

# Technical Memorandum

To: Abby Thorne-Lyman, Director  
Alesia Strauch, SR/WA, Base Reuse Manager  
Base Reuse and Economic Development  
City of Alameda

From: Andrew Romolo, PG  
Terraphase Engineering Inc.

cc:

Date: May 7, 2024

Project No.: 0284.001.013

Subject: **University of Washington Marine Cloud Brightening Project, USS Hornet,  
Alameda Point, California**

On behalf of the city of Alameda, Terraphase Engineering Inc (Terraphase) has reviewed the activities proposed by the University of Washington’s Marine Cloud Brightening Project at the USS Hornet located at Alameda Point, California. Terraphase understands that the University of Washington is proposing to study a small-scale series of atmospheric sea salt processes (marine cloud brightening) from the top deck of the USS Hornet. The study is expected to operate 4 days a week over a 20-week period.

As part of the study, spray nozzles will be temporarily affixed to the top deck of the USS Hornet to aerosolize sea water to the atmosphere. On the days of operation, the spray nozzles will be operated three times (up to 30 minutes each event) prior to opening the USS Hornet to the public. The sea water will be fabricated on site by mixing potable water with an artificial sea water product provided by Lake Products Company LLC (see attached product information). The potable water will be mixed with the product to meet the sea water composition standards defined in ASTM D1141-98.<sup>1</sup> The proposed study will measure the effects of sea salt aerosol between 10 to 200 meters from the spray nozzles by attaching sensors to scissor lifts that will be deployed on the deck of the USS Hornet. The study will not measurably alter local or regional weather or climate.

The chemical constituents in the sea water solution, listed in the attached document, are naturally occurring in the environment. Note that seawater naturally aerosolizes and is one of the largest sources of natural aerosols to the atmosphere. Given the chemistry of the solution, we do not see this operation as a health risk to the surrounding community, particularly because the solution reflects natural marine water chemistry and exposure to the aerosols is intermittent and limited to a relatively short timeframe. We also would expect a rapid dilution and attenuation of the aerosol plume as it disperses in ambient air away from the study location.

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<sup>1</sup> <https://www.astm.org/d1141-98r21.html>.

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The presence of a chemical does not always equate with a health risk; toxicity of a chemical is dependent on the amount to which an organism is exposed over a specific timeframe as well as the route through which it is exposed. While the U.S. Department of Labor's Occupational Safety and Health Administration recognizes that some of the individual constituents that comprise the artificial sea water, when evaluated on their own, may be hazards that can impact human health, it is important to consider both the concentration of the exposure and the duration. For example, concentrated solutions of boric acid (one of the constituents in the artificial seawater) can cause chemical burns upon contact with skin or eyes. However, boric acid is commonly used in eyedrops at concentrations up to 2 percent, a concentration 28 times higher than that used in making the artificial seawater. Terraphase does not expect that aerosolization of the seawater would result in any adverse effects to the surrounding community given the concentrations disclosed in the attached product information (which reflect the concentrations naturally present in seawater), the operational procedures where the saline solution is dispersed into the atmosphere (not an enclosed space), and the short, intermittent exposures as defined by the study's operating schedule.

Terraphase had the opportunity to discuss this study with the University of Washington on April 29, 2024. During the discussion, the study team indicated they intended to place particulate matter air monitors (i.e., PurpleAir air quality monitors) within the localized area of the study. We recommend this measure be implemented to verify that particulate matter levels in the area do not increase as a result of study activities.

Terraphase understands that both the study team and the USS Hornet director would like to run study trials during operating hours of the USS Hornet as a live museum exhibit. Given the nature of the product being used and the short duration of each test, we do not anticipate that operating study trials as an exhibit would present any adverse effects to museum visitors or staff.

Lastly, Terraphase recommend the study team review the requirements of California Proposition 65 and verify study compliance.<sup>2</sup> We also recommend that the operators of this experiment provide the city of Alameda written verification the study operations will be comply with all local, state, and federal regulations.

Attachment: Lake Products Company LLC "Sea-Salt" ASTM D1141-98 Composition

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<sup>2</sup> <https://oehha.ca.gov/proposition-65>.



**"Sea Salt" ASTM D1141-98 Composition:**

Sodium Chloride	NaCl	58.490%
Magnesium Chloride	MgCl <sub>2</sub> -6H <sub>2</sub> O	26.460%
Sodium Sulfate	Na <sub>2</sub> SO <sub>4</sub>	9.750%
Calcium Chloride	CaCl <sub>2</sub>	2.765%
Potassium Chloride	KCl	1.645%
Sodium Bicarbonate	NaHCO <sub>3</sub>	0.477%
Potassium Bromide	KBr	0.238%
Boric Acid	H <sub>3</sub> BO <sub>3</sub>	0.071%
Strontium Chloride	SrCl <sub>2</sub> -6H <sub>2</sub> O	0.095%
Sodium Fluoride	NaF	0.007%

\*Density of Seawater equals 1.025 at 15 degrees Celsius

\*Percentages of each component are measured by weight

**Lake Products Company LLC**

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lakeproductscompany.com