Water Quality Program

Category 4b Summary

Draft 2026 Integrated Report

Lingering Oiled Beaches, Exxon Valdez Oil Spill

Abstract

The *Exxon Valdez* oil spill (EVOS) occurred on March 24, 1989 in Prince William Sound (PWS). An estimated 11 million gallons of oil were spilled in PWS, yet only an estimated 10% of the total oil spill was recovered during immediate cleanup efforts. Since then, hundreds of scientific investigations have studied the long-term fate, transport, and effects of the EVOS on the ecological communities of PWS. More than 30 years of research has provided a great deal of information on the persistence of oil and the responses of different species to both acute (short-term) and chronic (long-term) effects of exposure to oil, as well as the role the ecosystem plays in the recovery of affected species. Despite the action of natural processes and cleanup efforts, a portion of the initial EVOS oil persists in the aquatic environment as sequestered subsurface oil and surface oil patches. This sequestered oil is termed lingering oil and is not considered bioavailable unless disturbed.

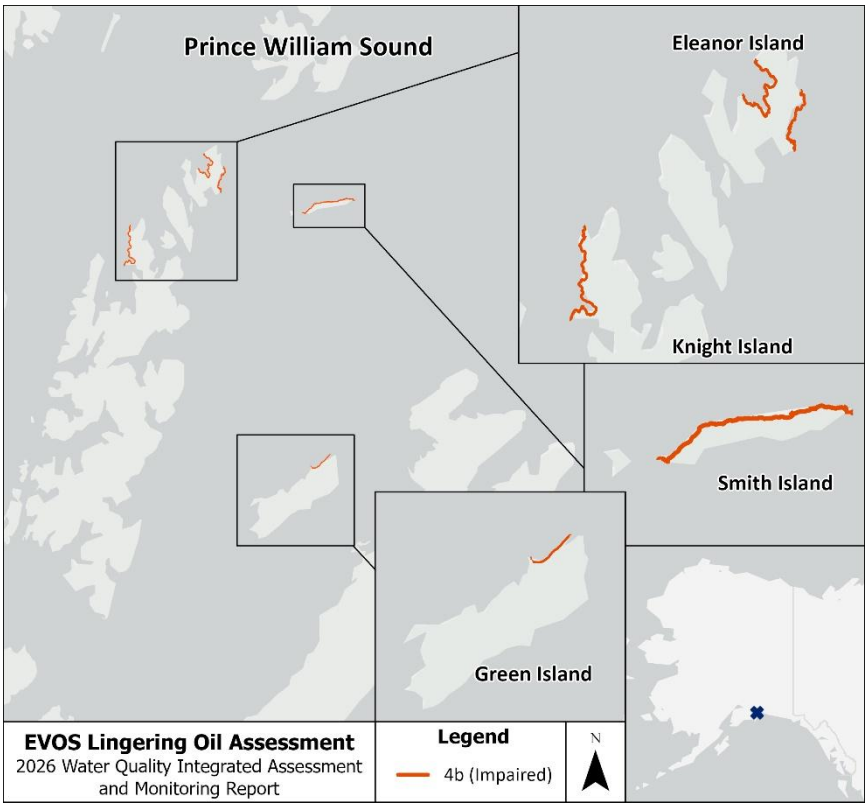


Figure 1. 2026 EVOS lingering oil assessment map

Several nearshore beach areas remain on the Alaska Department of Environmental Conservation (DEC) impaired waters list. DEC recently developed a tiered, science-based process to assess whether lingering oil impairs a beach assessment unit's[1] (AU) designated use(s). Based on this more robust approach, DEC recommends delisting 11 previously listed AUs[2], leaving five AUs as impaired, and adding no new impaired AUs.[3] EVOS

[1] An assessment unit is the segment of a waterbody from which data is analyzed to determine if water quality standards are being met.

[2] In the 2026 Integrated Report, DEC adjusted the assessment unit segment lengths to be based on shoreline HUC-14 scale watersheds. Throughout this document DEC uses the new assessment units when describing attainments or impairments. Appendix A provides a crosswalk of the previous and revised assessment units.

[3] This 4b demonstration is based on the 1989 *Exxon Valdez* oil spill and subsequent research including the new process for determining areas likely impacted by lingering oil developed by DEC in 2025.

scientific literature from the past decade indicates minimal change in the amount and distribution of lingering oil in PWS. The change in impaired areas reflects DEC's more robust decision approach and modified AUs that more accurately reflect geomorphic conditions. Because there are various recovery plans in place, DEC recommends placing EVOS beaches with lingering oil in Category 4b, Impaired with a Recovery Plan for Petroleum hydrocarbons, Oils and Grease.

Table 1. Current assessment unit status and applicable water quality standard (WQS)

Parameter	Lingering oil
Category Change	See Table 2
Water Quality Standard	Petroleum hydrocarbons, oils and grease, for marine water uses[4]
Designated Uses Affected	All

Table 2. EVOS assessment units (AU) with Integrated Report category information[5].

Assessment Unit Name	Assessment Unit ID	Number Previous AUs in New AU	PWS Island	Data Type Used for Decision	Current Category	2026 IR Proposed Category
Smith Island North	AK_B_3020207_000	3	Smith Island	Test pit	4b	4b
Herring Bay	AK_B_3020603_004	3	Knight Island	Test pit	4b	4b
Point Eleanor	AK_B_3020302_002	3	Eleanor Island	Modeled data	4b	4b
Northwest Bay	AK_B_3020301_000	5	Eleanor Island	Test pit	4b	4b
Gibbon Anchorage-Frontal Prince William Sound	AK_B_3040303_002	2	Green Island	Test pit	4b	4b
Smith Island South	AK_B_3020207_001	1	Smith Island	Modeled data	4b	2
South Arm Bay of Isles	AK_B_3020403_000	2	Knight Island	Modeled data	4b	2
Herring Bay	AK_B_3020603_006	1	Knight Island	Modeled data	4b	2
Herring Bay	AK_B_3020603_005	1	Knight Island	Modeled data	4b	2
Herring Bay	AK_B_3020603_003	1	Knight Island	Modeled data	4b	2
Sleepy Bay-Frontal Montague Strait	AK_B_3030605_000	4	Latouche Island	Modeled data	4b	2

[4] Alaska Department of Environmental Conservation. 2025. *18 AAC 70.010 Water Quality Standards*. Amended as of January 8, 2025.
[5] See Appendix A for a complete crosswalk of the 2014/16 Integrated Report impaired AUs to the revised 2026 assessment units.

