

Maine CDC Scientific Brief: PFOS Fish Consumption Advisory for the Former Naval Air Station in Brunswick, Maine

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I. Background

The Maine Center for Disease Control and Prevention (Maine CDC) is responsible for regularly assessing whether any health threats exist for persons consuming freshwater and anadromous fish caught in state waters by noncommercial anglers and issuing a consumption advisory in consultation with the Commissioners of the Maine Departments of Marine Resources, Environmental Protection, and Inland Fisheries and Wildlife if threats to public health are identified (MRSA 22 § 1696 I).

The United States Navy (“the Navy”) is conducting cleanup activity at the former Naval Air Station Brunswick (NASB) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The former NASB is located in Brunswick, Cumberland County, which is situated near the southern coastal area of Maine. Former NASB is located approximately 20 miles northeast of Portland, just south of the Androscoggin River and north of several coves (i.e., Harpswell, Buttermilk, and Woodward) that connect with Casco Bay. The prominent water bodies located on the former NASB include Mere Brook, Picnic Pond, and Merriconeag Stream. Groundwater flows toward these surface water bodies with discharge ultimately to the Androscoggin River to the north and Harpswell Cove to the south. In 2010, the Navy began investigations related to per- and polyfluoroalkyl substances (PFAS) at former NASB. The Navy is in the Remedial Investigation (RI) phase for PFAS with field efforts beginning in 2022 and continuing into 2023. Earlier investigations confirmed that PFAS were released to the environment. One of the RI objectives is to delineate the nature and extent of confirmed PFAS releases by performing additional data collection of soil, groundwater, surface water, sediment, stormwater, porewater, and biota.

The data collected as part of the PFAS RI will be used to evaluate potential risk to human and ecological receptors exposed to PFAS. The Navy has not issued the RI report but has completed data validation and shared data with the Maine Department of Environmental Protection (Maine DEP) and the United States Environmental Protection Agency (EPA) Region 1. The Navy is the lead federal agency, with oversight from EPA and Maine DEP, for cleanup of sites at NASB under CERCLA, commonly referred to as Superfund.

In April of 2024, Maine CDC was informed by Maine DEP of the new fish tissue PFAS data from the former NASB. Fish tissue samples include both freshwater finfish data, which will be evaluated in this assessment, and marine shellfish data. The shellfish data fall outside of Maine CDC’s statutory mandate to assess whether any health threats exist for persons consuming freshwater and anadromous fish caught in state waters by noncommercial anglers and are therefore not included in this assessment¹. Freshwater fish tissue samples were analyzed for a suite of 40 PFAS. Consistent with other freshwater bodies throughout the state, PFOS was the predominant PFAS detected in all fish tissue samples and is the driver for any fish consumption advisories. Freshwater fish tissue data collected included thirteen whole fish samples and seventeen skinless fillet samples and seventeen offal samples for adult fish. For the purposes of developing fish consumption advisories, Maine CDC uses fish fillet data as the edible

¹ All shellfish samples collected as part of the remedial investigation for the former NASB with the exception of two soft-shelled clam samples from North Harpswell Cove were below the limit of detection for PFOS. The two soft-shelled clam samples with PFOS detection were all below 1 ng/g (wet weight), which is below any existing freshwater fish tissue action levels. Additionally, the head of Harpswell Cove is closed for shellfish harvesting due to elevated levels of Arsenic.

portion, and most often relies on skinless fillets. This document discusses recent analyses and recommendations regarding freshwater fish consumption in the waters in and around NASB. Specifically, it describes proposed waterbody-specific advisories based on the skinless fillet data provided by the U.S. Navy collected during the fall of 2023 based on levels of PFOS in fish tissue.

II. Approach to Fish Consumption Advisories

Maine CDC derives and uses chemical-specific fish tissue action levels (FTALs) as a guide to determine the need to develop a fish consumption advisory. These FTALs are derived following the U.S. Environmental Protection Agency (EPA) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (EPA 1996; EPA 2000a; EPA 2000b). FTALs are concentrations of a contaminant, in this case perfluorooctane sulfonic acid (PFOS)², in fish tissue below which there should be negligible risk of toxicity at a high rate of fish consumption intended to be protective of most recreational anglers.

