THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Natural Resources
OFFICE OF PROJECT MANAGEMENT AND PERMITTING
P.O. Box 111030
Juneau, AK 99811-1030
907-465-3177

May 4, 2022

Earl Stewart
Forest Supervisor, Tongass National Forest
648 Mission Street
Ketchikan, AK 99901

Re: Mendenhall Glacier Visitor Facility Improvements Project

Dear Mr. Stewart,

Thank you for the opportunity to provide comments on the Mendenhall Glacier Visitor Facility Improvements Project draft environmental impact statement (DEIS). Per the DEIS (Notice of Availability published in the March 4, 2022 Federal Register) this project proposes to implement a variety of infrastructure projects over several years, including parking and access expansion, a new Welcome Center complex, Visitor Center improvements, Glacier Spur Road trailheads, a Lakeshore trail along the south shore of Mendenhall Lake, public use cabins, restoration of Steep Creek, Steep Creek Trail expansion, docks and motorized commercial boat use on Mendenhall Lake, a remote glacier visitor area, and new and improved multi-use trails throughout the Mendenhall Glacier Recreation Area. The proposal also includes new management strategies including changes to visitor capacity and commercial use and adjustments to management unit boundaries.

I have coordinated with the Alaska Departments of Fish and Game, Environmental Conservation and Natural Resources (DNR) on the review of this proposal. The following consolidate comments are offered on behalf of the State of Alaska.

In general, the State supports increased opportunity for recreation, tourism, and improved visitor experiences, however we have serious concerns related to the assertion that the US Forest Service (USFS) has management authority over state-owned navigable waterbodies that overlie the state land[1] within the project area.

In a letter dated September 7, 2021, the State submitted scoping comments asserting the ownership of the entirety of Mendenhall Lake, including all recently exposed waters and shorelands due to glacial retreat, and the Mendenhall River to be state owned navigable waterways (attached). The letter further stated that these lands and waters are managed by the State consistent with existing state statutes and regulations applicable to all state lands, that this withdrawal does not apply to state navigable waters, and they should be specifically excluded from the proposed withdrawal expansion. The USFS fails to acknowledge this critical factor in

[1] As defined under AS 38.05.965(23)(24).

the DEIS and in fact, indicates that the USFS manages the uses on the waterbody regardless of ownership.[2]

Through this proposed action, the USFS states its intention to construct three docks on Mendenhall Lake and to manage public and commercial access and modes of transportation on these State lands through USFS policies and special use permitting. These actions by the USFS place a cloud on the State's title to these lands it received upon statehood.

It is important for the public to understand the land ownership and agency authorities in evaluating this proposed action. In 2019, the State found Mendenhall Lake and River navigable for title purposes and issued a formal navigability determination that provides the background, rationale, and evidence supporting the decision (attached). Concurrent with this response to the DEIS, pursuant to § 2409a(m) of Title 28 of the United States Code, the State provided the USFS notice of its intent to file a quiet title action to the submerged lands of the Mendenhall River and Mendenhall Lake (attached).

As these waters are clearly navigable for title purposes the DEIS needs to acknowledge State ownership and management of navigable waters and those submerged lands that are within the project area, so the public understands that current USFS policies do not apply to Mendenhall Lake and Mendenhall River.

As the landowner, the State requires a permit under Alaska Statute 38.05.850 for construction of docks on State lands, including its shorelands. Since the Mendenhall Glacier Recreation Area contains State lands within its exterior boundary, it would benefit the USFS to work more closely with the State in land planning and project planning as we could achieve mutual goals in efficiently managing this area for the benefit of the public.

In addition to the comments above, more section specific technical comments are provided in a table as an attachment to this letter.

Again, thank you for the opportunity to comment. Please contact me if you have any questions or would like to discuss the State's comments further.

Sincerely,

Sylvia A. Kreel

Sylvia A. Kreel
Large Project Coordinator

cc: State Review Team

[2] Page 3-107, Vol 1 DEIS

Attachments:

- State of Alaska Consolidated Comments Table
- September 7, 2021, State of Alaska comment letter regarding Mendenhall Glacier Recreation Area mineral exploration withdrawal
- April 26, 2022, Notice of intent to file a quiet title action, and associated map
- January 15, 2019, Navigability Determination for Mendenhall Lake & River
- Juneau Cruise Ship Study 2019, Final Report June 2021 (referenced in Comments Table)

Mendenhall Glacier Recreation Visitor Facility Improvements Project - DEIS

State of Alaska Consolidated Comments Table

Department/Division/Section	Section/Fig./Table	Page #	Comment/Issue	Recommendation/Action
Department of Environmental Coordination (DEC)Commissioner's Office	Chapter 2, Table 2.1	2-6	Table 2.1 on this page notes that the West Glacier Dock under Alternative 3 would need to be dredged as needed to maintain the facility. There is no current dock, so it would appear that dredging would be needed for construction of the facility and to maintain the facility.	Please correct the discussion.
DEC Commissioner's Office	Chapter 2	2-17	It is not clear how the increased tourist capacity anticipated would be handled by the existing wastewater system. There does not appear to be any discussion of whether the existing wastewater system will be upgraded or if the plan is to extend wastewater utilities to the facility.	Please explain how the increased tourist capacity would be handled by the existing or upgraded wastewater system.
DEC Commissioner's Office	Chapter 2	2-30	Paragraph two on this page notes that "*Facilities would be serviced by pumping waste into holding tanks on a boat and transporting it to the West Glacier Dock at a frequency to be determined based on use.* " It is not clear if there will be any safeguards to protect water quality from sewage spills at while pumping waste as the Remote Glacier Landing Area or the West Glacier dock facility.	Please provide an explanation of how Mendenhall Lake water quality will be protected from sewage spill during these transfers.
DEC Commissioner's Office	Chapter 2	2-35	Paragraph three on this page discusses the propose restroom barge at the Remote Glacier Landing Area. Same comment as above.	Please provide an explanation of how Mendenhall Lake water quality will be protected from sewage spill during these transfers.
DEC Air Quality	Chapter 2	2-66	The proposed Mendenhall Glacier Visitor Facility Improvements Project is located within the Mendenhall Valley PM10 maintenance area. Because of this the project is subject to an applicability analysis under the General Conformity Regulations at 40 CFR Part 93 subpart A. All the trail improvement activities of the proposed action are exempt from the applicability analysis according to 40 CFR 93.153, subsection c.2.iv. Also, it would appear that the 2,000 sq ft maintenance building would be exempt under the Mass Transit category according to 40 CFR 93.126. However, all the construction activities below would require an applicability analysis: 1. Constructing new parking areas under alternatives 2, 3, and 4 2. Constructing five new cabins 3. Replacing the existing welcome center pavilion and parking area shelter with a new single story building 4. Renovating the upper floor and theater area of the visitor center 5. Replacing the culverts under Glacier Spur Road with vehicular bridges 6. Combining the two existing parking lots and improving the layout Although the potential increase in the average daily PM10 levels in all alternatives is identified as a minor effect, it is crucial to have the applicability analysis performed to ensure that the emissions are below the specified de minimis threshold of 100 tons per year.	Please perform the applicability analysis as required under 40 CFR Part 93, subpart A. Please also note the analysis needs to be approved by the Environmental Protection Agency in concert with DEC, so a copy of the analysis need to be sent to both entities.
DEC Air Quality	Chapter 3	3-28	In Section 3.6.6.2 Effects Common to All Action Alternatives there should be a small discussion on air quality. During construction there are many opportunities of particulate matter to be emitted, either by construction equipment or wind entrainment of glacial dust. DEC would suggest that construction activities follow all reasonable precautions in according with Alaska Air Quality regulations at 18 AAC 50.045(d), as well as construction site Best Management Practices (BMPs). There may be a need to suspend excavation and grading activities during air quality emergencies or when high winds and visible dust persists. In addition, if open burning is chosen as the preferred method of disposal of organic debris during construction activities, the contractors must use reasonable procedures to minimize adverse environmental effects and limit the amount of smoke generated. A complete description of open burn information, including policies, can be found at http://dec.alaska.gov/air/air-permit/open-burn-info/ . The City and Borough of Juneau Fire Department should also be contacted regarding a burn permit at https://juneau.org/fire/burn-permit-info	Please include a small discussion on air quality in Section 3.6.6.2.
DEC Commissioner's Office	Chapter 3	3-114 thru 3-116	Given the existing condition of annual glacial flood events, you may wish to expand the glacial flooding discuss to cover the mitigation that would be needed to minimize damages to visitor infrastructure (campgrounds, trailheads, toilet facilities). Didn't see this addressed elsewhere.	Please discuss mitigation measures needed to minimize impacts to proposed visitor infrastructure.

DEC Air Quality	Chapter 3	3-158	Section 3.10.4.2 Air Quality in the Mendenhall Valley on this pages discusses a potential long-term problem with black-carbon deposition and relating it to glacial retreat, which was described as one of many reasons for the reconfigurations of the Mendenhall Visitors Center complex. Because black carbon deposition is mentioned several times in the document, you may wish to address the issue in a mitigation measure, rather than just stating that it is a problem. The current mitigation measure mentioned on page 2-53 notes that bus engine idling will be prohibited when buses are parked, but does not address a ban on tour bus engine idling while waiting for tourists to emerge from the Mendenhall Glacier Visitors Center. In addition, the conclusions reached in the document regarding black carbon deposition do not appear to be supported by the cited reference (Nagorski 2019) which found that black carbon concentrations in the samples ranged between 3 - 4%, while dust concentrations were estimated to be 89% of the total impurity concentration. While this study specifically avoided areas near the Mendenhall Visitors Center and other anthropogenic sources (Juneau transportation, residences and cruise ship emissions), it would be important to address the concentration of black carbon on the Mendenhall Glacier before making these assumptions.	Please clarify the bus engine idling issue. You may also want to explore the extent of the actual problem in the future and contact the University of Alaska atmospheric sciences program on monitoring in order to better comprehend local wind and weather patterns and their relationship to glacial black carbon deposition. This would serve to differentiate between the impacts of forest fire emissions, rock dust from glacial moraines and particulate matter specifically from combustion of petroleum products. Please note that the cited study looked at a snapshot in time in 2016. Air quality data shows a spike in particulate matter air impacts due to summertime wildland fire smoke in 2019. The data in the attached cruise ship study that was done in 2019 using relatively inexpensive air monitors, is very specific to the downtown area, but shows the impact of other particulate matter sources, including wildfire smoke from Canada. The Forest Service may want to consider deploying similar air monitors at the Mendenhall Visitors Center and then tie the data back to the main monitor at Floyd Dryden Middle School which is also located in the Mendenhall Valley. The historical data from that site can be found here https://dec.alaska.gov/air/air-monitoring/community-data/juneau-pm10-data
DEC Commissioner's Office	Chapter 3	3-172	Paragraph two on this page notes that " The thinning rate of the Mendenhall Glacier is also being influenced by the deposition of black carbon particulates, caused by the burning of fossil fuels, onto the surface of the Juneau Icefield." The paragraph cites to Nagorski (2019) as a reference for this conclusion. As noted in the comment above, the study referenced found that black carbon concentrations in the samples ranged between 3 - 4%, while dust concentrations were estimated to be 89%.	Use of the wording "being influenced by the deposition of black carbon particles" implies a clear causation that does not appear to be scientifically defensible. The conclusions reached in the paper referenced the overall effects of light absorbing particles, but were not specific to black carbon in particular. Please remove this unsupported conclusion or edit to reflect the actual science in the article referenced.
Alaska Department of Fish and Game (ADF&G)	Sec. 2.3.3.4	2-24	The proposed West Glacier unit and Nugget Falls trails may encroach upon important winter goat habitat; disturbance effects may be exacerbated if the trails are groomed in winter conditions.	Where new trails are established within 1 km of areas with documented winter goat use, consider impacts of recreational use (e.g., groomed trails) and associated options to reduce potential impacts.
ADF&G	Sec. 2.3.4.4	2-30	This section describes intent to power passenger day-use vessels by "alternative energy fuel sources or have low-emissions motors". Electric outboard motor technology is rapidly improving and would prevent introduction of hydrocarbons into Mendenhall Lake. As stated elsewhere in the DEIS, this water body is in a transitional state undergoing ecological succession as the glacier recedes; any preventative measures regarding potential contamination should be prioritized.	Consider including an analysis or discussion of cumulative environmental effects of conventional (e.g., two-stroke, four-stroke), alternative (e.g., electric), and reduced emissions motors in Mendenhall Lake, specifically regarding the introduction of hydrocarbons.
ADF&G	Table 2.6	2-52	Additional mitigation measures should be considered with respect to wildlife disturbance.	To the extent feasible, disturbance activity (e.g., construction of trails and facilities, especially regarding helicopter support and blasting) should not occur within 1.8 km of winter habitat from November 1–April 30, and disturbance activity should not occur within 1.5–2 km of kidding habitat from May 1–July 15 (NWSGC 2020).