Point Eleanor North	AK_B_3020302_000	2	Eleanor Island	Modeled data	4b	2
Lower Passage-Frontal Prince William Sound	AK_B_3020305_008	3	Knight Island	Modeled data	4b	2
Lower Passage-Frontal Prince William Sound	AK_B_3020305_007	2	Disk Island	Modeled data	4b	2
Lower Passage-Frontal Prince William Sound	AK_B_3020305_003	2	Ingot Island	Modeled data	4b	2
Evans Point-Frontal Knight Island Passage	AK_B_3030505_000	1	Evans Island	Modeled data	4b	2

Identification of Impaired Segment and Statement of Problem Causing the Impairment

On March 24, 1989 the T/V *Exxon Valdez* ran aground and discharged approximately 11 million gallons of crude oil into PWS. Immediate cleanup activities included the use of mechanical recovery, dispersants, and in-situ burning in an attempt to mitigate the effect of spilled product. Activities specific to the initial remediation of oiled shoreline between 1989 and 1992 consisted of sediment removal, tilling, and bioremediation.

The persistence of lingering oil is associated with finer grain sand and gravel sediments and is in areas of heavy initial oiling that are sheltered from natural disturbance patterns (wave energy, groundwater flow). Studies have documented that lingering oil occurs in discontinuous patches in the subsurface. Field surveys and mathematical modeling in a 2018 study[6] suggests that about 0.6% of oil from the EVOS remains sequestered below 10 to 20 centimeters of clean sediment in intertidal areas and shorelines.

Lingering oil is defined as: ***"****an oil residue deposited in shoreline sediment from an anthropogenic [from human activity] release that is generally not bioavailable [sequestered, under clean gravel] unless disturbed."*

Lingering oil acts differently than other oils in three specific ways.

1. It has been in the environment a long time and is not part of an active spill.
2. It is typically buried several inches under the sediment.
3. Unless it's disturbed, it generally doesn't interact with humans, fish, birds, or other animals.

As of 2014, the EVOS Trustee Council (EVOSTC) has declared many species fully recovered, including glaucous-winged gulls, bald eagles, river and sea otters, and harlequin ducks, while other species including Pacific herring, pigeon guillemots, marbled murrelets, and orca whales have not. The mechanisms leading to both the injury and recovery timelines of populations vary greatly between the different species.

As of 2014/16 Integrated Report, 36 impaired beach AUs remained in Category 4b. Since then, additional scientific studies and lingering oil modeling efforts led DEC to develop a standardized and systematic process for

[6] Aderhold, D.G.R., Lindeberg M.R., Holderied K., Pegau W.S. 2018. "Spatial and Temporal Ecological Variability in the Northern Gulf of Alaska: What Have We Learned Since the *Exxon Valdez* Oil Spill?" *Deep Sea Research Part II: Topical Studies in Oceanography*. 147:3–8. doi:10.1016/j.dsr2.2017.11.015.

determining areas impaired by lingering oil (see Appendix C). This Category 4b demonstration updates the list of impaired beach areas and realigns the segments using Alaska's new assessment units (Table 2 and Appendix B).

The new assessment units were drawn by segmenting the shoreline using HUC-14 scale watersheds as boundaries. Where oiling was present based on past evidence (current impaired waters, predictive model data, test pit data, or initial oil trajectory), assessment units were further delineated using a headland-to-headland approach and taking into consideration shore types[7] and aspect. Using the new assessment units, there are five impaired AUs covering 25,600 meters, or 15.91 miles[8].

Description of Pollution Controls and How They Will Achieve Water Quality Standards

In the decades since the *Exxon Valdez* ran aground in PWS, there have been hundreds of studies conducted in PWS, making it one of the most studied oil spills in the United States. In November 1994, EVOSTC adopted an official Restoration Plan. This plan identified injured resources and services as a result of the spill. Since its adoption, EVOSTC has updated the list of injured resources and services six times, the most recent being 2014. Since 2015, EVOSTC has focused on understanding where lingering oil occurs, if the oil is bioavailable, and the role that changes to the ecosystem have on the ability of species injured by EVOS to recover. Studies also include long-term monitoring of marine conditions and injured resources, harbor protection and marine restoration, and habitat acquisition and protection.

In 2023 DEC completed a literature review of lingering oil studies conducted since 2015[9]. Key findings include:

- Surveys conducted in PWS during the summer of 2015 indicate there is little evidence of change in subsurface oil area or mass over the last 14 years, and no change in the distribution of oiling intensities[10].
- The estimated area and mass of subsurface oil, weathering, oiling intensities, and oil locations have not changed since the surveys conducted in 2001.
- Subsurface oils have higher concentrations of phenanthrenes and chrysenes, which indicates that the subsurface oil has the potential to be toxic, but the lack of weathering suggests that the oil is sequestered in the subsurface.
- Mathematical modeling suggests that lingering subsurface oil is typically sequestered below 10-20 centimeters (cm) of clean sediment.
- This sequestered oil is not bioavailable unless disturbed and is predicted to persist in the environment for at least another decade, likely more.

[7] Shore types were downloaded from the NOAA Response and Restoration website at https://response.restoration.noaa.gov/esi_download#Alaska, and classifications were rated as 1-5 based on their oil capturing capabilities (sand and gravel = high oil capture, rocky outcrops = low oil capture).
[8] The 2014/16 Integrated Report included 36 impaired areas covering 10,071 meters or 6.26 miles.
[9] Alaska Department of Environmental Conservation. 2023. "Final Long-term Effects and Location of Lingering Oil from the Exxon Valdez Oil Spill in Prince William Sound, Literature Review".
[10] The change in impaired areas in the 2026 Integrated Report reflects DEC's more robust decision approach and modified AUs that more accurately reflect geomorphic conditions in PWS.

Water Quality Target

Table 3. Summary of designated uses and narrative Water Quality Standards

Designated Use	Reference	Summarized Narrative Criteria
(A) Water supply - drinking water, culinary, food processing - agriculture - aquaculture - seafood processing - industrial (B) Water recreation - contact recreation - secondary recreation (C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife (D) Harvesting for consumption of raw mollusks or other raw aquatic life	Petroleum Hydrocarbons, Oils and Grease 18 AAC 70.020(5) & (20) Toxic and Other Deleterious Organic and Inorganic Substances 18 AAC 70.020(11) & (23) Residues 18 AAC 70.020(8) & (20) Color 18 AAC 70.020(1) & (13) Sediment 18 AAC 70.020(9) & (21)	Surface waters, adjoining shorelines, and waterbody floor must be virtually free from floating oil, film, sheen, or discoloration. There can be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life.[11] May not exceed concentrations that individually or in combination impart undesirable odor or taste to organisms as determined by bioassay or organoleptic tests.