When analyzing fish tissue contaminant data, Maine CDC's preference is to have a minimum of five composite samples consisting of five individual fish per composite of the same species per waterbody, preferably over at least two years, as the basis for assessing the need for issuing fish consumption advisories. Selection of appropriate indicator species to sample may vary depending on the contaminant and waterbody and will rely on input from the Maine DEP and the Maine Department of Inland Fisheries and Wildlife. Maine CDC uses EPA's ProUCL software to compute an upper confidence limit on the mean (UCL) of the composite samples (EPA 2022). Maine CDC compares the UCL to the maximum measured contaminant concentration and uses the lower of the two values as an upper-level estimate of fish tissue concentrations for a given species and waterbody. In circumstances where contaminant levels are high enough to suggest the need for a very restrictive consumption advisory, Maine CDC may issue fish consumption advisories with fewer than five composite samples, especially if there are supporting data (e.g., presence of elevated PFAS levels in surface water samples).

Measured concentrations of PFOS in fish tissue are compared to the FTAL. When fish tissue concentrations exceed an FTAL, the development of a fish consumption advisory is considered. Fish consumption advisories are presented as an allowable fish consumption rate that is not expected to exceed the toxicity value of PFOS, which is a measure of daily dose that results in a minimal risk of any adverse health outcome. In 2022, Maine CDC updated the PFOS FTAL to 3.5 nanograms per gram (ng/g) to reflect the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) 2021 toxicity value (see [2023 Scientific Brief](#)³ for full derivation of the PFOS FTAL). Maine CDC typically relies on toxicity values developed by federal agencies such as the U.S. EPA or ATSDR. On April 10, 2024, the U.S. EPA published updated toxicity values for PFOS used in the development of their finalized National Primary Drinking Water Regulations. These toxicity values are considerably lower than ATSDR's 2021 toxicity value for PFOS (0.1 ng/kg/day vs 2 ng/kg/day, respectively). Maine CDC is reviewing EPA's updated toxicity values and their suitability for use in developing fish consumption advisories, as well as awaiting EPA guidance on the use of these toxicity values in the development of fish consumption

² For PFAS action levels, Maine CDC follows the PFAS naming convention indicated by ATSDR, which follows the U.S. CDC's PFAS terminology in using the acid form when listing the compounds full name, e.g., perfluorooctane sulfonic acid versus perfluorooctane sulfonate (ATSDR 2021).

³ <https://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/documents/pfas-fish-scientific-brief-04202023.pdf>

advisories. In the interim Maine CDC is continuing to rely on ATSDR’s toxicity value of 2 ng/kg/day for PFOS.

Using ATSDR’s toxicity value of 2 ng/kg/day for PFOS and an 8 oz fish meal size for adults, Maine CDC calculates fish tissue PFOS concentrations that correspond to specified meal frequencies (Table 1).

Table 1. Levels of PFOS in fish and corresponding 8-ounce meal advice categories.

PFOS in fish (ng/g)	Meal advice
3.5	One meal per week
7.5	Two meals per month
15	One meal per month
30	Six meals per year
60	Three meals per year
> 60	Do Not Eat

Maine CDC considers issuing a fish consumption advisory if fish cannot be safely consumed at a rate of at least one meal per week. Thresholds for issuing a Do Not Eat (DNE) advisory are evaluated on a contaminant-specific basis. For PFOS, Maine CDC will issue a DNE advisory when fish cannot be safely consumed at a rate of at least three meals per year because at lower consumption rates (and the associated higher fish tissue levels), the impact on exposure to PFOS of eating just one additional fish meal per year becomes increasingly large. Maine CDC is aware of other states using 12 meals per year (New Jersey), six meals per year (Michigan), and one meal per year (Massachusetts) as the threshold for a DNE advisory for PFOS.

In considering whether to issue an advisory, Maine CDC also evaluates whether the resulting advisory would be more restrictive than any existing advisories⁴, such as the statewide mercury fish consumption advisory (Table 2). The FTAL of 3.5 ng/g for PFOS allows for consumption of 8-ounces per week of any sport caught fish of any species for adults. However, the existing statewide mercury fish consumption advisory recommends anglers eat no more than two fish meals per month for most fish species and consumption of up to a meal per week is restricted to brook trout and landlocked salmon. For sensitive populations (children less than 8 years of age and women who are or who may become pregnant), the statewide mercury advisory is even more restrictive and recommends no consumption of freshwater fish from Maine’s inland waters except for landlocked salmon and brook trout which can be consumed at a rate of one meal per month (Table 2). Thus, in determining whether a PFOS-specific advisory needs to be issued, Maine CDC will evaluate whether the concentrations of PFOS in fish tissue warrant an advisory that is more restrictive than the current statewide mercury advisory or any other waterbody-specific advisories.