ADF&G	Table 2.6	2-52	Additional mitigation measures should be considered with respect to wildlife disturbance.	To prevent negative human-bear interactions, consider the following additional mitigation measures concerning black bears: 1) Increase the number of employees responsible for ensuring compliance regarding leashed dogs and food along trail networks. 2) Lower the speed limit approaching the visitor center to reduce potential for vehicular wildlife collisions. 3) Ensure an adequate amount of bear-proof trash receptacles are strategically placed in areas in which food will be allowed and at trail parking areas. 4) Ensure the dumpster associated with proposed food service is enclosed and bear-proof.
ADF&G	Table 2.6	2-53	Regarding mitigation measures associated with aquatic habitat, this table suggests ground disturbing activities along the lakeshore will be avoided April 1–May 31. More specifically these activities should occur during the same instream work timing window specified for work in Steep Creek (June 1–July 15) to minimize impacts to outmigrating smolt and returning adults. In-stream work for trail crossings on other identified anadromous water bodies should also be restricted to this timing window.	Specify timing window for ground disturbing activities along the lake shore and in-stream activities associated with stream crossings in identified anadromous water bodies. The preferred timing window for such activities in streams with spawning salmonids is June 1–July 15; prior to construction of stream crossings, consult with ADF&G Habitat Section during the concurrence process on timing windows for activities in streams without documented spawning activity.
ADF&G	Sec. 3.6.6.3	3-30	As presented in this section pertaining to impacts to migratory birds, the shoreline of Mendenhall Lake provides important and unique habitat for birds, and construction and pedestrian use of the Lakeshore Trail would likely disturb these populations.	As presented in Alternatives 3 and 4, constructing the trail inland from the lakeshore is preferable as this design will reduce impacts to migratory bird habitat.
ADF&G	Sec. 3.6.6.3	3-38	Regarding the proposed wildife and pedestrian underpass, ABR, Inc. (2021) alludes to limited information available regarding the success of underpasses as wildlife corridors when shared with pedestrian traffic. Implementation of this design could lead to an increase of negative bear-human interactions.	The underpass should be designed as a wildlife corridor exclusively with a crosswalk connecting the trail for pedestrians, as presented in Alternate 4.
ADF&G	Sec. 3.8.4.3	3-106	Regarding additional salmonid water body surveys, ADF&G Habitat Section biologists revisited the area in 2021 to conduct additional Anadromous Waters Catalog surveys (Giefer and Blossom 2021) and will again revisit in 2022.	ADF&G Habitat Section biologists will coordinate with USFS personnel to complete stream surveys within MGRA.
ADF&G	Sec. 3.8.4.6	3-113	Snow storage within the northernmost extent of Glacier Spur Rd. and adjacent visitor parking areas has historically encroached upon anadromous water bodies (e.g., Steep Creek, Zig Zag Pond).	Specify designated snow storage areas for the visitor center parking lots and ensure these locations do not encroach upon fish-bearing water bodies.
ADF&G	Sec. 3.8.6.2	3-121	Consideration of fish removal and exclusion during construction activities associated with in-water work for the Steep Creek Habitat Restoration component is absent from this section.	ADF&G Habitat Section biologists will coordinate with USFS personnel to strategize removing and excluding fish if practicable during in-water work associated with this component.
ADF&G	Sec. 3.8.6.2	3-122	The Steep Creek Habitat Restoration project component provides a unique opportunity to establish baseline metrics of suitable salmonid habitat (e.g., spawning gravel availability, refugia) and monitor dynamics after channel realignment, providing a case study in habitat restoration.	Consider implementing a long-term monitoring plan documenting the changes in Steep Creek fish habitat.
ADF&G	Sec. 3.8.6.2	3-122	Under all alternatives, a connection between Steep Creek and Backside Pond is proposed to mitigate for fill of Zig Zag Pond; however an analysis of technical feasibility and utility of the pond regarding potential rearing habitat is absent from the DEIS and supporting documents (e.g., ABR, Inc. 2020, Solstice Alaska Consulting, Inc. 2022).	Conduct a preliminary feasibility assessment of the proposed connection to Backside Pond (i.e., ensure basic water quality measurements suggest potential for rearing habitat).
ADF&G	Sec. 3.8.6.3	3-128	Additional water crossings are discussed in this section and accurately allude to beaver-related complications associated with culverts.	Where feasible, bridges should be prioritized over culverts in identified fish-bearing streams.
ADF&G	Sec. 3.8.6.3	3-130	This section discusses advantages of boats powered by alternatives to traditional gasoline or diesel-powered vehicles specifically as they relate to potential for environmental contamination. Also discussed here are diesel-powered construction vessels to support construction operations and maintenance activities, which would introduce hydrocarbons into a water body in which this has never been permitted.	Consider including an analysis or discussion of cumulative environmental effects of conventional (e.g., two-stroke, four-stroke), alternative (e.g., electric), and reduced emissions motors in Mendenhall Lake, specifically regarding the introduction of hydrocarbons.

				References: ABR, Inc. – Environmental Research and Services (ABR). 2021. Biological Resources Review for The Mendenhall Glacier Recreation Area, Tongass National Forest, Alaska. September 2021. Giefer, J., and B. Blossom. 2021. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Southwestern Region, effective June 1, 2021, Alaska Department of Fish and Game, Special Publication No. 21-05, Anchorage. NWSGC. 2020. Northern Wild Sheep and Goat Council position statement on commercial and recreational disturbance of mountain goats: recommendations for management. Proceedings of the Biennial Symposium of the Northern Wild Sheep and Goat Council, 22: 1-15. Solstice Alaska Consulting, Inc. 2022. Mendenhall Glacier Visitor Facility Improvement Project Essential Fish Habitat Assessment. Prepared for the USDA Forest Service, Juneau Ranger District.

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

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September 7, 2021

David Schmid
Regional Forester
USDA Forest Service
8510 Mendenhall Loop Road
Juneau, AK 99801
Submitted electronically: https://cara.ecosystem-management.org/Public//CommentInput?Project=60550

Tom Heinlein
Acting State Director
BLM Alaska State Office
222 West Seventh Avenue, No. 13
Anchorage, AK 99513-7504

Re: Mendenhall Glacier Recreation Area Mineral Exploration Withdrawal

Dear Mr. Schmid and Mr. Heinlein,

Thank you for the opportunity to provide comments on the Forest Service proposal for mineral withdrawals on National Forest lands at Mendenhall Glacier Recreation Area. This proposed withdrawal of mineral resources on 4,560 acres of federally managed lands adjacent to an existing mineral withdrawal (Public Land Order 829) is requested for a 20-year term. Based on a letter from the Forest Service to interested parties (File Code 2760, August 4, 2021), the intent of the proposed withdrawal is to protect the unique landscape from adverse effects of mining activities based on a need to continue to provide a predominately natural setting for semi-primitive types of recreation and tourism, protect recreational and natural resources, scenic integrity, existing infrastructure, and planned future facility development of the Mendenhall Glacier Recreation Area.

The Office of Project Management and Permitting (OPMP) has coordinated with the following state agencies to review the withdrawal proposal in relation to State of Alaska (State) authorities and expertise: Alaska Departments of Natural Resources (DNR), Environmental Conservation (ADEC), Fish and Game (ADF&G), and Law. This letter constitutes the State's consolidated comments for your consideration.

ANILCA withdrawal constraints

Section 1326(a) of the Alaska National Interest Lands Conservation Act (ANILCA) is clear that withdrawals exceeding 5,000 acres **in the aggregate** require notice in the Federal Register and to both Houses of Congress.[1] As noted, the approval of the proposed expansion of the existing

[1] "No future executive branch action which withdraws more than five thousand acres, in the aggregate, of public lands within the State of Alaska shall be effective except by compliance with this subsection. To the extent authorized by existing law, the President or the Secretary may withdraw public lands in the State of Alaska

withdrawal will result in an area exceeding this 5,000-acre limit. This is also likely to be an on-going need as the glacier continues to recede, leaving no doubt that the intent of the withdrawal is to exceed 5,000 acres in the aggregate. This withdrawal and future withdrawals must be considered cumulatively, in accordance with ANILCA Section 1326(a). If approved, the withdrawal expansion must be submitted to both Houses of Congress for it to become effective. The withdrawal will terminate within one year unless Congress passes a joint resolution of approval for the action. The Federal Land Policy and Management Act (FLPMA) Section 202(e)(2) also requires the Bureau of Land Management (BLM) to report any management decision or action that excludes one or more of the principal or major uses for two or more years on one hundred thousand acres to Congress, which terminates, if not adopted. The U.S. Forest Service (Forest Service) and BLM need to address the impact these requirements will have on this action and future planning efforts in the area.

For this proposed action, a focused purpose and need statement regarding the intended recreational and scenic use of the area should be clearly articulated in the Environmental Assessment (EA). The Forest Service and BLM should not apply, as a general policy, the withdrawal of federal lands due to glacial retreat, as these emerging areas are important for multiple uses. A broad purpose and need statement in the EA related to protecting exposed resources due to a receding glacier could be applied to any glacier in Alaska. The EA should specify the rationale for this proposed mineral withdrawal, so the public does not misinterpret that the proposed mineral withdrawal is a general policy to be applied where glaciers are receding.

State assertion over navigable waters

The State asserts the entirety of Mendenhall Lake, including all recently exposed waters and shorelands due to glacial retreat, and the Mendenhall River to be state owned navigable waterways. These lands and waters are managed consistent with existing state statutes and regulations applicable to all state lands. All maps and descriptions in the EA should identify these state-owned lands and waters. This withdrawal does not apply to state navigable waters, which should be specifically excluded from the proposed withdrawal expansion.

Timely processing of withdrawals

This proposed withdrawal should not be processed prior to other withdrawals already waiting to be revoked as a high priority to allow the State to finalize its selections and receive its full land entitlement. Numerous Resource Management Plans (RMP) have analyzed and recommended revoking prior Public Land Orders (PLOs) and these have not been processed in a timely manner. For example, the 2008 Kobuk Seward RMP Record of Decision recommended revoking PLOs 5169, 5170, 5171, 5179, 5180, 5184, 5186, 5187, 5188, and 5353, and over 12 years later these withdrawals have not been lifted. Further, the state has prioritized PLO 5150 as its highest priority for BLM to repeal but has not been notified of any action on that PLO. With limited staff available to process/revoke withdrawals, the State requests that BLM prioritize processing high priority requests from the state and older withdrawals that have been recommended for

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exceeding five thousand acres in the aggregate, which withdrawal shall not become effective until notice is provided in the Federal Register and to both Houses of Congress. Such withdrawal shall terminate unless Congress passes a joint resolution of approval within one year after the notice of such withdrawal has been submitted to Congress."

revocation in previously completed Resource Management Plans before devoting staff time to new requests.

Additionally, the State suggests the Forest Service and BLM develop a comprehensive long-range plan to address the need for a withdrawal, consistent with ANILCA and other applicable laws, rather than a twenty-year withdrawal period with the option for a twenty-year extension, as proposed. A comprehensive long-range plan addressing this issue would be prudent considering the need for this withdrawal will remain in twenty years when this proposed withdrawal would expire.

National Historic Preservation Act

The State Historic Preservation Office notes the proposed withdrawal is an administrative action rather than an undertaking under Section 106 of the National Historic Preservation Act, and thus has no additional comments.

Fish and wildlife

Currently on the Tongass National Forest, the Mendenhall Glacier Recreation Area (excepting the Mendenhall Lake and Juneau Road System closed areas) is open to hunting and closed to trapping by the Alaska Board of Game. If glacial changes occurred to allow better access to the proposed withdrawal area, interest in opportunities for trapping may occur in the area. The current Master Plan for the area does not address this potential interest. The State requests potential impacts of the withdrawal on hunting and trapping interests in the area be evaluated and disclosed in the EA, as well as future planning efforts.