See 18 AAC 70 for complete narrative criteria.

Appendix C describes the decision process and types of data DEC used to identify lingering oil impaired nearshore assessment units. It specifies the preferred data type, quantity, quality and age; and provides criteria used to determine whether the AU is impaired or meeting WQS.

In summary, four data types are preferred, listed in order of preference (Table 4). Generally, at least 10 high-quality data points are needed per AU being assessed. For example, Tier 1 will first be explored and if test pit data does not exist or does not meet the minimum data requirements, Tier 2 would be explored. Exceptions to the minimum data requirements are allowed under the Overwhelming Evidence tier (Tier 5).

This approach prioritizes direct measurements (Tiers 1 and 2) while still allowing consideration of important indirect measurements (Tiers 3 and 4). If multiple types of screening level data fall short of one or more of the data requirements described in Appendix C, they can be assessed together using the Tier 5 overwhelming evidence approach.

[11] Although 18 AAC 70 contains numeric water quality standards for hydrocarbons, fats, or oils, when assessing lingering oil impairment, chemical concentrations alone might not provide sufficient data for the impairment decisions due to lingering oil's sequestered state within the shoreline sediments.

Table 4. Tiered data types for evaluating lingering oil.

Tier	Data Type
1	**Test Pit Data** dug to see how much oil has penetrated deeper sediment. Depth and amount of oiling are used to compare to water quality standards.
2	**Sediment Chemistry Data** analyzed for polycyclic aromatic hydrocarbon concentrations. Results are compared to safe thresholds for humans and aquatic organisms.
3	**Biological Data** evaluates impacts to wildlife by looking at tissue chemistry data, whether sediment is toxic to organisms, whether populations of organisms are low, or if an organism's diet uptakes pollutants. At least one of two lines of evidence must show a negative difference compared to an unimpacted reference.
4	**Modeled Data** that predicts locations and probability of oil. The probability of oiling is used to compare to water quality standards.
5	**Overwhelming Evidence** allows for multiple lines of evidence when only partial or inconclusive data is available for other tiers but as a whole, they may indicate if it meets water quality standards.

Controls That Will Achieve WQS

Oil is removed through either physical factors or microbial degradation, and the lack of change in vertical distribution suggests beach armoring and other geomorphic features are sequestering oil by reducing the effects of wave action. Microbial degradation, on the other hand, is limited by the low dissolved oxygen levels found within subsurface layers of oiled beaches in PWS. Low exposure to waves, beach armoring, and protective geomorphic features all play a large role in the sequestration of the oil, which contributes to its persistence but also its lack of bioavailability unless disturbed.

Several EVOS studies have identified potential site locations and different remediation techniques that might be possible. However, EVOS-related oil removal or remediation activities have not occurred for several years and are not likely to occur in the near future due to cost and potential for causing additional environmental harm.

After EVOS, safety measures have been instituted to reduce the risk of future spills such as use of double hulled tanker ships, two escort vessels accompany each tanker while passing through PWS, and improved spill prevention and response measures.

Even with improved safety and operational measures, the most likely recovery process for lingering oiled beaches is through monitored natural attenuation over time. Despite the potential for chronic toxicity from remaining oil, results from passive samplers measuring polycyclic aromatic hydrocarbons in a 2018 study[12] indicate low exposure to oil at the sediment surface, and the oil within the sediment is isolated from the environment. DEC is committed to evaluating new data as it becomes available and recommending further recovery activities if warranted.

Description of Requirements under which Pollution Controls Will Be Implemented

EVOSTC was formed to oversee restoration of the injured ecosystem using the civil settlement funds. EVOSTC consists of three state and three federal trustees and is advised by members of the public and scientific

[12] Lindeberg M.R., Carls M., Maselko J. 2018 "Lingering Oil: Extending the Tracking of Oil Levels and Weathering (PAH Composition) in Prince William Sound through Time. Exxon Valdez Oil Spill Trustee Council Project 16120114-S.

community. The DEC commissioner is a member of EVOSTC. As a member of EVOSTC DEC is committed to overseeing the restoration of injured resources through engagement with the public and scientific community.

Public Advisory Committee (PAC)
EVOSTC PAC is a Federal Advisory Committee Act (FACA) committee formed pursuant to FACA and advises the Trustee Council on decisions relating to allocation of funds and the restoration and monitoring activities related to the oil spill. The composition of the PAC is intended to reflect balanced representation from the public at large as well as members from selected principal interests. Starting in 2024, PAC members serve a four-year period effective the date of appointment by the Secretary of the Interior.

Science Panel
Members of the Science Panel advise EVOSTC on the effectiveness of specific restoration efforts. The Science Panel also participates in peer review of research proposals.

Projection of Time When WQS Will Be Met

DEC will continue to evaluate PWS lingering oil studies and restoration efforts. The timeframe for full recovery is expected to be decades unless areas with sequestered lingering oil become disturbed.

Schedule for Implementing Pollution Controls

There is no on-going point or nonpoint source loading to the impaired beaches or adjacent water as a result of the *Exxon Valdez* oil spill; hence there is no need for "pollution controls." Rather, DEC is continuing to evaluate data on the extent of the impairment, the hindrances to recovery, and will establish and implement (most likely through the work of partnering agencies and EVOSTC) any appropriate methods to enhance the recovery timeframe and spill reduction.

Monitoring Plan to Track Effectiveness of Pollution Controls

The 1994 Restoration Plan (Plan) recognized that recovery from the spill would likely take decades. A Restoration Reserve[13] was created in part to provide for long-term observation of injured resources and services and for appropriate restoration actions into the future. To further this effort, in 1999 EVOSTC also supported development of a long-term research and monitoring program. Long-term monitoring after a spill has two components: monitoring the recovery of resources from the initial injury and monitoring how factors other than oil may inhibit full recovery or adversely impact recovered resources.

Ongoing monitoring of lingering oil continues under the EVOSTC Long-Term Monitoring Program (Gulf Watch Alaska). The program goal is to provide data on the quantity of oil remaining and to assess the weathering state through time. Because of the slow degradation rate, oil sampling is scheduled once every five to ten years.