⁴ Current fish consumption advisories can be found under Maine CDC’s Freshwater Fish Safe Eating Guidelines (<https://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/2kfca.htm>)

Table 2. Statewide mercury fish consumption advisory.

Sensitive populations (pregnant and nursing women, women of childbearing age, children under age 8)

Brook trout and landlocked salmon	One meal per month
All other species	Do Not Eat

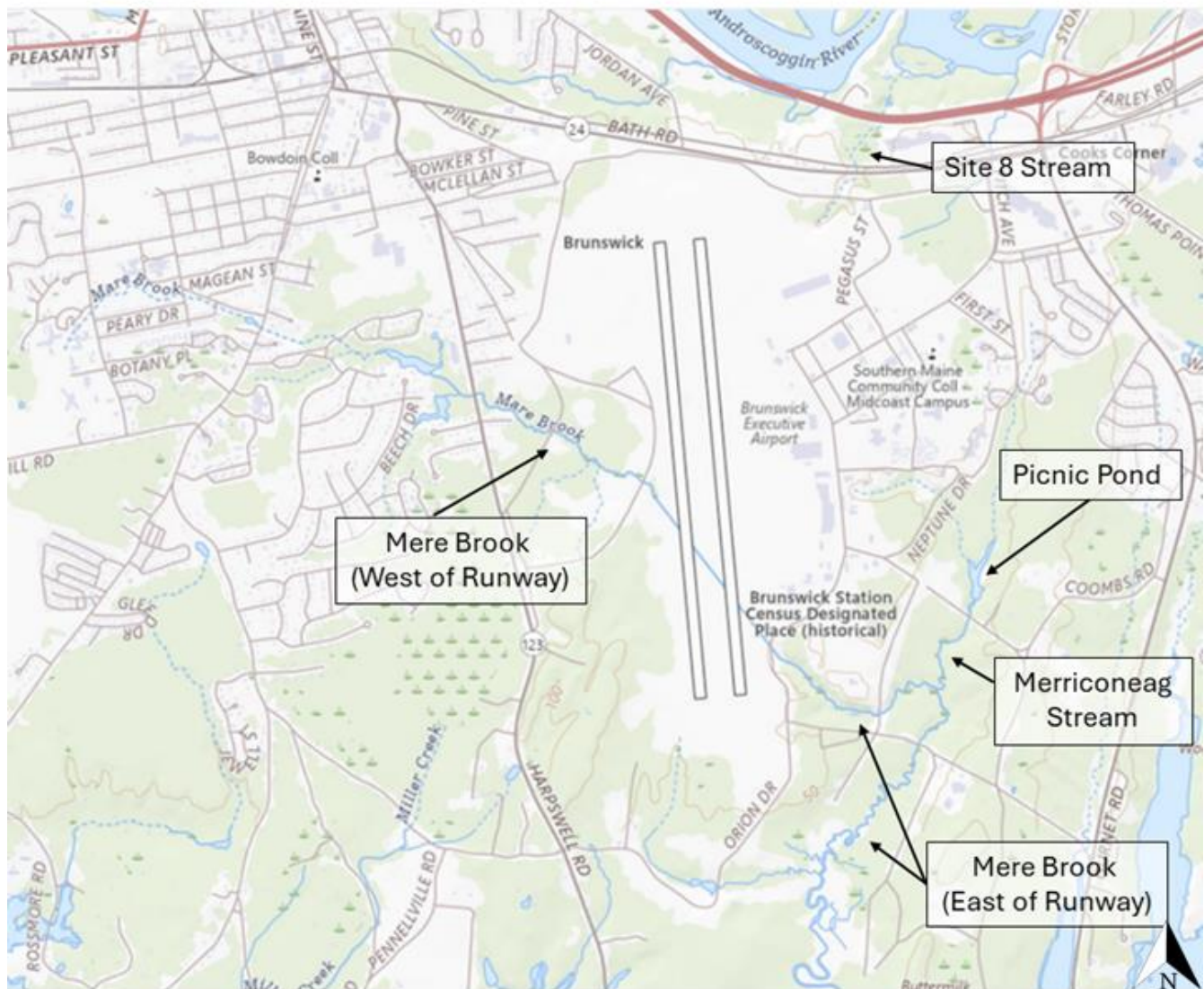
General population (all other adults and children aged 8 and older)