The State requests the Forest Service and BLM cooperatively work with ADF&G management staff to address fish and wildlife related issues, including potential trapping opportunities in the expansion area, within the context of all uses. The EA should discuss planning in the area holistically, over time, as the glacier is likely to continue to recede.

Conclusion

Thank you for the opportunity to review the proposal and submit comments regarding this mineral exploration withdrawal. Please contact me if you have any questions.

Sincerely,

Catherine Heroy
Large Project Coordinator

Ecc: State Review Team
Kyle Moselle, Executive Director, DNR Office of Project Management and Permitting
Chelsea Kreiner, Realty Specialist, BLM

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

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CIVIL DIVISION

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April 26, 2022

VIA CERTIFIED MAIL

Honorable Thomas Vilsack
Secretary of Agriculture
1400 Independence Avenue SW
Washington, D.C. 20250

Honorable Deb Haaland
Secretary of the Interior
1849 C Street NW
Washington, D.C. 20240

Re: Waters of the Mendenhall Lake and River, Alaska

Dear Secretary Vilsack and Secretary Haaland:

Pursuant to Section 2409a(m) of Title 28 of the United States Code, the State of Alaska hereby provides notice of its intent to file a quiet title action to the submerged lands underlying the waters of the Mendenhall Lake and River, Alaska. To the extent the United States continues to dispute the State's title, in not less than 180 days, the State intends to sue to quiet title to the submerged lands underlying the waters of the Mendenhall Lake and River within T40S, R66E, CRM. and T39S, R66E, CRM, adjacent to the Tongass National Forest, Map attached.

Title to these lands passed to Alaska at statehood based on the equal footing doctrine, the Submerged Lands Act, 43 U.S.C. §§ 1301 *et seq.*, and the Alaska Statehood Act, 72 Stat. 339, 48 U.S.C. note preceding § 21.

Sincerely,

TREG R. TAYLOR
ATTORNEY GENERAL

By:
Ronald W. Opsahl
Senior Assistant Attorney General

RWO/csf
Enclosure

cc: Thomas Heinlein, BLM Alaska Acting State Director
Earl Stewart, USDA, Tongass National Forest

Mendenhall River & Mendenhall Lake Mendenhall Valley Juneau, AK

Miles
0 0.1 0.2

Projection: Albers Equal Area
Extract of NHD 2018 edited
Extract of NHD 2007 edited
Alaska High Res Imagery, AGC
Map Printed: April 8, 2021
Produced by Wendy Steinberger, NRS III

Mendenhall Lake & River

This map is based on the most recent data available; however the actual and/or historical location of the waters involved may differ from that shown on this map due to the changes in the waters over time. Land Status describes ownership types within a section. Please note that Land Status may not cover entire section; please refer to Master Title Plat for precise land ownership.

The State of Alaska makes no expressed or implied warranties (including warranties of merchantability and fitness) with respect to the character, function, or capabilities of this product or its appropriateness for any user's purposes. In no event will the State of Alaska be liable for any incidental, indirect, special, consequential or other damages suffered by the user or any other person or entity whether from use of the product, any failure thereof or otherwise, and in no event will the State of Alaska's liability to you or anyone else exceed the fee paid for the product.

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THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Natural Resources
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STATE OF ALASKA NAVIGABILITY DETERMINATION
Mendenhall Lake & Mendenhall River

Date of Determination: January 15, 2019

River: Mendenhall River

Lake: Mendenhall Lake

Determination:

Mendenhall Lake is navigable for title purposes.

The Mendenhall River is navigable for title purposes the entire length of the river from tide water to Mendenhall Lake.

Date of Request: April 25, 2013

Requester: Department of Transportation and Public Utilities and Department of Natural Resources (DNR)

Type of Request: Navigability for title.

Location:

The Mendenhall River from tidewater in Fritz Cove and Gastineau Channel, within Sections 4, Township 41 South, Range 66 East, Copper River Meridian upstream to its source in Mendenhall Lake within Sections 7, Township 40 South, Range 66 East, Copper River Meridian. Mendenhall Lake within Sections 5, 6, 7, and 8, Township 40 South, Range 66 East, Copper River Meridian.

Reason for Navigability Determination:

The Department of Transportation and Public Utilities requested the determination on the Mendenhall River. The upgrade and reconstruction of the Brotherhood Bridge over the Mendenhall River was requested for consideration of bridge height. Upgrades to Loop Road Bridge were discussed in telephone conversation and added to the request. DNR, Survey Section contacted this office on March 10, 2015 requesting consideration of easement permit application for bank stabilization project on the Mendenhall River and is now added to this determination.

Standards Used For Making Navigability Determination

The question of navigability for the purpose of state ownership is decided according to federal law. *Ahtna, Inc.*, 891 F.2d at 1404 (citing *United States v. Holt State Bank*, 270 U.S. 49, 55-56 (1926)). The Supreme Court expressed the basic test for navigability in *The Daniel Ball*, 77 U.S. (19 Wall) 557, 563 (1870), as follows:

> Those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used, or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water.

Id. This test is applied in multiple situations, including when answering questions of title to river or streambeds under the Equal Footing Doctrine. *See PPL Montana, LLC v. Montana*, 132 S. Ct. 1215, 1228 (2012).

Case law subsequent to *The Daniel Ball*, including *Ahtna, Inc.* and the U.S. Department of the Interior's decision in *Appeal of Doyon, Ltd.*, 86 Interior Dec. 692, 698 (ANCAB 1979), explained the meaning of that basic test. The physical character of the waterway, and in particular its capacity to be navigated, is an important factor when considering navigability for title. In the Supreme Court's most recent decision regarding navigability for title, *PPL Montana, LLC v. Montana*, it again emphasized that rivers and streams are not only navigable if they were *used* for commerce, but also if they were *susceptible* of being used as highways of commerce at the time of statehood. 132 S. Ct. at 1233. And, as previously stated by the Ninth Circuit in *Ahtna, Inc.*: "Although the river must be navigable at the time of statehood, *this only means* that, at the time of statehood, *regardless of the actual use of the river*, the river must have been *susceptible* to use as a highway of commerce. . . . [I]t is not even necessary that commerce be in fact conducted . . . 'The extent of existing commerce is not the test.'" 891 F.2d at 1404 (emphasis added) (quoting *United States v. Utah*, 283 U.S. 64, 75, 82-83 (1931)). Rather, it is enough to show:

> the capacity of the rivers in their ordinary condition to meet the needs of commerce as they may arise in connection with the growth of the population, the multiplication of activities, and the development of natural resources. And this capacity may be shown by physical characteristics and experimentation as well as by the uses to which the streams have been put.

Utah, 283 U.S. at 83. Present-day recreational use is relevant to determining whether a river was susceptible to commercial use at the time of statehood if: "(1) the watercraft are meaningfully similar to those in customary use for trade and travel at the time of statehood; and (2) the river's post-statehood condition is not materially different from its physical condition at statehood." *PPL Montana, LLC*, 132 S. Ct. at 1233.

Although portages—or the need to bypass a river segment—may defeat navigability for title for that particular river segment, *id.* at 1231–32, the presence of rapids, sandbars, and other obstructions, which may make navigation difficult, but not impossible, does not destroy title

navigability, *see Utah*, 283 U.S. at 86. In *Utah*, a case addressing navigability for title, the Supreme Court stated "the mere fact of the presence of . . . sandbars causing impediments to navigation does not make a river nonnavigable." 283 U.S. at 86. Although "the presence of sandbars must be taken in connection with other factors making for navigability," the "essential point is whether the natural navigation of the river is such that it affords a channel for useful commerce." *Id*; *see also Oregon v. Riverfront Protection Ass'n*, 672 F.2d 792, 795 (9th Cir. 1982), (relying on the use of the McKenzie River in Oregon for log drives to determine the river navigable for title and stating that the "use of the river need not be without difficulty, extensive, or long and continuous."); *Doyon, Ltd.*, 86 Interior Dec. at 697 ("Although rapids, shallow waters, sweepers, and log jams make navigation difficult on both [the Kandik and Nation Rivers], the evidence shows that these impediments do not prevent navigation.").

Boat use is not the only method for proving a river or stream's ability to serve as a highway for useful commerce. In *Oregon v. Riverfront Protection Association*, the Ninth Circuit considered evidence of the transporting of logs on the McKenzie River relevant to determining the river's potential use for commerce. 672 F.2d at 794–96. The court further found that the seasonal and sometimes difficult nature of these log drives did not destroy navigability. *Id.* at 795–96 (holding that "notwithstanding [the] difficulties, thousands of logs and millions of board feet of timber were driven down the river" and this use was not "occasional" as it occurred over a three-month period for over seventeen years).

Applying these standards to Alaska, the courts and Department of the Interior found waterways navigable for title based on their susceptibility to use for navigation by river boats, inflatable rafts, or canoes having a capacity for "commercial" loads of about 1000 lbs. of supplies or recreationists. *Ahtna Inc.*, 891 F.2d 1401 (Gulkana River); *Appeal of Doyon*, 86 Interior Dec. 692 (Kandik and Nation Rivers); Feb. 25, 1980 Memorandum from Regional DOI Solicitor John ("Jack") Allen to BLM Alaska State Director re "Kandik, Nation Decision on Navigability"; *see also Alaska v. United States*, 201 F.3d 1154 (9th Cir. 2000); August 18, 1983 Recommended Decision by DOI Administrative Law Judge Luoma in *Appeal of Alaska*, Interior Board of Land Appeals No. 82-1133 (recommending that the Matanuska River be determined navigable) & July 19, 1990 Memorandum of BLM Alaska State Director E. Spang (Matanuska River is navigable), BLM Files AA-11153-23, -31; *Appeal of State of Alaska & Collier*, 168 IBLA 334 (2006) (noting navigability standards). Although a water body may be navigable in fact there may be one more question to resolve concerning whether or not the State received title from the United States to the submerged lands at statehood. The Supreme Court defined the principle that the United States holds the submerged lands of navigable waters in the territories in trust for the future state. *See Pollard's Lessee v. Hagen, 44 U. S. 212 (1845).* The Court further clarified that the United States Congress, by virtue of the Property Clause of the U. S. Constitution, may make grants of the submerged lands on water bodies which are navigable-in-fact and had not yet conveyed to the State. *See Shivley v. Bowlby, 152 U. S. 1 (1894).* Recently the Court has further clarified by stating that the disposal of territorial submerged lands by the United States should not be inferred unless "the intention was definitely declared or otherwise made very plain". *See United States v. Holt Bank, 270 U. S. 49, 55 (1926).* Referring particularly to reservations the Court announced a two part test for pre-statehood reservations of territorial submerged lands under navigable waters. The facts must show that the Congress clearly intended to include the submerged lands in the reservation and that the

Congress intended to defeat the future State's title. *See Utah Division of State Lands v. United States et. al., 482 U. S. 193, 209-10 (1987).*

Pre-statehood Withdrawal:

Portions of the Mendenhall River and the entirety of Mendenhall Lake are located within the current boundaries of the Tongass National Forest. The Mendenhall Valley was initial withdrawn by the Second Proclamation of the Tongass National Forest dated February 16, 1909, signed by Theodore Roosevelt.[1] Portions of the Mendenhall Valley were eliminated by Presidential Proclamation 2263, dated February 7, 1922, signed by Warren G. Harding.[2] U. S. Survey 1536, created in 1924 is the survey of the 1922, Mendenhall Valley Elimination. On June 27, 1935 President Franklin D. Roosevelt signed Executive Order 7088 returning a portion of the Mendenhall Valley Elimination to the Tongass National Forest.[3] U. S. Survey 2385, created in 1940 is the survey of this addition to the Tongass National Forest. In 1989, U. S. Survey 2385 was resurveyed for a National Forest Community Grant for the Mendenhall Elementary School, adjacent to the Mendenhall River.

The Second Proclamation dated February 16, 1909 states:

> …it appears that the public good would be promoted by adding to the Tongass National Forest certain lands within the Territory of Alaska, which are in part covered with trees.