Commitment to Revise Pollution Controls, as Necessary

DEC and EVOSTC are committed to the long-term health and sustainability of the PWS region. DEC will review submitted data and assessments and will determine whether remediation activities are effective in achieving WQS. If future data collection efforts show that actions taken to-date are insufficient to attain and maintain

[13] EVOS Restoration Reserve is part of EVOSTC efforts to restore PWS and the Gulf of Alaska to their pre-spill state. EVOSTC has developed a habitat protection program that includes purchasing lands or establishing conservation easements to protect habitat important to injured species.

WQS, DEC will work with EVOSTC and partner agencies to identify additional needed measures and recovery actions.

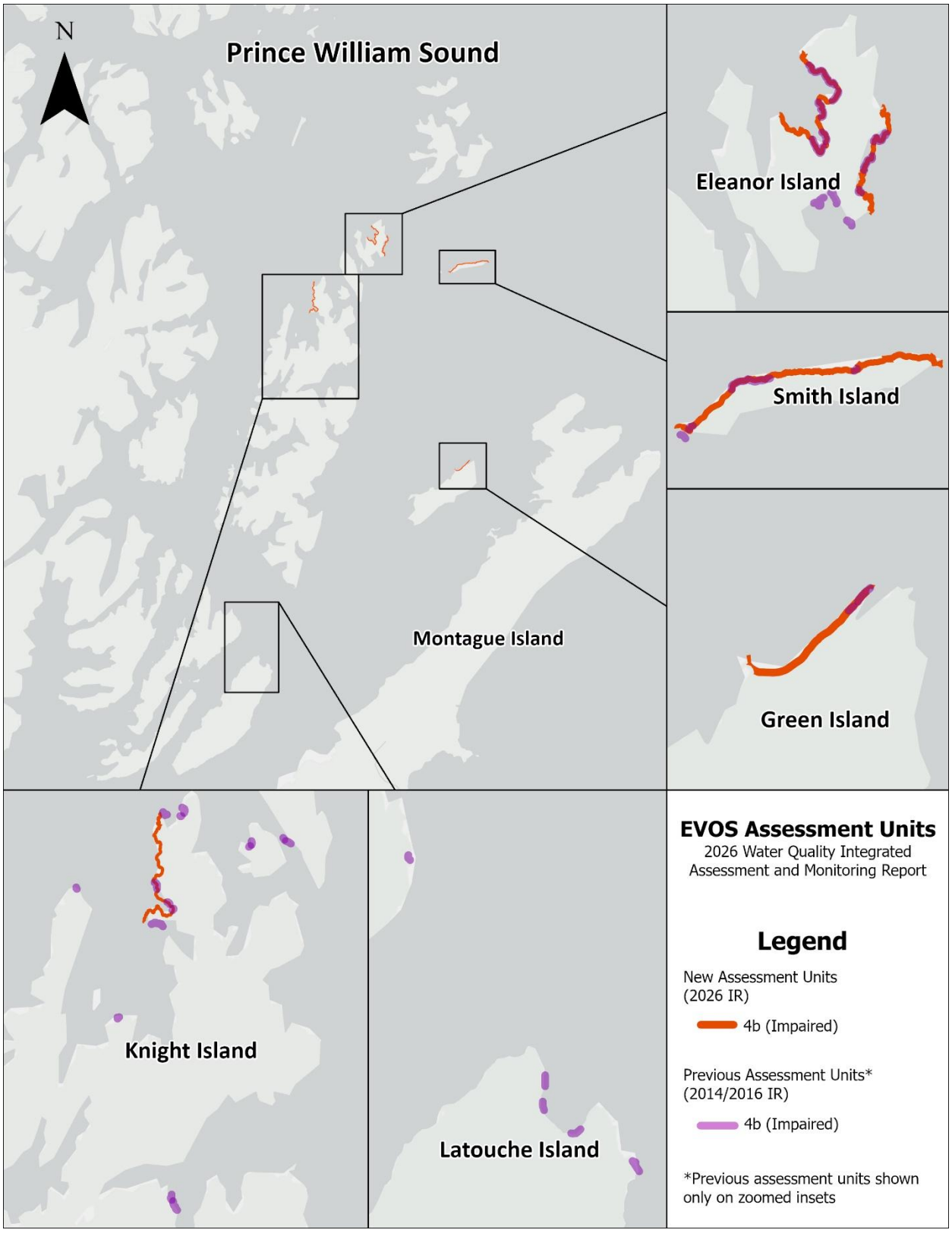
As long-term monitoring, biologic, and chemical degradation data associated with the remaining lingering oil becomes available, DEC will update the public through future Integrated Reports.

Appendix A. Assessment Unit Crosswalk

New AU identifiers compared to AU numbers used in Alaska's 2014/16 Integrated Report.

New Assessment Unit ID	2014/16 Integrated Report DEC AU Number	Prince William Sound Island
AK_B_3020305_007	AK-20202-849	Disk Island
	AK-20202-850	
AK_B_3020302_002	AK-20202-810	Eleanor Island
	AK-20202-827	
	AK-20202-828	
AK_B_3020302_000	AK-20202-829	Eleanor Island
	AK-20202-830	
AK_B_3020301_000	AK-20202-831	Eleanor Island
	AK-20202-832	
	AK-20202-833	
	AK-20202-834	
	AK-20202-835	
AK_B_3030505_000	AK-20202-820	Evans Island
AK_B_3040303_002	AK-20202-847	Green Island
	AK-20202-848	
AK_B_3020305_003	AK-20202-851	Ingot Island
	AK-20202-852	
AK_B_3020403_000	AK-20202-845	Knight Island Bay of Isles
	AK-20202-846	
AK_B_3020603_006	AK-20202-836	Knight Island Herring Bay
AK_B_3020603_003	AK-20202-837	Knight Island Herring Bay
AK_B_3020603_005	AK-20202-838	Knight Island Herring Bay
AK_B_3020603_004	AK-20202-839	Knight Island Herring Bay
	AK-20202-840	
	AK-20202-841	
AK_B_3020305_008	AK-20202-842	Knight Island Herring Bay
	AK-20202-843	
	AK-20202-844	
AK_B_3030605_000	AK-20202-803	Latouche Island
	AK-20202-806	
	AK-20202-807	
	AK-20202-823	
AK_B_3020207_001	AK-20202-824	Smith Island
AK_B_3020207_000	AK-20202-822	Smith Island
	AK-20202-825	
	AK-20202-826	