Brook trout and landlocked salmon	One meal per week
All other species	Two meals per month

III. Basis for Fish Consumption Advisories at the Former Naval Air Station in Brunswick

The following sections present the basis for the fish consumption advisories on and around NASB. Figure 1 provides a map of the area with each sampled waterbody marked. For the purposes of this assessment each waterbody is evaluated individually. In the following sections, for each species within a waterbody, fish tissue PFOS concentrations are presented graphically and compared to recommended consumption rates as described in Table 1, which provides the basis for fish consumption advice.

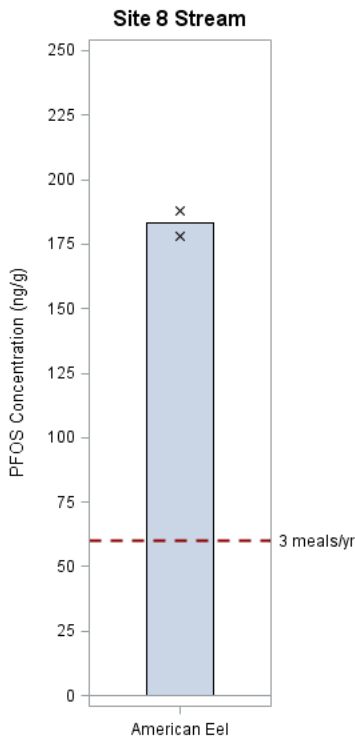
Figure 1. Map of waterbodies sampled on and around the former Naval Air Station in Brunswick.



A. Site 8 Stream

Area: All of Site 8 Stream.

Advisory: Do Not Eat fish of any species.



Justification: In 2023, two composite samples of American eel were collected from Site 8 Stream to the Northeast of the base. Site 8 Stream was selected as a sampling location as it receives inputs from the base. One composite sample was made up of three eels and the other was made up of four eels, with fish lengths ranging from 7.5 to 11.2 inches with most greater than 9 inches, a life stage often referred to as “yellow eels”. The two composite eel fillet samples had PFOS levels of 178 and 188 ng/g with a mean concentration, weighted by the number of fish per composite, of 184 ng/g (Figure 2). At these concentrations fish cannot safely be consumed at a rate of three meals per year, which corresponds to Maine CDC’s DNE threshold for PFOS. Although there are limited data with only two American eel composite samples, given the highly elevated PFOS levels in fish tissue and historical surface water concentrations in the stream ranging from 190 to 2000 ng/L, a DNE advisory is recommended for any species of fish caught from all of Site 8 Stream.

Figure 2. Fish Tissue PFOS concentrations in Site 8 Stream. The bar corresponds to the mean PFOS tissue concentration for American eel. The Xs correspond to the PFOS concentration of each composite sample.

B. Picnic Pond

Area: All of Picnic Pond.

Advisory: Do Not Eat fish of any species.

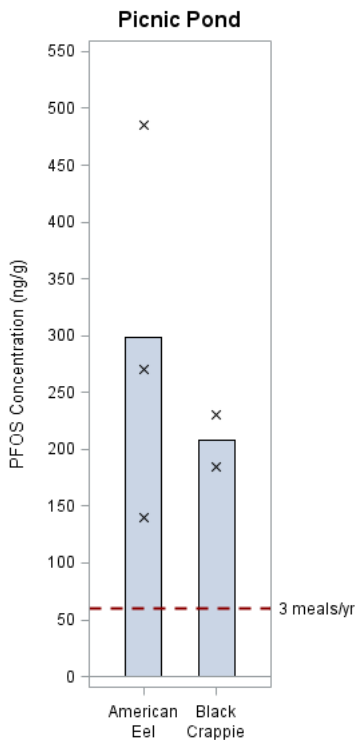


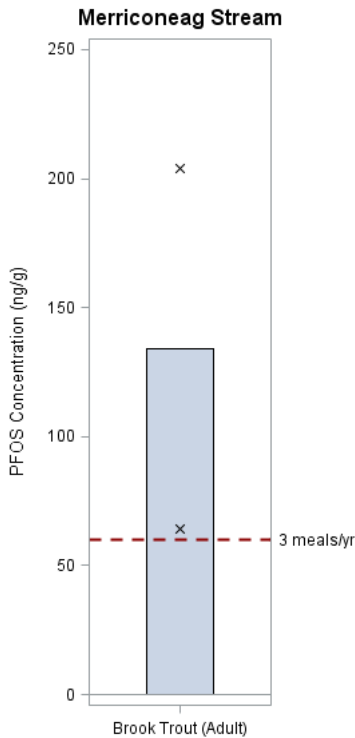
Figure 3. Fish Tissue PFOS concentrations in Picnic Pond. The bar corresponds to the mean PFOS tissue concentration for each species. The Xs correspond to the PFOS concentration of each composite sample.