When describing the area, it is qualified as "all of the public lands" within that area. Submerged lands under navigable waters were not be considered "public lands". The Proclamation intention is to reserve forest lands. The Proclamation contains no express language to reserve the submerged lands under Mendenhall River and Lake or intent to defeat the future state's title. Subsequently, the language in Executive Order 7088 does not indicate Congress intended to convey the bed of the Mendenhall River or to defeat the State's title. The reservations for the Tongass National Forest do not defeat the State's title.[4]

Natural and ordinary condition:

To evaluate the ordinary and natural condition of the Mendenhall River and Lake aerial photography before statehood in 1948[5] and after statehood in 1973[6] were analyzed. An oblique photograph from 1956[7] of the Mendenhall glacier and a portion of Mendenhall Lake was also

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[1] Presidential Proclamation 846, February 16, 1909, available in PAAD Files.
[2] Presidential Proclamation 2263, February 7, 1922, available in PAAD Files.
[3] Executive Order 7088, June 27, 1935, available in PAAD Files.
[4] The argument that the Tongass withdrawal defeated state title to the submerged lands was repudiated by the IBLA and the Department of Justice by its quiet title act disclaimer for the Stikine River. Katalla River, 102 IBLA 357 and IBLA 85-768. United States'Amended Quiet Title Act (28 U.S.C.§ 2409a(e)) Disclaimer and Order and Decree Confirming Quiet Title Act Disclaimer, Case No. 3:15-cv-0226-RRB, Stikine River.
[5] Photo CSEA001400072, August 25, 1948, downloaded from USGS Earth Explorer.
[6] Photo B7140B01P0086, August 21, 1973, downloaded from USGS Earth Explorer.
[7] J.H. Harsthorn, photo 475, Mendenhall Glacier taken late in the evening on return flight by Ken Loken from the Lemon Creek (glacier) camp June 1956, USGS Photo Library, Denver

analyzed. Artificial changes observed from the pre-statehood photographs was a wing dike and a bank dike protecting the Juneau Airport runway from erosion. These dikes are still in place. Not in the photographs, but also noted, is the bank stabilization for Brotherhood Bridge. There is no indication that those dikes or the bank stabilization made the river more or less navigable, so for determining if the river and lake were navigable-in-fact at statehood its condition at statehood is considered its ordinary and natural.

The post-statehood photography shows gravel extraction areas that are likely post-statehood activities. This activity does not appear to have modified the navigability of the Mendenhall River from its condition at statehood so post-statehood use is indicative of the river's susceptibility to use for travel, trade and commerce in its ordinary and natural condition at statehood.

Mendenhall Lake has expanded in size since statehood as the glacier recedes. The icebergs in the lake have remained few throughout that time and are not significantly different from statehood until today. The lake in the 1948 photograph (see Figure 1[8]) is over 400 acres[9]. By 1956 (see Figure 2) the glacier had receded enough that the rock face has become visible indicating that the lake was likely bigger at statehood then in 1948[10]. By 1973 (see Figure 3) the rock face appears slightly more visible than in 1956. The lake in 1973 was approximately 650 acres, which appears to be slightly larger than it was at statehood. In 1979 (see Figure 4) more of the rock face is showing and the lake appears to be approximately 750 acres. Based on the area calculations of the lake at statehood was between approximately 400 and 650 acres. Mendenhall Lake appears to be its ordinary and natural condition at statehood.

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[8] Mendenhall Glacier Recreation Area Management Plan EIS, USFS, 1996, page ROD – 8.

[9] The area was calculated by a function on the State of Alaska's *Alaska* Mapper program based on an estimation of the limits of the lake derived from the aerial photography.

[10] Since the 1956 photograph is oblique the area calculation could not be made.

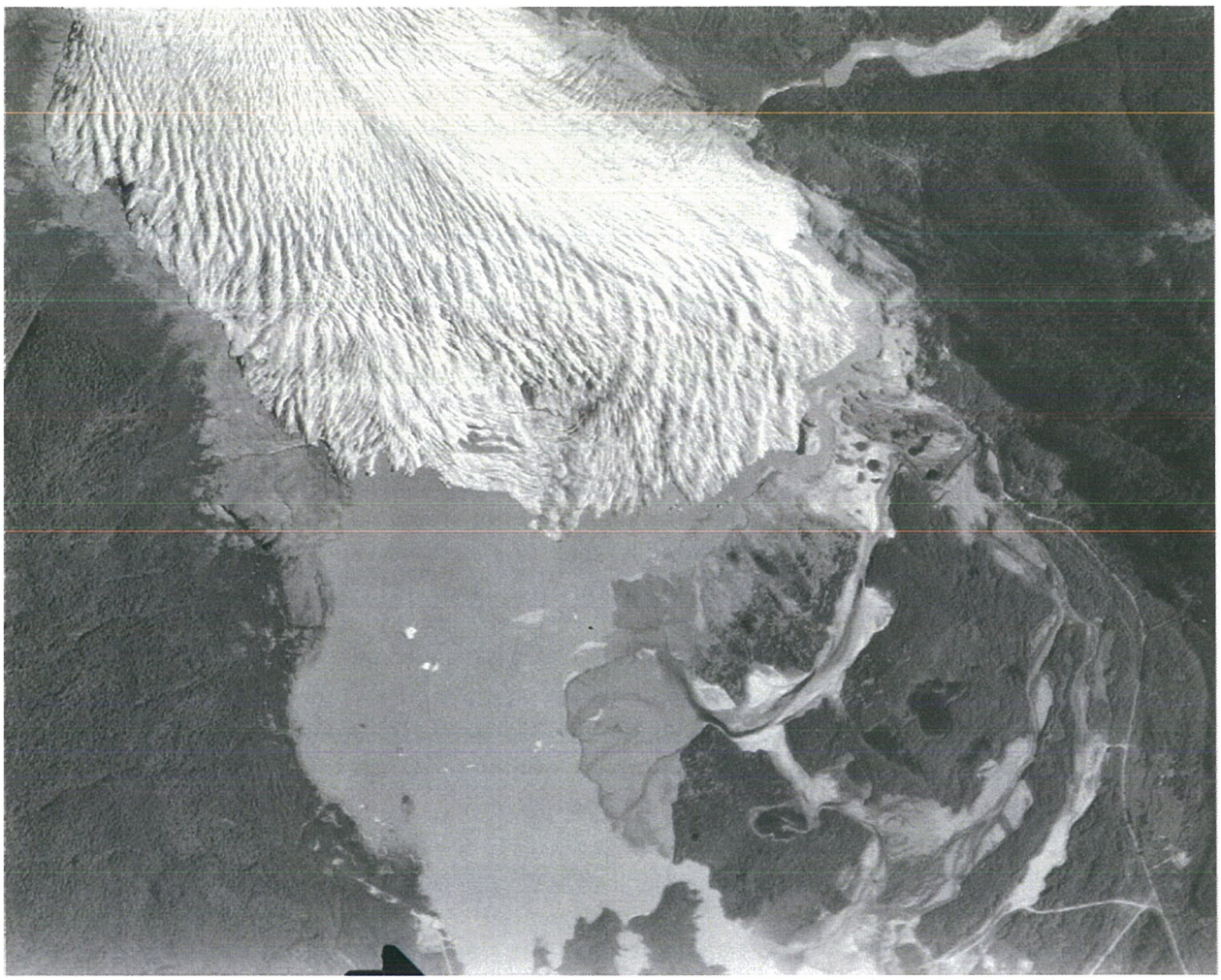

Figure 1. Mendenhall Glacier and Lake. Crop of photo CSEA001400072, August 25, 1948, downloaded from USGS Earth Explorer.

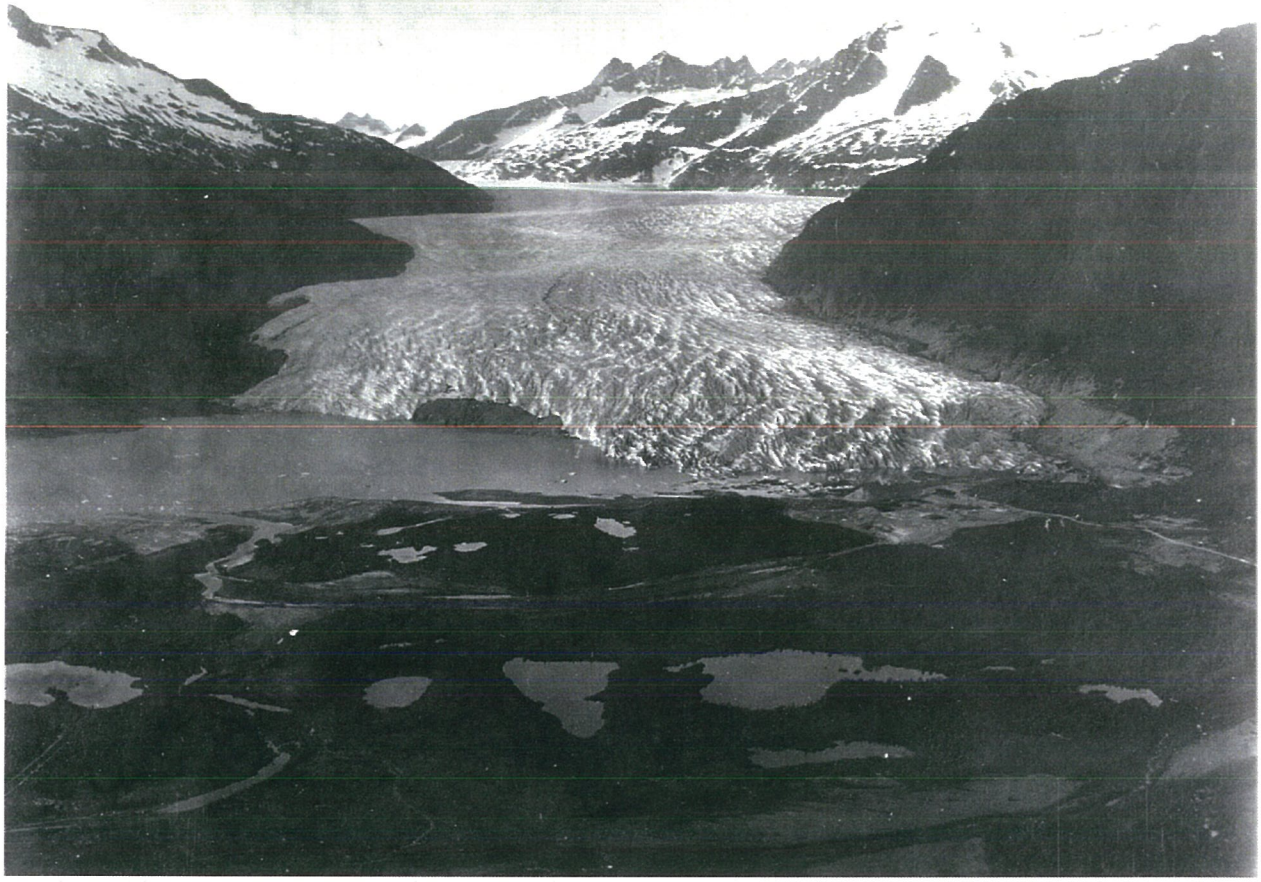

Figure 2. Mendenhall Glacier and Lake. J.H. Harsthorn, photo 475, Mendenhall Glacier taken late in the evening on return flight by Ken Loken from the Lemon Creek (glacier) camp June 1956, USGS Photo Library, Denver.