Appendix B. Map of Assessment Units



Appendix C. Lingering Oil Decision Process

DRAFT LINGERING OIL Decision Process

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Table of Contents

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
CAS	Chemical Abstracts Service Number
DEC	Alaska Department of Environmental Conservation
BaP	benzo(a)pyrene
cm	centimeter(s)
dw	dry weight
HMW	high molecular weight
in	inch(es)
LMW	low molecular weight
mg/kg	milligram(s) per kilogram
PAH	polycyclic aromatic hydrocarbon
PEF	potency equivalent factor
QAPP	Quality Assurance Project Plan
ww	wet weight

1. INTRODUCTION

1.1 Background

The purpose of this document is to provide guidance to Alaska Department of Environmental Conservation (DEC) staff for the assessment of lingering oil for the Alaska Integrated Water Quality Monitoring and Assessment Report. This document includes the following:

- A definition of lingering oil
- The purpose or need for a methodology
- Applicable regulations as adopted in the Alaska water quality standards in 18 Alaska Administrative Code (AAC) 70 (DEC, 2003)
- Information on the quantity and characteristics of data identified as sufficient and credible for assessment
- Assessment guidelines

This guidance outlines methodology for determining water body status for lingering oil based on available data. It provides guidelines for evaluating whether sufficient data are available to determine if an assessment unit is attaining applicable water quality standards, and for assessment of that data.

1.2 Lingering Oil Definition

The following definition was developed to support this listing methodology. It has undergone review by DEC, DEC internal counsel, and the *Exxon Valdez* Oil Spill Trustee Council:

> "Lingering oil is an oil residue deposited in shoreline sediment from an anthropogenic release that is generally not bioavailable unless disturbed."

The definition provides a basis for interacting with Alaska Water Quality Standards. It also clearly separates lingering oil from freshly oiled locations due to anthropogenic releases.

1.3 Designated Uses and Water Quality Criteria

Alaska's water quality standards are established in 18 AAC 70. Both fresh water and marine water quality standards are applicable to assess potential impacts of lingering oil on designated uses for shorelines and adjacent waterbodies. Table 1-1 summarizes the applicable narrative criteria; Appendix A provides the detailed applicable criteria. The uses and narrative water quality standards summarized in Table 1-1 apply to all data tiers in this listing methodology as described in Section 2.

Table 1-1: Summary of Designated Uses and Narrative Water Quality Standards

Designated Use	Reference	Summarized Narrative Criteria
(A) Water supply - drinking water, culinary, food processing - agriculture - aquaculture - seafood processing - industrial (B) Water recreation - contact recreation - secondary recreation (C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife (D) Harvesting for consumption of raw mollusks or other raw aquatic life	Petroleum Hydrocarbons, Oils and Grease 18 AAC 70.020(5) & (20) Toxic and Other Deleterious Organic and Inorganic Substances 18 AAC 70.020(11) & (23) Residues 18 AAC 70.020(8) & (20) Color 18 AAC 70.020(1) & (13) Sediment 18 AAC 70.020(9) & (21)	Surface waters, adjoining shorelines, and waterbody floor must be virtually free from floating oil, film, sheen, or discoloration. There can be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life.[1] May not exceed concentrations that individually or in combination impart undesirable odor or taste to organisms as determined by bioassay or organoleptic tests.

Complete narrative criteria are provided in Appendix A and in 18 AAC 70.

1.4 Data Qualification

Data characteristics such as age, quality, and quantity are key elements of data assessment. Data less than 10 years old are required for the initial steps of assessment, older data may be considered in the overwhelming evidence approach (Tier 5), provided natural or anthropogenic conditions in the assessment unit have not changed since original data collection.

DEC considers data collected under a Quality Assurance Project Plan (QAPP), or other approved data collection plan, to be credible and of sufficient quality for assessment. Data collected without a QAPP can be considered but must be corroborated by supplemental lines of evidence. Generally, a minimum of 10 data points is required to conduct an assessment. Data requirements are the same for impairment or attainment determinations.

Assessment for lingering oil may rely on various forms of data and will follow a tiered approach (Table 1-2). For example, Tier 1 will first be explored and if test pit data does not exist or does not meet the minimum data requirements (Table 1-3), Tier 2 would be explored. This approach

[1] Although 18 AAC 70 contains numeric water quality standards for hydrocarbons, fats, or oils, when assessing lingering oil impairment, chemical concentrations alone might not provide sufficient data for the impairment decisions due to lingering oil's sequestered state within the shoreline sediments.

prioritizes direct measurements (Tiers 1 and 2) while still allowing consideration of important indirect measurements (Tiers 3 and 4). If multiple types of data fall short of one or more of the data requirements in Table 1-3, they can be assessed together using the Tier 5 overwhelming evidence approach.

Table 1-2: Tiered Data Types

Tier	Data Type
1	Test Pit Data
2	Sediment Chemistry Data
3	Biological Data
4	Modeled Data
5	Overwhelming Evidence

Table 1-3: Minimum Data Requirements

Parameter	Conditions
Data Age	Tier 1-3: Less than or equal to 10 years old. Tier 4: Model updated in the last 10 years Tier 5: Data more than 10 years old may be considered
Spatial Area	Assessment unit (see section 1.5 for more information)
Density	Tier 1 and 2: At least 10 samples (observations) per assessment unit. Tier 3: Variable. Reference site or value required. Tier 4: At least 50% of the shoreline length per assessment unit must have modeled data coverage. Tier 5: Variable.
Quality	Peer-reviewed data and/or data collected under an approved QAPP or similar are preferred. Data that does not meet the minimum data requirements can be used to support Tier 5 assessment.
Frequency	Tier 1: Data from at least two years within the last 10-years. Tier 2: Data from at least two years within the last 10-years, with sample depths between 1 and 12 inches below the surface. Tier 3: Data from at least two years within the last 10-years. A minimum of two biological lines of evidence (tissue, sediment toxicity, community metrics or food web contaminant uptake analysis). Tier 4: Model updated within the last 10 years. Tier 5: Two or more lines of evidence.

1.5 Assessment Units

Waterbodies are segmented into smaller units, called assessment units (AU), based on hydrological boundaries. Assessment units for lingering oil decisions will depend on the data type available. Physical characteristics that affect oil distribution may be used for finer AU delineation. Beach AU's cannot be standardized across Alaska due to the varying scales of data, GIS imagery available, and physical features of Alaska's shoreline.

