Water Resources – Revive's PFAS Annihilator® would have even fewer potential adverse effects on soils, surface water, and groundwater. While the risks for vehicle accidents or spills in transport exist, Revive's complete destruction of PFAS means there are no harmful byproducts, and no further contamination risk, after processing. Conversely, this is not true for the Incumbent Disposal Options. Solidification and landfilling can always seep back into landfill leachate and sanitary sewers. Deep well injection necessarily puts untreated AFFF directly into the ground with the hope that it will not contaminate groundwater. And the emissions from incineration may contain PFAS particulate that can land in lakes and waterways.

Aquatic Resources; Terrestrial Habitats; Vegetation – The PFAS Annihilator® poses virtually no risk of an adverse environmental impact to earth – from aquatic resources to vegetation - for multiple reasons. First, the PFAS Annihilator® can be deployed to locations close to previously collected AFFF significantly reducing risks associated with transporting AFFF. Second, the complete mineralization of the PFAS in the AFFF means there is no risk of PFAS eventually making its way into Washington's waterways.

Human Health and Safety; Tribal Resources; Cultural and Historical Resources – For the reasons state above, there are no risks to inhabitants of Washington State during the processing and destruction of PFAS via the PFAS Annihilator®.

Environmental Justice - There are societal benefits to SCWO and Revive's PFAS Annihilator® beyond the complete and broad destruction of PFAS. Many incumbent PFAS disposal methods are problematic beyond the uncertainties regarding their effectiveness. Landfills and incinerators are frequently located in marginalized areas, with their harmful effects disproportionately impacting low-income, minority communities. This siting practice contributes to health disparities and environmental burdens in these areas. The communities affected by these siting decisions lack the

political and economic power to oppose such facilities, leading to a concentration of pollution and associated health risks in regions already facing socio-economic challenges. Because SCWO and Revive's PFAS Annihilator® completely mineralizes PFAS without creating harmful byproducts, it is safe for every community.

**REVIVE ENVIRONMENTAL TECHNOLOGY, LLC'S PUBLIC COMMENT IN RESPONSE TO THE
STATE OF WASHINGTON DEPARTMENT OF ECOLOGY'S
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¹ See Washington State Department of Ecology, AFFF Collection and Disposal Program Draft EIS, Chapter 2: Project Description and Alternatives, Section 2.2

² See Washington State Department of Ecology, AFFF Collection and Disposal Program Draft EIS, Chapter 2: Project Description and Alternatives, Table 2-3: PFAS Destruction Technologies Considered and Eliminated as Alternatives, pages 2-25 and 2-26

³ Revive would further support a consolidated collection program whereby all AFFF is collected and stored in a single facility



There are multiple companies⁴, in various stages of development, currently using SCWO-based technology systems to destroy PFAS compounds.

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Finally, and perhaps most significantly, Revive is already assisting multiple states organize and conduct AFFF Takeback programs. Revive has been working with New Hampshire⁶ and Ohio⁷ on their respective takeback programs, which are scheduled for 2024. In addition to destroying their respective AFFF stockpiles, we are providing program infrastructure support, including arranging for collection, tracking, storage, destruction, and disposal. Thus, we have real world experience at every stage of the collection and disposal process.

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"The intent of [DoE's] DEIS, as detailed in Chapter 1, is to provide sufficient information on the best options for AFFF disposal that align with the protection of human health and the environment. With this information, [DoE] will make an informed decision on which alternative or alternatives should be selected for implementation."⁹ Pursuant to this mission, DoE sought to analyze the "potential adverse

⁴ [Revive Environmental Technology](#), [General Atomics](#), and [374Water](#) are companies actively deploying SCWO technology to destroy PFAS

⁵ Revive has operated within all necessary permits or exemptions in Michigan and is currently in the process of receiving permits and exemptions in Ohio

⁶ <https://newhampshirebulletin.com/2023/07/25/nh-is-first-state-to-partner-with-pfas-annihilator-to-destroy-firefighting-foams/>

⁷ <https://governor.ohio.gov/media/news-and-media/governor-dewine-announces-project-to-destroy-toxic-firefighting-foam>

⁸ Please note these responses are from Revive's perspective. While SCWO technologies are similar, Revive does not have any experience with other SCWO providers to be able to speak to their capabilities in regard to individual risks

⁹ Washington State Department of Ecology, AFFF Collection and Disposal Program Draft EIS, Chapter 2: Project Description and Alternatives, Section 2.1, page 2-1



environmental impacts” of the available PFAS disposal options on “earth, water, and air quality, and sensitive biological species and communities.”

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¹⁰ See Exhibit 1 for a detailed summary of the reduced environmental impacts of the PFAS Annihilator®



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