Justification: In 2023 three composite samples of American eel were collected from Picnic Pond in the Southeastern portion of the former base. Each composite sample was made up of five eels. Additionally, two composite samples of black crappie were collected; one composite sample was made up of three black crappie and the other was made up of four black crappie. The three eel composite samples ranged from 10.6 to 20.3 inches in length (yellow eels) and had PFOS concentrations ranging from 140 to 485 ng/g with a mean concentration of 298 ng/g (Figure 3). The two black crappie composite samples ranged from 3.1 to 5.9 inches in length and had PFOS concentrations of 185 and 230 ng/g with a mean concentration, weighted by the number of fish per composite, of 211 ng/g (Figure 3). At these concentrations fish cannot safely be consumed at a rate of three meals per year, which corresponds to Maine CDC's DNE threshold for PFOS. Although there are limited data with only two black crappie composite samples and three eel composite samples, given the highly elevated PFOS levels in fish tissue and historical surface water concentrations in the pond ranging from 200 to 900 ng/L, a DNE advisory is recommended for any species of fish caught from Picnic Pond.

C. Merriconeag Stream

Area: All of Merriconeag Stream.

Advisory: Do Not Eat fish of any species.



Justification: In 2023, two composite samples of adult brook trout were collected from Merriconeag Stream downstream of Picnic Pond. One composite sample was made up of three brook trout and the other was made up of four brook trout. The fish lengths ranged from 5.9 to 7.3 inches in length. The two brook trout composite samples had PFOS concentrations of 64.3 and 204 ng/g with a mean concentration, weighted by the number of fish per composite, of 144 ng/g (Figure 4). At these concentrations fish cannot safely be consumed at a rate of three meals per year, which corresponds to Maine CDC’s DNE threshold for PFOS. Although there are limited data with only two brook trout composite samples, given the highly elevated PFOS levels in fish and historical surface water concentrations in the stream ranging from 130 to 280 ng/L, a DNE advisory is recommend for any species of fish caught from Merriconeag Stream.

Figure 4. Fish Tissue PFOS concentrations in Merriconeag Stream. The bar corresponds to the mean PFOS tissue concentration for brook trout. The Xs correspond to the PFOS concentration of each composite sample.

D. Mere (Mare) Brook (East of Runway)

Area: Mere (Mare) Brook from the Eastern side of the runway to Liberty Crossing.

Advisory: Do Not Eat fish of any species.

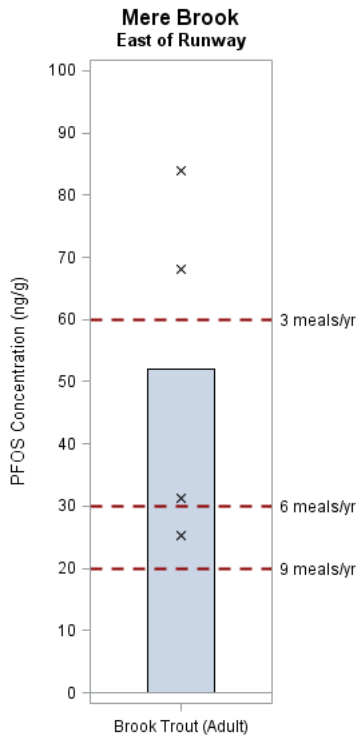


Figure 5. Fish Tissue PFOS concentrations in Mere Brook (East of runway). The bar corresponds to the mean PFOS tissue concentration for brook trout. The Xs correspond to the PFOS concentration of each composite sample.