For example, when the shoreline cleanup and assessment technique (SCAT) is employed following an initial spill event, beaches/shorelines are typically segmented into sections 0.2 to 2 kilometers (km) long. Assessment units with a finer scale of data, such as EVOS beaches, might be drawn by segmenting the shoreline using HUC-14 scale watersheds as boundaries. Where oiling was present based on past evidence (current impaired waters, predictive model data, test pit data, initial oil trajectory), assessment units can be further delineated using a headland-to-headland approach and taking into consideration shore types[2] and aspect. DEC will document the methodology used to delineate assessment units in the Integrated Report.

[2] Shore types were downloaded from the NOAA Response and Restoration website at https://response.restoration.noaa.gov/esi_download#Alaska, and classifications were rated as 1-5 based on their oil capturing capabilities (sand and gravel = high oil capture, rocky outcrops = low oil capture).

2. IMPLEMENTATION

The tiered approach incorporates several forms of shoreline assessment data developed through oil spill response actions, specifically those potential impacts or impairments to designated uses that may remain long after (e.g., years, decades) surface oils have either been removed or naturally degraded. Data used for assessment may include test pits, sediment chemistry data, biological data, modeling data, or some combination of these data types.

The tiered approach for data assessment begins with Tier 1. If sufficient data are available to complete an assessment, then no further assessment of that AU occurs. If sufficient data are not available, then proceed to Tier 2. This process repeats through Tier 5. This approach prioritizes empirical data less than 10 years old while allowing for other lines of evidence to still be considered in Tier 5. For example, if test pit data from 1989 to 1991 for an oiled beach were available as well as sediment chemistry data from 2021, the sediment chemistry data would take precedence because it is more recent (within the last 10 years) and thus more likely to reflect the current conditions of that area.

2.1 Tier 1: Test Pit Data

Test pits are generally defined as a hole dug into sediment to determine if oil has penetrated the subsurface. Lingering oil exists entrenched in sediment. Subsurface oiling in an assessment unit and is typically categorized as heavy, moderate, light, or very light (Table 2-1).

Table 2-2: Test Pit Data Categorization and Depth of Penetration or Thickness of Oil

Oil Categorization	More than 30 cm Depth	21–30 cm Depth	11–20 cm Depth	0–10 cm Depth
Oil-Filled Pores	Heavy	Heavy	Moderate	Moderate
Partially Filled Pores	Heavy	Moderate	Moderate	Light
Oil Residue	Moderate	Moderate	Light	Light
Trace	Light	Very Light	Very Light	Very Light

Modified from Environment and Climate Change Canada 2018

The thresholds in Table 2-2 apply to test pits on lingering oil in an assessment unit, which will be considered impaired if it is not virtually free of oil. To establish that the oil is lingering and not bioavailable/degrading, there should be existing test pit data for the initial spill from the shoreline cleanup and assessment technique (Environment and Climate Change Canada 2018) or from other evidence. If the minimum data requirements for test pit data are met (Table 1-3), conduct assessment using the methodology described below (Table 2-2). If the minimum requirements for test pit data are not met, move to Tier 2, or evaluate if multiple lines of evidence are available for Tier 5.

Table 2-3: Test Pit Data Assessment Approach

Attainment Status	Test Pit Data Assessment Thresholds
Attaining	Less than or equal to 10% of test pits with light to moderate oil; more than 90% of test pits are clean or very light AND No pit with heavy oil
Impaired	More than 10% of test pits have presence of light to heavy oil OR One pit or more with heavy oil

2.2 Tier 2: Sediment Chemistry Data

If Tier 1 data are unavailable or do not meet the minimum data requirements in Table 1-3, sediment chemistry data are considered the next best available data.

Sediment chemistry data include measurements of chemical concentrations within the sediment measured by a laboratory. Oil is a complex mixture of many chemical compounds. While a wide variety of chemicals can be used to characterize oil in sediments, polycyclic aromatic hydrocarbons (PAHs) are selected because of their ability to indicate risks to health for humans and aquatic life from oil. For human health, the concentration of benzo(a)pyrene (BaP) equivalents in sediment are evaluated to protect humans against cancer risks of PAHs.

Samples should be, at minimum, analyzed for the compounds in Table 2-3. If more than two compounds were not measured, the data is inadequate for using sediment chemistry for assessment. The results should be summed for high molecular weight (HMW) PAHs and low molecular weight (LMW) PAHs. In addition, PAH results should be used to calculate the BaP toxicity equivalent (BaP equivalents). For this calculation, multiply the concentration of the PAHs in a sediment sample by the BaP potency equivalent factors provided in Table 2-3, and sum the results.

Table 2-4: B[a]P Potency Equivalent Factors[3]

Polycyclic Aromatic Hydrocarbon	CAS Number	Designation	B[a]P PEF
acenaphthylene	208-96-8	LMW	--
acenaphthene	83-32-9	LMW	--
anthracene	120-12-7	LMW	--
benzo(a)anthracene	56-55-3	HMW	0.01
benzo(a)pyrene	50-32-8	HMW	1
benzo(e)pyrene	192-97-2	HMW	--
benzo(b)fluoranthene	205-99-2	HMW	0.1
benzo(g,h,i)perylene	191-24-2	HMW	0.01
benzo(k)fluoranthene	207-08-9	HMW	0.1
biphenyl	92-52-4	LMW	--
chrysene	218-01-9	HMW	0.01
dibenzo(a,h)anthracene	53-70-3	HMW	2.4
fluoranthene	206-44-0	HMW	--
fluorene	86-73-7	LMW	--
indeno(1,2,3-cd)pyrene	193-39-5	HMW	--
1-methylnaphthalene	90-12-0	LMW	--
2-methylnaphthalene	91-57-6	LMW	--
1-methylphenanthrene	832-69-9	LMW	--
naphthalene	91-20-3	LMW	--
phenanthrene	85-01-8	LMW	--
pyrene	129-00-0	HMW	--
perylene	198-55-0	HMW	--

--: no available B[a]P PEF
CAS: chemical abstract service number
HMW: high molecular weight
LMW: low molecular weight
BaP PEF: benzo(a)pyrene potency equivalent factors (e.g. chrysene is 1% as toxic as B[a]P (0.01 PEF)

If the minimum data requirements (Table 1-3) are met, conduct assessment using the methodology described below (Table 2-4). Attainment status will be determined if all samples meet the condition statements in Table 2-4, or if, for any one set of samples where more than 10% exceed the thresholds for HMW, LMW, or BaP, then the assessment unit will be impaired.

[3] See Section 3.2 of Technical Approach document for references.

If the minimum data requirements for sediment chemistry data are not met, move to Tier 3, or evaluate if multiple lines of evidence are available for Tier 5.