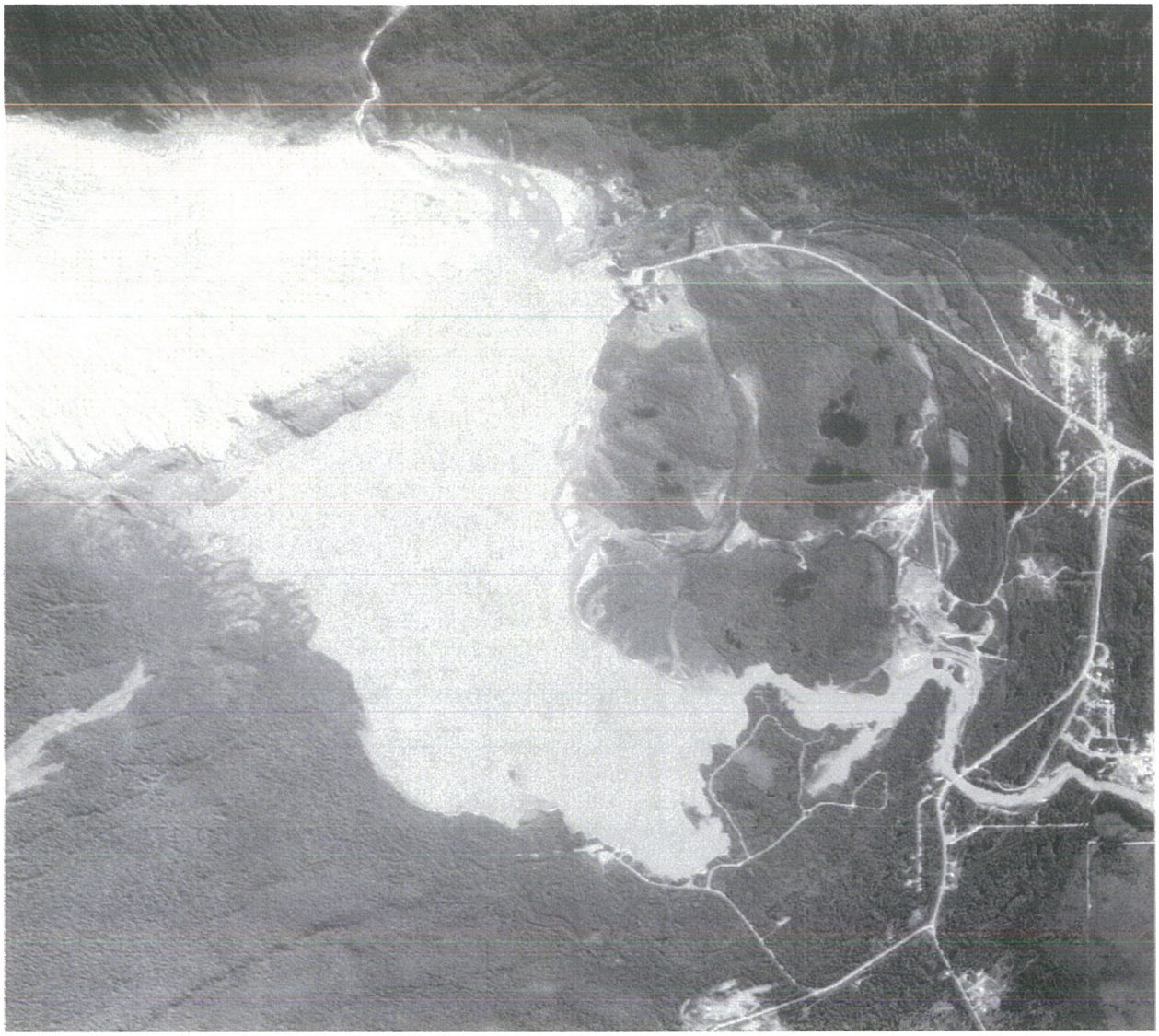

Figure 3. Mendenhall Glacier and Lake. Crop of photo B7140B01P0086, August 21, 1973, downloaded from USGS Earth Explorer.

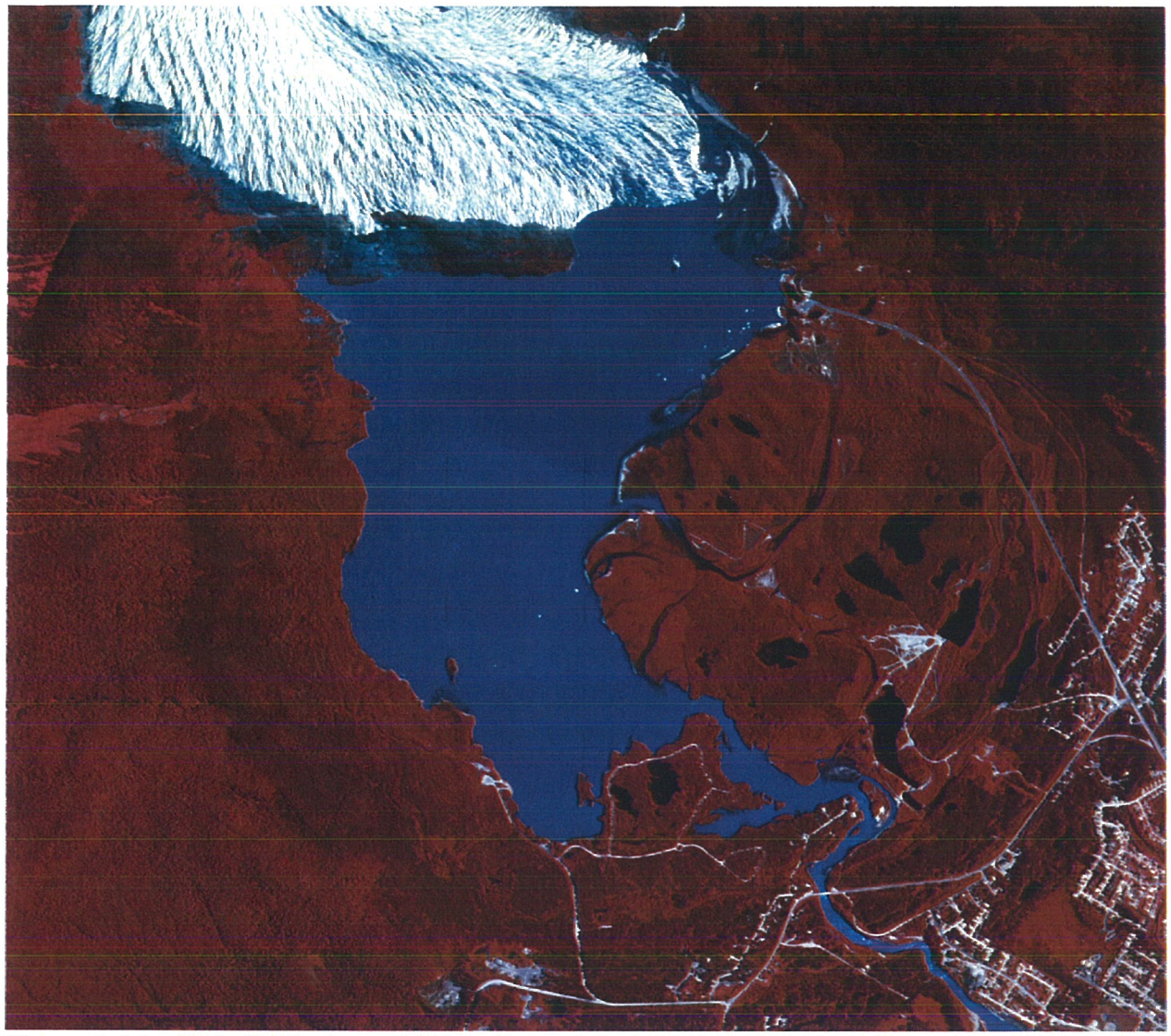

Figure 4. Mendenhall Glacier and Lake. Crop of photo 6406001100034, August 11, 1979, downloaded from USGS Earth Explorer.

Evidence Used In Making the Determination

Physical Characteristics: The Mendenhall River drains Mendenhall Lake, and flows 6 miles south to Gastineau Channel. The average gradient of the river is 10.8 feet per mile. At the outlet of Mendenhall Lake, the river is 220 feet wide. At the Inlet to Gastineau Channel, the river is 340 feet wide. The Mendenhall River is a sinuous, single channel river for most of its length. More than half the Mendenhall River is tidally influenced. The mean monthly discharge is shown below in Table 1 and demonstrates the flow is relatively constant from June through October.

	Max	Min	Mean
Jan	600	31	116
Feb	254	22	91
Mar	379	22	90
Apr	445	47	144
May	1602	269	695
Jun	2819	733	1924
Jul	3835	1939	3063
Aug	4701	2025	3377
Sep	4100	1380	2694
Oct	2649	532	1345
Nov	1105	111	350
Dec	563	40	170
Ann	1547	758	1183

Table 1 Monthly and annual stream flow statistics for USGS station 15052500 Mendenhall River near Auke Bay Alaska, full years of record displayed (May 15, 1965 to September 30, 2011).[11]

Prior Navigability Determinations: The Bureau of Land Management (BLM) researched rivers in the Juneau area and made navigability determinations in order to make acreage calculations for land conveyances under the Statehood Mental Health Grants and Municipal Grants in 1982. The BLM determined Mendenhall Lake non-navigable while noting boat use for recreation[12]; and determined Mendenhall River non-navigable while noting the commercial floating of the river by inflatable rafts and by other recreational whitewater enthusiasts. The BLM pointed out one specific reference of a 1920 canoe trip by ornithologist Alfred M. Bailey and his wife. This record described the stream as being so swift and narrow that the Bailey's turned back. The determination also states that "Under existing departmental criteria, floatplane use, recreational use, and commercial recreational use (in themselves) do not lead to a determination of navigability."[13] The BLM surveyors meandered the Mendenhall River to just upstream of the Back Loop Bridge and the property line of the Community Grant for the Mendenhall Elementary School while calling out the withdrawal line across the river and referencing the bed of the river as USS 2385.[14]

The State of Alaska reviewed the navigability of the Mendenhall River and Lake at least four times, as documented in the file. In an October 29, 1991 memo titled Juneau Borough – Navigability Review, both Mendenhall River and Lake were determined to be susceptible to navigation at statehood. Another memo dated February 3, 1993 documents Navigability Field

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[11] USGS, *National Water Information System: Web Interface*, Retrieved 6/22/12, http://waterdata.usgs.gov/ak/nwis/inventory

[12] BLM has been resistant to acknowledge recreational use as a way to demonstrate that a waterbody was susceptible to commercial use even after the *Gulkana* case had been adopted by the Ninth Circuit. BLM's failure to follow *Gulkana* was a primary reason given by the District Court to find the United States had acted in bad faith. See *State of Alaska v. United States*, No. 3:12-cv-00114-SLG, Order Regarding Attorney Fees, (May 3, 2016), pages 11-18. (Appeal to the Ninth Circuit pending).

[13] Chief, Division of Resources to State Director, Navigablility Recommendations – Juneau #2, FY82, March 10, 1982.

[14] Master Title Plat, C040S066E, downloaded from http://sdms.ak.blm.gov/sdms/

Investigations for Southeast Alaska lists the Mendenhall River as navigable. A draft navigability report dated October 10, 1994 describes two interviews but does not draw any conclusions. The final report dated September 18, 1996 describes four interviews regarding the Mendenhall River and does not make a determination.

Summary of Interviews: ADF&G Sport Fish staff Paul Suchananek interviewed on October 6, 1994 stated that he has seen jet boats using the river above Montana Creek. USCG, Bridge Administrator, James Helfinstine interviewed on the same day stated that he had observed commercial rafting and power boats on the river. He provided brochures for the local guides for the file. On October 12, 1994 BLM Navigability Supervisor, Mike Brown indicated that the BLM had not looked at the Mendenhall River for a navigability report. The same day local Juneau historian, Dave Stone (now deceased) was interviewed; he stated that a local dairy used the Mendenhall River to transport milk to the mines in Juneau area.

In a December 12, 2013 telephone conversation with follow up email James Helfinstine, USCG provided listing of USCG navigable waters. This listing states that the Mendenhall River is considered navigable by the USCG from Gastineau Channel upstream to Montana Creek. He stated in the conversation that for much of this distance the river is subject to tidal influence.

On August 4, 2014 Deputy Commissioner of DNR, Ed Fogels was interviewed regarding the time period in the 1980's when he worked for Alaska Travel Adventures (ATA) as a professional guide on the Mendenhall River. Beginning in May 1980 through the 1983 tour season Mr. Fogels worked as a guide taking tourists down the Mendenhall River. For the remaining time that Mr. Fogels was with ATA he was the statewide operations manager.

The Mendenhall River raft trips would start from the put in at Skaters Cabin on the west shore of Mendenhall Lake and proceed across the lake and downriver to the take out at a warehouse near the airport; customers were dropped off at Brotherhood Bridge. Mr. Fogels indicated that when the company first offered the trip they utilized 2 rafts with 10 customers and took one trip per day. The popularity of this guided raft trip quickly increased to 17 rafts with 10-12 customers and three trips per day. During the time that Mr. Fogels was guiding ATA utilized Avon wrap floor (non-self bailing) rafts starting with smaller rafts that would accommodate up to 10 customers then upgrading to larger Avon wrap floor boats that would accommodate up to 12 customers. Each year the company would begin each season by ensuring the river was clear of sweepers and log jams. One year Mr. Fogels stated it took a week to clear log jams with a chain saw.