Justification: In 2023, six composite adult brook trout samples were collected at three points along Mere Brook. All composite samples consisted of five brook trout. Two composite samples were collected on the Western side of the base upstream of the runway, two composite samples were collected East of the runway upstream of Mere Brook’s confluence with Merriconeag Stream, and two composite samples were collected downstream of Mere Brook’s confluence with Merriconeag Stream. The size of the brook trout caught along all three sections of Mere Brook were similar, ranging from 5.9 to 8.5 inches in length. The Western and Eastern sections of Mere Brook are separated by a culvert that runs underneath the runway of the former base (see Figure 1). It is unlikely that fish will cross through the culvert under the runway. Additionally, the Western section of Mere Brook is upstream of the base and is not suspected to be largely impacted by base inputs. For the purposes of this analysis, the sections of Mere Brook West and East of the runway will be treated as distinct and analyzed separately.

For the section of Mere Brook East of the runway, the PFOS concentrations in the fish tissue from brook trout samples collected upstream of the confluence with Merriconeag Stream were 25.2 and 31.3 ng/g with a mean concentration of 28.3 ng/g. The PFOS concentrations in the fish tissue from the brook trout samples collected downstream of the confluence were 68.1 and 83.9 ng/g with a mean concentration of 76.0 ng/g. Combined, the upstream and downstream

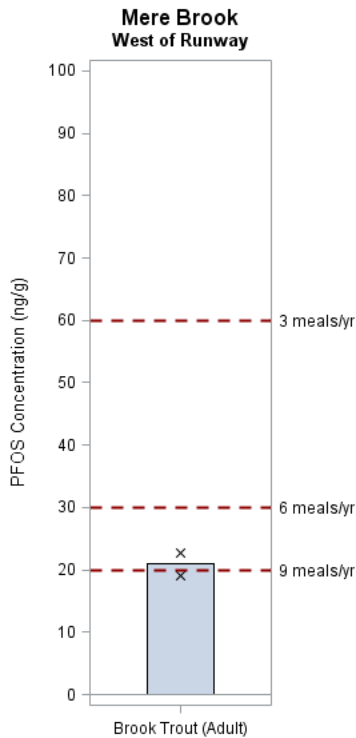
samples have a mean PFOS concentration of 52.1 ng/g with a UCL of 85.6 ng/g (Figure 5, UCL not pictured). As the maximum concentration of 83.9 ng/g is lower than the UCL, the maximum level will be used as a conservative estimate of fish tissue PFOS levels for determining consumption advice. Although the brook trout samples from upstream of the confluence with Merriconeag Stream have lower PFOS concentrations than those downstream, there are no physical impediments (e.g., dams) that would prevent fish movement throughout this section of Mere Brook and fish tissue PFOS concentrations are elevated along the entire Eastern section of Mere Brook. As a result, and given historical surface water concentrations ranging from 69 to 130 ng/L downstream of the confluence with Merriconeag Stream, the DNE advisory extends upstream to the culvert on the Eastern side of the runway and downstream to Liberty Crossing. Liberty Crossing is near the head of tide where Mere Brook becomes part of the Harpswell Cove estuary.⁵

⁵ <https://www.brunswickme.gov/233/Mare-Brook-Watershed-Planning>

E. Mere (Mare) Brook (West of Runway)

Area: Mere Brook from Coffin Ice Pond to the Western edge of the runway.

Advisory: Consume no more than six meals per year of brook trout.



Justification: In 2023, two composite adult brook trout samples, consisting of five fish, were collected from Mere Brook along the section upstream and to the West of the runway. The PFOS concentration in the fish tissue from these brook trout samples were 19.1 and 22.7 ng/g with a mean concentration of 20.9 ng/g (Figure 6). Given the limited data, the maximum concentration of 22.7 ng/g will be used as a conservative estimate of fish tissue PFOS levels for determining consumption advice. In the absence of additional fish tissue samples and given historical surface water concentrations in the Western section of Mere Brook were elevated at 47 ng/L, Maine CDC recommends anglers consume no more than six meals per year of any fish species. This advisory will extend upstream to the dam at Coffin Ice Pond and downstream to the Western edge of the runway. Both boundaries are largely based on physical impediments to fish movement. The Western section of Mere Brook and Coffin Ice Pond will be prioritized for additional sampling by the Maine DEP Surface Water and Ambient Toxics (SWAT) program to better characterize PFOS levels in fish tissue for both waterbodies.

Figure 6. Fish Tissue PFOS concentrations in Mere Brook (West of runway). The bar corresponds to the mean PFOS tissue concentration for brook trout. The Xs correspond to the PFOS concentration of each composite sample.

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