Table 2-5: Sediment Chemistry Data Assessment Approaches

Attainment Status	Sediment Chemistry Assessment Thresholds
Attaining	Less than or equal to 10% of samples exceed HMW PAHs threshold (13 mg/kg dw)[4] AND Less than or equal to 10% of samples exceed LMW PAHs threshold (3.1 mg/kg dw)[4] AND Less than or equal to 10% of samples exceed BaP equivalents threshold (5.3 mg/kg dw)[5]
Impaired	More than 10% of samples exceed HMW PAHs threshold (13 mg/kg dw)[4] OR More than 10% of samples exceed LMW PAHs threshold (3.1 mg/kg dw)[4] OR More than 10% of samples exceed BaP equivalents threshold (5.3 mg/kg dw)[5]

mg/kg dw: milligrams per kilogram on a dry weight basis

2.3 Tier 3: Biological Data

If Tier 1 and Tier 2 data are unavailable or do not meet the minimum data requirements, biological data are considered the next best available data. Biological data include measurements of exposure and effects of oil on biota or measurements of individual, population, or community health. Data should be collected over a relatively short period of time (i.e., less than 10 years but preferably over 3 years). Additionally, organism-related data tend to be highly variable; therefore, multiple lines of evidence are assessed within this tier.

Four lines of evidence were selected for Tier 3 as shown in Table 2-5:

These lines of evidence were selected for assessing lingering-oil-related impacts because they can be collected within a single sampling event and allow for a quantitative or semiquantitative evaluation of impacts relative to a reference site (or a reference toxicity value). For assessments using Tier 3 biological data, two or more of the lines of evidence provided in Table 2-5 are required.

[4] This value is the geometrical mean of marine and generic (neither marine nor freshwater) values that indicate an adverse effect is likely at concentrations higher than this value for HMW PAHs. See section 3.3 and Appendix B of the Lingering Oil Listing Methodology Technical Support Document for more information on the development of sediment thresholds.

[5] This value is equivalent to a 10^{-5} excess lifetime cancer risk from PAHs. See section 3.2 of the Lingering Oil Listing Methodology Technical Support Document.

Table 2-6: Relevant Biological Lines of Evidence

Data Type	Description
Tissue chemistry	Immobile invertebrates such as clams, mussels, or other intertidal species
Sediment toxicity	Amphipods
Population abundance and intertidal community diversity	Benthic infauna (e.g., shrimp, worms) Benthic epifauna (e.g., mussels)
Food web contaminant uptake analysis	Sensitive invertivorous birds or mammals (e.g., shorebirds, sea otters, etc.)

If the minimum data requirements (Table 1-3) are met for at least two lines of evidence, determine if the assessment unit is attaining or impaired using the methodology described below (Table 2-6). Attainment will be assessed against two or more of the lines of evidence thresholds. If the minimum data requirements are not met, move to Tier 4, or evaluate if multiple lines of evidence are available for Tier 5.

Table 2-7: Biological Data Assessment Approach

Attainment Status	Biological Lines of Evidence Endpoint Assessment Thresholds
Attaining	Two of four endpoints: • For tissue chemistry: no statistically significant difference at α= 0.05 and effect size[6] less than 20% and below the PAH tissue threshold of 97 mg/kg ww total PAHs[7] • For sediment toxicity: no statistically significant difference at α= 0.05 and effect size less than 20% • For community diversity and population: no statistically significant difference at α= 0.05 and effect size less than 20% • For food web contaminant uptake analysis: lack of dietary uptake risk relative to toxicity reference values
Impaired	Two of four endpoints: • For tissue chemistry: statistically significant difference at α= 0.05 and effect size greater than 20% and above the PAH tissue threshold of 97 mg/kg ww total PAHs. • For sediment toxicity: statistically significant difference at α= 0.05 and effect size greater than 20% • For community diversity and population: statistically significant difference at α= 0.05 and effect size greater than 20% • For food web contaminant uptake analysis: dietary uptake risk relative to toxicity reference values

mg/kg ww: milligrams per kilogram on a wet weight basis

2.4 Tier 4: Modeling Data

If Tier 1, Tier 2, and Tier 3 data are unavailable or do not meet the minimum data requirements, modeled data are considered the next best available data. Modeled data for lingering oil can include data from the shoreline cleanup and assessment technique (Environment and Climate Change Canada 2018) or data for the level of oiling, toxicity, bioavailability, or other parameters. In general, the model would produce a spatially continuous distribution of one or more of these parameters and could include a temporal component. The processes and conditions considered in the model would likely include distance from oil source, currents, shape of shoreline, slope of shoreline, sediment type, etc.

Different model outputs will vary. If model outputs do not include probabilities for the categories of heavy, moderate, or light oil, then best professional judgement will be used to

[6] % effect size = [(mean at reference site – mean at oiled beach)/(mean at reference site)] X 100

[7] The tissue threshold of 97 mg/kg comes from the geometrical mean value for lowest observed effects levels for PAHs for invertebrates using the United States Army Corps of Engineers Environmental Residue-Effects Database (2024).

determine if model outputs are comparable to either of the modelled data assessment thresholds in Table 2-7. As other models are developed and more advanced techniques are used, Tier 4 processes and thresholds might need to be updated to accommodate the types and probability values of the modeled data.

A model used for the assessment of lingering oil should be high quality and suitable for this purpose. As such, the following criteria should be met (ASTM International 2018):

- Thorough documentation of boundary conditions, assumptions, and methods
- Displayed calibration: test of a model with known input and output information that is used to adjust or estimate coefficient or parameter values
- Displayed validation: test of a model to accurately produce modeled values that have been verified by field observations, analytical samples, or other means of evidence
- Repeatable results: a basic principle of scientific documentation that a report should provide enough details for others to reproduce the findings (Nature Publishing Group 2013)
- Undergone third-party expert review: either through DEC or in the publication process

If a model used for predicting the presence of lingering oil has not been updated within the last 10 years, then its output should be assessed as a line of evidence alongside other data types (Tier 1, Tier 2, etc.), if available, as Tier 5. If the minimum data requirements (Table 1-3) for the model are met and the model is of high quality and suitable for this purpose, determine if the assessment unit is attaining or impaired using the methodology described below (Table 2-7). If the minimum data requirements for the model are not met, evaluate if multiple lines of evidence are available for Tier 5.