While guiding on the river Mr. Fogels stated that he saw other boats such as rafts and canoes utilize Mendenhall Lake and motorboat use on the lower portions of Mendenhall River. Local recreational boaters would also use the Mendenhall River with their personal rafts and kayaks. In the lower river Lund type skiffs with 35 hp motors were also seen utilizing the river. The lengths of these boats ranged from 12 feet to 14 feet and had one or two people on board.

Online research indicates that ATA is continuing to provide Mendenhall Glacier Float Trips on the Mendenhall River. The company has expanded into offering Mendenhall Lake Canoe Adventures. Utilizing a traditional Tlingit style canoe that will hold up to 12 customers plus

guides the trip crosses Mendenhall Lake from near Skaters Cabin to near Nugget Creek Falls and then near the face of the glacier.[15]

A follow up interview with Deputy Commissioner of DNR, Ed Fogels took place on April 22, 2015. Purpose of the interview was to review color infrared photography of the Mendenhall River from August 11, 1979 in relation to the clearing of logs from the river. This was in association of the start up of operations by ATA. Mr. Fogels indicated that there were no trees within the river above the local landmark of "junk car bend". All logs removed were below this corner with the largest cleanup below Montana Creek. No logs were in the river along the strait portion above Brotherhood Bridge to the take out.

On March 24, 2015 Terry Schwarz, Hydrologist II with the DNR, DMLW, Hydrologic Survey Unit provided information of his personal recreational use of the Mendenhall River. Mr. Schwarz indicated that he put in near the skaters cabin on the west side of Mendenhall Lake. Utilizing three different watercraft, 14-ft Avon, 16-ft cataraft, and pack raft; Mr. Schwarz traveled to the public take out at Clinton Drive. Generally taking one or two trips down the river per year Mr. Schwarz has been using the Mendenhall River since 2009.

Mr. Schwarz stated that he has seen an approximately 20-ft aluminum boat with soft top tied up behind a home in the area of Meander Way. It was unclear if the boat was propelled by a jet or propeller motor. From Mr. Schwarz experience boating on Alaska waters, the Mendenhall River would support a 24-ft jet boat.

Pre-statehood Commercial Use: In September 1991, the City and Borough of Juneau (CBJ) published a Draft Report of the Juneau Dairy Farming Historic Resources Survey; a final version was not located. In a discussion of delivery routes, the report describes the delivery of dairy products from the northwest side of the Mendenhall River as traveling by boat to town as there was no bridge until around 1928.[16] Albert and Jensine Pederson located a 160-acre homestead on the northwest side of the Mendenhall River. The Alaska Treadwell Gold Mining Company purchased the Pederson's produce for the boarding house kitchens. Albert Pederson "delivered the products by boat going down the Mendenhall River when the tide was high."[17][18] William Pederson, Albert and Jensine's son also utilized a boat to attend the Mendenhall School.[19]

General Post-statehood Use: The Tongass National Forest issued a Final Environmental Impact Statement (EIS) for the Mendenhall Glacier Recreation Area Management Plan Revision in April 1996.[20] The EIS states that commercial raft tours began in 1981, taking 10,000 visitors down the Mendenhall River that year. Authorized use levels increased to 25,700 by 1995 for these rafting tours.[21] The EIS indicates that in 1996 new commercial use requests had been received; five for

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[15] http://www.bestofalaskatravel.com/alaska_day_tours/pages/j_mendenhall_lake_canoe.htm reviewed April 20, 2015.
[16] CBJ, *Draft Report of the Juneau Dairy Farming Historic Resources Survey*, September 1991, Page 3.
[17] Id., p. 13.
[18] Id., p. 14.
[19] Id., p. 13.
[20] Alaska Region, Tongass National Forest, Chatham Area, Juneau Ranger District, Mendenhall Glacier Recreation Area Management Plan Revision, Final Environmental Impact Statement, April, 1996.
[21] Id. p. 3-29.

raft/canoe/kayak tours; one for small motorized boat tour, one for tourist "barge" to face of Glacier tour.[22] It is indicated further in the document that under all alternatives there is no developed boat launch with vehicle access. This will affect motorized boat use on Mendenhall Lake and River by limiting access, except by motorized boats that travel up river to access the lake.[23] In determining the capacity for Mendenhall River and Lake the USFS determined that the capacity of the shoreline area was the limiting factor in using the river and lake.[24]

The record of decision (ROD) for the EIS authorized commercial use allocation levels for Mendenhall Lake and Mendenhall River. The ROD stated that the commercial use allocation levels for Mendenhall Lake are:

> 2980 visitors per summer (24 visitors per day; maximum group size of twelve, including guide(s). Maximum of two groups per day; special use permit stipulations will include specified "minimum approach distances" to protect gull colony; commercial tour use/ landings on the rock outcrop near the Glacier is prohibited).[25]

The Mendenhall River, on the other hand, was allotted significantly higher levels, the ROD allowed "38,190 visitors per summer (average of 308 visitors per day; maximum of four groups per day)."[26]

The ROD authorizes public access behind an existing gate currently reserved by a special use permit holder at Mendenhall Lake. This will provide a boat launch area for non-motorized recreational boating for the public.[27] Within a discussion regarding mitigation and monitoring the ROD indicates that outfitter/guide boat tours on both Mendenhall River and Lake will occur between 8 am and 8 pm only. It is indicated that there is competition between the commercial users and non-commercial users for boating on the river and lake.[28]

The Tongass National Forest issued an Environmental Assessment (EA) for the Mendenhall Glacier Recreation Area (MGRA) Management Plan Revision in October 2014.[29] This EA makes note that use within the area has changed four ways. First, the season of intense use has expanded to visitors arriving earlier in the summer and staying later in the fall. Second, the number of visitors to MGRA has more than doubled "from 200,000 in 1999 to more than 400,000 in 2013." Third, the type of visitor "looking for a more active experience such as hiking or boating with a guide" has increased. Finally, the report states that the "demand for river rafting excursions has been decreasing … while demand for guided excursions on the lake has

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[22] Id. p. 3-33.
[23] Id. p. 4-2.
[24] Mendenhall Glacier Recreation Area Capacity Determination, United States Department of Agriculture, United States Forestry Service, Juneau Ranger District, September 2014, page 29
[25] Id. ROD p. 9.
[26] Id. ROD p. 9.
[27] Id. ROD p. 10.
[28] Id. ROD p. 12
[29] Tongass National Forest, Juneau Ranger District, Environmental Assessment, Mendenhall Glacier Recreation Area Management Plan Revision, Commercial Guide, Outfitter and Transport Services, October 2014.

been increasing." The change in the commercial activities requires the reevaluation of environmental and or social impacts.[30]

The EA discusses the capacity, the allocations and the commercial use for the various units in the MGRA. Data from the EA regarding the Mendenhall River and Lake is extracted from Tables 3, 4, 7 and 8 of the EA and combined into Table 2 of this document shown below.

TABLE 2: Capacity, Commercial Allocation and Actual Commercial Use Reported[31]

Facility	1996 Capacity	2014 Capacity	Commercial Allocation 1996	Commercial Allocation 2014	Use 2008	Use 2009	Use 2010	Use 2011	Use 2012	Use 2013
Mendenhall River	58,754	30,000	38,190	15,000	19,538	16,145	12,732	13,964	13,614	11,936
Mendenhall Lake	4,585	32,480	2,980	16,240	2,850	2,776	2,959	3,081	4,288	3,196

On March 10, 2014 the Juneau Ranger District published the Draft Decision Notice and Finding of No Significant Impact for the MGRA Management Plan Revision. This document adopts Alternative 2 from the EA for the MGRA. Another major change from the 1996 decision is commercial electric motor boat use will be allowed on Mendenhall Lake during the visitor season.

Tidal Influence: The USGS performed investigations of the Mendenhall River to estimate water-surface profiles in 1997. USGS Water-Resources Investigations Report 99-4150; Hydrology, Geomorphology, and Flood Profiles of the Mendenhall River, Juneau, AK describes the results of this study.[32] This document states; "the lower reaches of the Mendenhall River are significantly influenced by high tides. The lower reach of the river is noticeably influenced by large high tides as far upstream as cross section 69 (fig. 2D)."[33]

This location, cross section 69, described by the USGS coincides with the 15 feet elevation, by the USGS survey. From the NOAA tides and currents page; the mean high tide at the Fritz Cove, Douglas Island, Station ID TWC1697 is calculated to be 15.04 feet elevation.[34] This analysis indicates that this would be a minimum distance upstream that the mean high tide would influence. The mean high tide may be located further upstream from this location, if backwater is considered.

The Habitat Division of The Alaska Department of Fish and Game (ADFG) investigated the Mendenhall River in 2007-2008 to document fish use of the river. This report, ADF&G Technical Report No. 11-03; Juvenile Salmonid presence in the Mendenhall River, Juneau, AK

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[30] Id. P.2.
[31] Id. Table 3, p. 15, Table 4, p. 16 Table 7, p. 21 and Table 8, p. 23.
[32] Neal, E.G. and Host, R.H., *Hydrology, Geomorphology, and Flood Profiles of the Mendenhall River, Juneau, Alaska*, Water-Resources Investigations Report 99-4150, Anchorage, Alaska, 1999.
[33] Id. p. 14.
[34] http://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=TWC1697 downloaded 2/19/2014.

provides further information regarding the upstream extent of tidal influence.[35] Tidal influence within the Mendenhall River is discussed twice. The first is in a general river description stating; "Tidal influence extends about 4 km upriver from Fritz Cove to near the confluence with Montana Creek."[36] The second, within the description for "Reach C established from about 400 m upstream of the Montana Creek Confluence downstream to the Brotherhood Bridge on Glacier Highway… The majority of this reach is tidally influenced."[37]

SUMMARY

The Mendenhall River and Lake at the date of statehood was in its ordinary and natural condition. Pre-statehood commercial use in the lower reaches and post statehood recreational use and physical characteristics indicate that the Mendenhall River and Lake were navigable in fact at the time of statehood.

Freighting goods from the Pederson Farm along the Mendenhall River to the Alaska Treadwell Gold Mining Company pre-statehood was documented by the City and Borough of Juneau. The Pederson's also used boats to cross the Mendenhall River to attend school.

Alaska Travel Adventures began offering commercial guided raft trips in the 1980's with boats equivalent to those available prior to the date of statehood. This use expanded to the Mendenhall Lake with historically designed canoes after the 1996 USFS review. Tens of thousands of people have boated on the Mendenhall River and/or Lake each year for decades on twelve-man rafts from early summer to late fall. This use seems to match or exceed the use in *Gulkana* in every meaningful way.

The Stikine River Disclaimer and Order and Decree Confirming Quiet Title Act Disclaimer issued by the U. S. District Court defeated any argument that the Tongass National Forest was a valid pre-statehood withdrawal. Please see Recordable Disclaimer of Interest and Litigation documents and history at the Navigable Waters home page: http://www.dnr.state.ak.us/mlw/nav/

Summary of the navigability determination is summarized within Figure 5, below. The Mendenhall River is influenced by the tide to within Section 24, Township 40 South, Range 65 East Copper River Meridian, and the State holds the submerged lands based upon the Submerged Lands Act of 1953. The remainder of the Mendenhall River and Mendenhall Lake are susceptible to navigation and therefore determined navigable in fact based upon the continued large volume of commercial rafting and canoeing upon these waters.

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[35] Eaton, K.A., T. V. Schumacher, and S.A. Cameron, *Presence of juvenile salmonid rearing habitat in the Mendenhall River, Juneau, AK*, Alaska Department of Fish and Game, Technical Report No. 11-03, Douglas, Alaska, 2011.
[36] Id. p. 2.
[37] Id. p. 3.

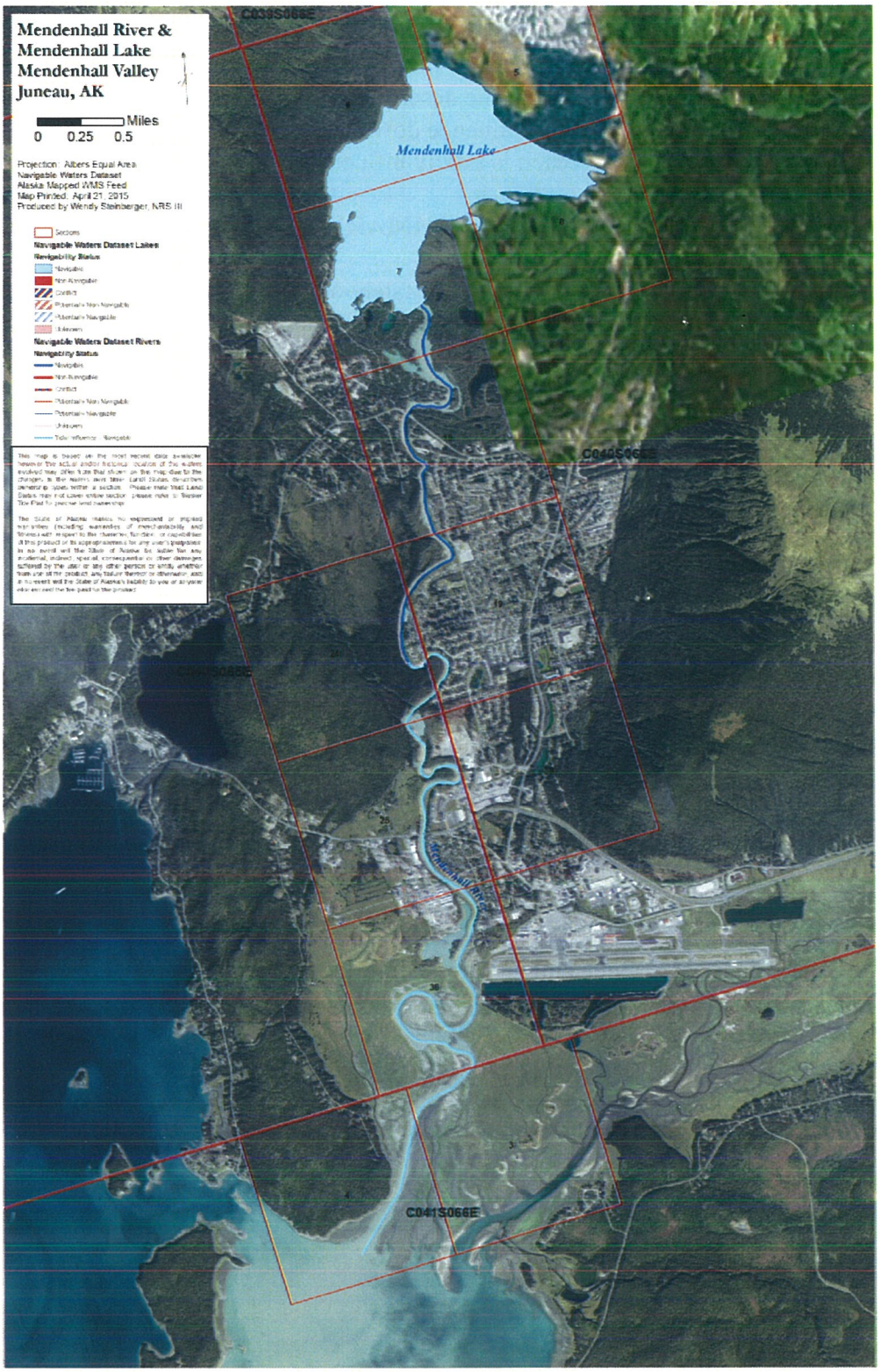

Figure 5. Mendenhall River and Mendenhall Lake Determination Map

Recommendation: Based upon the evidence on file at the Department of Natural Resources as summarized in this document, I recommend:

The Mendenhall River is determined tidal influenced from its mouth at Gastineau Channel and Fritz Cove within Section 4, Township 41 South, Range 66 East, Copper River Meridian upstream to a point within Section 24, Township 40 South, Range 65 East Copper River Meridian. The remainder of the river upstream of this location is determined navigable to the outlet of Mendenhall Lake, within Section 7, Township 40 South, Range 66 East, Copper River Meridian.

Mendenhall Lake is determined navigable within Sections 5, 6, 7and 8, Township 40 South, Range 66 East, Copper River Meridian.

1-15-2019

Wendy Steinberger, Natural Resource Specialist III Date
Navigable Waters Specialist

Determination: The Mendenhall River is determined tidal influenced from its mouth at Gastineau Channel and Fritz Cove within Section 4, Township 41 South, Range 66 East, Copper River Meridian upstream to a point within Section 24, Township 40 South, Range 65 East Copper River Meridian. The remainder of the river upstream of this location is determined navigable to the outlet of Mendenhall Lake, within Section 7, Township 40 South, Range 66 East, Copper River Meridian

Mendenhall Lake is determined navigable within Sections 5, 6, 7 and 8, Township 40 South, Range 66 East, Copper River Meridian.

This determination is not a final agency action. The State reserves the right to consider additional information and/or evidence in the future which may affect this determination and issue a subsequent determination which considers and incorporates that information.

1/15/2019

James H. Walker, Natural Resource Manager II Date
Public Access Assertion and Defense Unit Manager

Summary Report
For the
Juneau Saturation
Study
April – October 2019

June, 2021

Air Quality Division

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Table of Contents

Table of Figures

List of Tables

Executive Summary

The Department of Environmental Conservation (DEC) Division of Air Quality conducted a study from 4/19/19 to 10/7/19 in the downtown Juneau area to assess air quality impacts from the cruise ship industry. The study was initiated to address increasing public complaints regarding cruise ship emissions over the previous two years.

DEC designed a saturation study using a tightly-spaced grid of low-cost fine particulate matter ($PM_{2.5}$) monitors and passive sulfur dioxide (SO_2) samplers throughout downtown Juneau and 'the flats' to identify areas of high, medium, and low impact. The Air Monitoring and Quality Assurance Program (AMQA) of the Air Quality Division chose the PurpleAir PA-II PM Sensor (https://www.purpleair.com/sensors) for measuring particulate matter and Ogawa Passive samplers for SO_2 measurements.

Figure ES-1. Cruise ship monitoring PurpleAir site locations. Red pins are PA site locations and green stars indicate sites used as SO2 sampling sites.

The AMQA Program selected pollutants for the study that have established National Ambient Air Quality Standards (NAAQS) for the protection of public health. However, because the equipment used in the study does not meet the regulatory requirements needed to officially compare to the NAAQS, the Division is only able to qualitatively conclude that pollutant concentrations measured during the study were below the NAAQS. The main reason for selecting $PM_{2.5}$ and SO_2 for measurement is that low-cost commercially available sampling

technology and standard sampling protocols exist, and the pollutants are good indicators of cruise ship emissions.

Results

Based on the particulate matter measurements from the Purple Air (PA) monitors, the air quality in Juneau during the study period can be considered as "Good" using the EPA Air Quality Index (AQI) classifications, with only a few days during wildfire smoke events considered as "Moderate" to "Unhealthy for Sensitive Groups".[1] While there is strong evidence cruise ships had short-term impacts on air quality in downtown Juneau, there is no evidence to suggest the cruise ship industry air quality impacts in Juneau during the 2019 cruise ship season would have led to 24-hour $PM_{2.5}$ violations of the NAAQS.

Emissions in downtown Juneau did not originate from one consistent source during the study period. Besides cruise ship emissions, slash burning, outdoor food vendors, and residential activities had noticeable short-term impacts on air quality at sites throughout downtown Juneau. With different cruise ships in port every day, ships entering and leaving the port at different times, and inconsistent meteorological conditions, each study day was assessed independently for local air quality impacts. Webcam footage and data collected from downtown Juneau meteorological stations were used to locate likely sources during periods of elevated $PM_{2.5}$ concentrations observed at the PA sites. In addition to local sources, Juneau also experienced an above-average influx of wildfire smoke from Western Canadian wildfires during the 2019 summer season. Each day during the study period was closely scrutinized to determine sources of air quality impacts and what sites or group of sites seemed to be the most affected.

Rather than discuss every day during the study period, DEC chose to detail our data analysis process by conducting a case study of the data collected on August 30th and 31st. These days represent a period in which cruise ship emission air quality impacts lasted for many hours each day. Light winds coming from southern directions blew emissions towards Juneau from multiple ships each day leading to increases in $PM_{2.5}$ concentrations across all sites, with greater spikes in $PM_{2.5}$ concentrations resulting from ships coming into port and leaving port. Webcam footage and meteorological data assisted in identifying emissions sources. In addition to cruise ship emissions, a large slash burning fire was identified as an emissions source leading to a sharp 1-hour increase in $PM_{2.5}$ concentrations at several sites. Large spikes in $PM_{2.5}$ concentrations affecting only one site were also observed during the case study and were likely the result of recreational activities such as grilling or bonfires.

During the six-month study, emissions events from cruise ships were typically brief and only lasted one or two hours. Although hourly peak $PM_{2.5}$ concentrations from cruise ship emissions

[1] AQI classifications are based on more accurate regulatory grade sampling equipment but are often used in the context of sensor measurements to describe air quality in general terms.

do not appear to cause sharp peaks like those observed in localized events, the PA grid was able to detect air quality impacts from ship emissions.

Conclusion

Assessing short-term air quality impacts from cruise ships in Juneau can be difficult due to varying emissions sources and meteorological conditions. Additionally, the Ogawa passive SO_2 samplers were not sensitive enough to detect short-term increases in SO_2, which may have further helped to identify diesel emissions from ships. During the study period, however, short-term emissions plumes from cruise ships were detected by the PA monitors in the form of widespread elevated $PM_{2.5}$ concentrations affecting multiple sites simultaneously.

Early in the 2019 cruise season, cruise line companies worked together to reduce their impact on local air quality[2]. Two of the strategies used for reducing emissions were reducing idle times in the harbor and switching to a low sulfur marine fuel while in port. While it is difficult to compare Juneau's 2019 cruise ship-related air quality impacts to the previous year's impacts as no monitoring data exists for 2018, the 2019 season had fewer public complaints[3] than the previous two years.

Data collected did not identify a single maximum impact location in downtown Juneau or the flats that should be used for a follow-up study. But the data indicated that various parts of the downtown area and the flats were impacted by short-term plumes, depending on weather conditions.

The PurpleAir saturation study provided information about areas of Juneau affected, and demonstrated the need to better assess short-term impacts with at least 1-hour resolution. Furthermore, meteorological data from nearby meteorological stations and webcam footage proved to be valuable in identifying air impact sources. The Ogawa passive SO_2 samplers were unable to detect concentrations of SO_2 over short periods needed to assess emissions plumes.

Next Steps

DEC has ordered several survey-grade sensor pods capable of measuring PM, carbon monoxide (CO), nitrogen oxides (NO_x), and SO_2 to deploy at multiple locations in downtown Juneau, with at least one site in the elevated area and one site in the flats area. The new sensor pods will be similarly assessed for accuracy and precision to the PurpleAir sensors before being installed in the community. While the new equipment is not regulatory grade, the addition of gaseous monitoring combined with onsite meteorological data will provide better and more detailed information for source identification. The new CO, NO_x, and SO_2 sensor technology allows for short-term resolution with one-hour averaging and will not only be capable of measuring short-term air quality impacts but will also help to evaluate emission plume characteristics to

[2] https://www.juneauempire.com/news/cruise-ship-complaint-numbers-for-this-year-may-surprise-you/
[3] https://dec.alaska.gov/media/19814/2019-cpvec-air-annual-report-final.pdf

determine possible sources.

With the new monitoring equipment and continued use of available webcam footage, DEC expects to better assess all emissions sources affecting the downtown area, and provide more accurate information regarding year-to-year air quality impacts from cruise ship emissions and other emission sources.

The saturation study only addressed air quality impacts at the port of Juneau. Air quality impacts from cruise ships at other port communities may also need to be addressed. While emissions mitigation plans put in place in 2019 by cruise line groups specifically for Juneau seemed to be effective, the impacts from cruise ship emissions at other Southeast Alaska port communities likely vary by location and remain unclear.