Table 2-8: Modeled Data Assessment Approach

Attainment Status	Modeled Data Assessment Thresholds
Attaining	Less than or equal to 10% of modeled subsegments have greater than or equal to 15% probability of subsurface oil.
Impaired	More than 10% of modeled subsegments have greater than or equal to 15% probability of subsurface oil.

2.5 Tier 5: Overwhelming Evidence

If insufficient Tier 1 to 4 level data are available, overwhelming evidence can be considered. Overwhelming evidence uses multiple lines of evidence to determine whether the narrative threshold is exceeded. This approach would be used in cases where previous tier results are inconclusive or don't meet the minimum data requirements. Rationale for Tier 5 determinations will be documented in the Integrated Report.

Lines of evidence used can include the following:

- Data that does not meet minimum data requirements
- Division of Spill and Response cleanup status
- Visual observations (e.g., if lingering oil becomes unburied and exposed following a severe weather event)
- Additional observational data could include reported changes in human recreational and/or subsistence use of an area (e.g., clammers no longer collect clams from a beach because they smell like oil, or swimmers stop swimming in an area due to observed oil sheens.
- New science or new data types
- Public health advisories
- Other biologic indicators or habitat data

Data from Tiers 1 through 4 that exceed established numeric thresholds, but do not meet minimum data requirements to make a determination, should be prioritized for consideration in the overwhelming evidence approach (Tier 5).

3. REFERENCES

DEC. 2003. 18 AAC 70 Water Quality Standards. Alaska Department of Environmental Conservation. As amended through June 26.

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ASTM International. 2018. *ASTM E978-18, Standard Practice for Evaluating Mathematical Models for the Environmental Fate of Chemicals*. ASTM International. https://doi.org/10.1520/E0978-18.

Environment and Climate Change Canada. 2018. *Shoreline Cleanup Assessment Technique (SCAT) Manual*. 3rd edition, prepared and provided by Triox Environmental Emergencies, Owens Coastal Consultants, Environmental Mapping Ltd.

Nature Publishing Group. 2013. "Guide to Publication Policies of the Nature Journals." Retrieved from www.nature.com/authors/gta.pdf.

APPENDIX A
Applicable Water Quality Standards

Table A-1:

Applicable Water Quality Standards for Lingering Oil: Narrative Criteria Only

Petroleum Hydrocarbons, Oils and Grease, Toxic and Other Deleterious Organic and Inorganic Substances, and Residues

Fresh Water Uses

18 AAC 70.020(5), (8), (11)

Designated Use	Freshwater Narrative Criteria
(A) Water supply (i) drinking, culinary, and food processing (ii) agriculture, including irrigation and stock watering (iii) aquaculture (iv) industrial	18 AAC 70.020 (b)(1)(A): May not cause detrimental effects on established water supply treatment levels. 18 AAC 70.020 (b)(5)(A): May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life.[1] Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. May not make the water unfit or unsafe for the use. 18 AAC 70.020 (b)(8)(A): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. May not be present in quantities to cause soil plugging or reduced crop yield, or to make the water unfit or unsafe for the use. 18 AAC 70.020 (b)(11)(A): Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter.[1] Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests. Concentrations of substances that pose hazards to worker contact may not be present.[1]

Designated Use	Freshwater Narrative Criteria
(B) Water recreation (i) contact recreation (ii) secondary contact recreation	18 AAC 70.020 (b)(1)(B): May not interfere with or make the water unfit or unsafe for the use 18 AAC 70.020 (b)(5)(B): May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils. 18 AAC 70.020 (b)(8)(B): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(9)(B): May not pose hazards to incidental human contact or cause interference with the use. 18 AAC 70.020 (b)(11)(B): Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use. Concentrations of substances that pose hazards to incidental human contact may not be present.[1]

Designated Use	Freshwater Narrative Criteria
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	18 AAC 70.020 (b)(5)(C): There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. 18 AAC 70.020 (b)(8)(C): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(9)(C): In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life, their reproduction or habitat may be present. 18 AAC 70.020 (b)(11)(C): There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter.[1] Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.

[1] Although 18 AAC 70 contains numeric water quality standards for hydrocarbons, fats, or oils, when assessing lingering oil, chemical concentrations alone might not provide sufficient data for assessment due to lingering oil's sequestered state within the shoreline sediments.

Table A-2:

Applicable Water Quality Standards for Lingering Oil: Narrative Criteria Only

Petroleum Hydrocarbons, Oils and Grease, Toxic and Other Deleterious Organic and Inorganic Substances, and Residues

Marine Water Uses

18 AAC 70.020(17), (20), (23)

Designated Use	Marine Narrative Criteria
(A) Water Supply (i) aquaculture (ii) seafood processing (iii) industrial	18 AAC 70.020 (b)(17)(A): There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life.[1] Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests. May not make the water unfit or unsafe for the use. 18 AAC 70.020 (b)(20)(A): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; may not detrimentally affect established water supply treatment levels; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(23)(A): There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter.[1] Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests. Substances may not be introduced that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use. Concentrations[1] of substances that pose hazards to worker contact may not be present.

Designated Use	Marine Narrative Criteria
(B) Water Recreation (i) contact recreation (ii) secondary contact recreation	18 AAC 70.020 (b)(13)(B): Surface waters must be free of substances that produce objectionable color. 18 AAC 70.020 (b)(17)(B): May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils. 18 AAC 70.020 (b)(20)(B): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(21)(B): May not pose hazards to incidental human contact or cause interference with the use. 18 AAC 70.020 (b)(23)(B): There may be no concentrations of substances in water, that alone or in combination with other substances, make the water unfit or unsafe for the use. Concentrations of substances that pose hazards to incidental human contact may not be present.[1]
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Same as 18 AAC 70.020 (b)(17)(C): There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life.[1] Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. 18 AAC 70.020 (b)(20)(C): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods; may not, alone or in combination with other substances, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(23)(C): There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter.[1] Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.

Designated Use	Marine Narrative Criteria
(D) Harvesting for consumption of raw mollusks or other raw aquatic life	18 AAC 70.020 (b)(17)(D): May not exceed concentrations that individually or in combination impart undesirable odor or taste to organisms as determined by bioassay or organoleptic tests.[1] 18 AAC 70.020 (b)(20)(D): May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use; cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines. 18 AAC 70.020 (b)(23)(D): There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter.[1] Substances may not be present in concentrations[1] that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.

[1] Although 18 AAC 70 contains numeric water quality standards for hydrocarbons, fats, or oils, when assessing lingering oil, chemical concentrations alone might not provide sufficient data for assessment due to lingering oil's sequestered state within the shoreline sediments.