Introduction

During the 2019 Alaska summer cruise ship season, the Department of Environmental Conservation (DEC) Division of Air Quality conducted a study in the downtown Juneau area to assess air quality impacts from the cruise ship industry. The study was initiated to address increasing public complaints regarding cruise ship emissions over the previous two years.

The Air Monitoring and Quality Assurance Program (AMQA) conducted a saturation study in Juneau before and during the summer cruise season of 2019 focusing on the overall ambient air quality. The objectives of the Juneau saturation study were:

- to address ambient air quality complaints centered on cruise ship industry emissions;
- to determine which areas of downtown Juneau are most affected (maximum impact locations); and
- to assess if the scale in terms of frequency, duration, spatial variability, and severity of these impacts has the potential to significantly affect public health and/or violate Clean Air Act air quality standards.

AMQA conducted sampling from 4/19/19 to 10/7/19. This report summarizes the findings of the six-month-long study.

Background

Public interest in air quality impacts from cruise ship emissions has led to two previous studies in Juneau directed at measuring the criteria pollutants sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and fine particulate matter (particulate matter with an aerodynamic diameter of 2.5 micrometers or less, i.e. $PM_{2.5}$). Criteria pollutants are pollutants for which the U.S. Environmental Protection Agency (EPA) has developed health-based standards, called the National Ambient Air Quality Standards (NAAQS). The 1995 study focused on SO_2 data collected from two sites from May through September. The study initiated in 2000 collected SO_2 and $PM_{2.5}$ data from three sites and NO_2 data from one site mid-August through September. This study was extended from approximately May 2001 through the end of the year. The results from both studies led to the same conclusions: air quality in the downtown Juneau area was considered good and pollutant concentrations were far lower than the NAAQS.

Over the past few years growing numbers of cruise ships and passengers visiting Alaska have increased public concerns about their potential impacts on port communities. 2017 and 2018 saw dramatic increases in complaints regarding cruise ship emissions and potential air quality degradation. The increase in complaints coincided with the increased use of Exhaust Gas Cleaning Systems (EGCSs, or Scrubbers) by cruise ships while in port. EGCSs are designed to

extract sulfur oxides from exhaust gas allowing vessels to achieve compliance with federal and international regulations while continuing to burn fuel with higher levels of sulfur.[4]

Since the early 2000s EPA has conducted several reviews of the NAAQS as required by the Clean Air Act. These reviews are intended to determine if the standards are still protective of public health and the environment. As a result of these reviews, EPA has either strengthened existing standards or created new ones. The 24-hour average $PM_{2.5}$ standard was changed from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. For SO_2 and NO_2, EPA established one-hour standards. These new short-term standards are much more sensitive to localized pollution sources than the previous 24-hour average or annual average standards. The 2019 study was designed with these new standards and the one-hour averaging period in mind.

Study Design

Downtown Juneau is located on Gastineau Channel which is oriented northwest to southeast and bordered by mountains on both sides. The local topography divides the residential areas of Juneau into a low-lying "flats" area and a residential area at a higher elevation on the main hill of Juneau. The cruise ship docks and anchorages are located directly southeast of Juneau so that when winds blow from southern directions, the cruise ship emissions are transported to the downtown area. Air pollution levels will vary depending on meteorological conditions with higher levels expected to occur during clear, low wind periods and lower levels seen when rain and/or higher winds disperse air pollutants.

With multiple cruise ships arriving, positioning, and departing almost continuously during the prime cruise ship season, it is impossible to pinpoint the main location of emission sources as is possible for stationary sources, such as power plants. The impacts will depend on the local meteorology, the number of ships docked or maneuvering around the docks and the ship emissions. These emissions in turn depend on the various ship emission sources, their activity levels, and type of fuel. Surrounding activities in the community also can contribute to localized pollution. Variability in weather and the emission source are the dominating factors on whether an area is impacted and for how long.

All these contributing factors make it difficult to predict the best location for a monitoring site without taking actual measurements on the ground as part of a short-term study. These studies are usually saturation studies, intended to determine the locations of maximum impact in the community and to assess the frequency and severity of the impacts. A saturation study is a type of investigation that utilizes many samplers in a small geographic area over a limited amount of time. Saturation studies are often the first step in any air quality monitoring assessment. Saturation studies usually employ low-cost sampling equipment to determine initially if an air

[4] https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-amendments-related-global-marine-fuel

quality problem exists or if the problem reaches the levels that warrant a more in-depth and long-term monitoring project.

Cruise ship air emissions consist predominantly of diesel exhaust. There are no direct measurement methods for diesel exhaust or human health standards. Instead, diesel emissions contain a multitude of organic and inorganic pollutants, both in gaseous and particulate form. One of the gaseous pollutants in diesel is sulfur dioxide (SO_2). Fine particulate matter can also be used as a tracer, representing diesel plumes. Both of these pollutants have standards against which measurements can be compared.

The DEC saturation study used a tightly spaced grid of low-cost $PM_{2.5}$ monitors and several passive SO_2 samplers throughout downtown Juneau and the flats to identify areas of high, medium, and low impact. New sensor[5] technology has greatly improved in accuracy and precision for particulate matter but is still lagging for SO_2 and Nitrogen Dioxide (NO_2). Alternatively, other low-cost sampling methods exist like passive samplers. The advantage of passive samplers is that they do not require electrical power and are less expensive and time-intensive to operate than conventional gaseous analyzers. Currently, the passive sampling technology for SO_2 is more accurate with shorter collection time requirements than for NO_2. AMQA, therefore, focused on testing the SO_2 sampling method.

To aid in the identification of diesel sources contributing to the measurements, AMQA identified five meteorological sites around the study area. The sites were part of the MesoWest network. MesoWest is operated by the University of Utah Atmospheric Science Department. Additionally, AMQA used images and videos from publicly available webcams[6] to corroborate pollution events that may have been caused by cruise ship emissions. The data from the air sensors were analyzed with the data from the meteorological sites, along with the number of ships in the area at the time, their activity, the video observations, as well as any other available information about other potential sources.

AMQA engaged with the community for the selection of appropriate sampling sites. Staff initially reached out to gather general information of where complaints had been registered in the previous years and compiled a list of potential volunteer study participants. At a public meeting in February 2019, the residents were able to identify areas of interest on a map and sign up to allow AMQA to place a sampler on their property. Ultimately, AMQA used a mix of public and private properties in downtown and the flats to create a grid-like sampling network. Sensors were installed before the arrival of the first cruise ship to establish a background and ran continuously from mid-April through early October. The map in **Figure 1** shows the sampler network of 22

[5] The term sensor is often used for lower cost, portable and generally easier to operate monitors than regulatory grade monitors used in the U.S.
[6] http://webcams.thesnowcloud.com/

$PM_{2.5}$ and 11 SO_2 sampling sites.

Figure 2. Cruise ship monitoring PurpleAir site locations. Red pins are PA site locations and green stars indicate sites used as SO2 sampling sites.

Monitoring Methods

Equipment

For this saturation study, AMQA chose the PurpleAir-II PM Sensor for $PM_{2.5}$ measurements (https://www.purpleair.com/sensors). The PurpleAir (PA) sensor uses a fan to draw air past a small laser. The reflections of the light from the particles in the air are counted. The PA-II is equipped with two sensors that measure and report particle concentrations in six sizes between 0.3µm and 10µm diameter. Each sensor measures a particle count every second and reports an averaged value every 80 seconds[7]. Temperature, relative humidity, and pressure values are also recorded. The sensors are calibrated by the manufacturer to associate a particle size with particle mass and estimate the total mass for $PM_{1.0}$, $PM_{2.5,}$ and PM_{10}. Readings are then uploaded to a cloud network after every measurement where they are stored for download and display on the PurpleAir map.

The PA sensors were equipped with a cellular hotspot which reported the instantaneous reading to the PurpleAir website. Data were displayed on the PurpleAir map website in real-time.

[7] https://www.atmos-meas-tech-discuss.net/amt-2019-396/amt-2019-396.pdf

AMQA created a second interactive map posted on the Air Quality website to display the hourly averaged data. The PA sensors are also equipped with an SD card that stores all data. These cards were downloaded to the state network periodically to ensure no data was lost in case of Wi-Fi failure. Nineteen of the twenty-one sites used a mobile Wi-Fi hotspot unit to upload the data to the PurpleAir online map. The other two sites used a connection to a local Wi-Fi network. The instrument properties and field setup are detailed in Appendix A.

To protect the electronics from the elements for an outdoor installation, AMQA used weatherproof junction boxes. **Figure 2** and **Figure 3** show pictures of a typical PA installation.

Figure 3. Example of PurpleAir site set up. The PurpleAir unit attached to the junction box is indicated by the purple arrow.

Figure 4. PurpleAir unit and Ogawa SO2 passive sampler attached to the junction box housing.

AMQA selected the Ogawa samplers for SO_2 measurements. The Ogawa passive SO_2 samplers were collocated at 11of the PM sites, with one site housing two SO_2 samplers for precision information.

The small footprint of the samplers makes them easy to place in the field. A pre-coated collection pad is placed inside a weatherproof sampling cartridge and installed outside. As air moves through the sampling cartridge over the pad, the SO_2 molecules react with the chemical on the pad and are captured. After the desired exposure time, the collection pad is removed, the SO_2 is extracted into an aliquot of ultrapure water with hydrogen peroxide, prepared for shipment, and analyzed in a lab. Typical exposure times range from 1 week for clean areas to 1 day for more polluted locations (https://ogawausa.com/).

The samplers were exposed to ambient air for at least 48 hours and up to 72 hours. The lab analysis showed that with those exposure times, concentrations were close to or below the detection limit.

Comparison to the National Ambient Air Quality Standards

While AMQA selected pollutants for the study ($PM_{2.5}$ and SO_2) that could be compared to the NAAQS, the equipment used in the study does not meet the specifications to fulfill federal monitoring requirements and officially compare to the NAAQS. However, the Division can qualitatively conclude that pollutant concentrations measured during the study were below the NAAQS. The main reason for selecting these pollutants for measurement is that low-cost commercially available sampling technology and standard sampling protocols exist.

EPA revised the fine particulate matter standard in 2012, resulting in two standards, a 24-hour average standard of 35 micrograms per cubic meter (35 $\mu g/m^3$) and an annual average standard of 12 $\mu g/m^3$. Cruise ship emissions include fine particulate matter but due to emission patterns, topography, and local wind patterns during the cruise ship season in Juneau, AMQA considered it unlikely at the onset of the study that the impacts in downtown Juneau were severe and consistent enough to exceed a 24-hour standard at any given location. The expectations were that cruise ship plumes would create short-term elevated values in the range from minutes to several hours, but not average out to levels that would exceed the standard. The PurpleAir sensors were selected to measure these short-term spikes in $PM_{2.5}$, with the main focus on determining the frequency of elevated hourly concentrations and the locations most likely to receive repeated impacts and the additional goal of identifying a future monitoring site.

EPA revised the SO_2 standard in 2010 creating a new 1-hour standard of 75 parts per billion (75 ppb). The passive SO_2 samplers require an exposure time from 1 day to 1 week and are not sensitive enough to provide data for hourly averages. While sensor technology exists for SO_2, none have the required precision, accuracy, and sensitivity at a cost that would have allowed AMQA to include them in this study. Therefore, the intent was to see if AMQA could detect elevated SO_2 emissions on days with multiple cruise ships in port compared to the background levels before the season.

Quality Assurance Analysis

Initial PA Unit Collocations

Upon initial receipt of the PA units, DEC conducted an indoor collocation to assess sensor performance and gain an understanding of operational requirements. Indoor particulate concentrations measured during the collocation period were low, but the sensors operated correctly and indicated similar trends.

After the initial indoor collocation of the PA units, DEC performed an outdoor collocation in Anchorage, AK. The data from the 8-day collocation period was collated into 5-minute averages and a mean of the concentrations recorded by all of the sensors every 5 minutes was calculated. Average 5-minute concentrations ranged between 0 and 39 $\mu g/m^3$. The performance of each sensor was evaluated by calculating linear correlation statistics between data from each sensor and the mean concentration. The multiplicative bias amongst the individual sensors ranged between 0.87 and 1.12, the additive bias between -0.35 and 0.97 $\mu g/m^3$. The r-squared statistics ranged between 0.985 and 0.999, where an r-squared value of 0.95 is a very strong positive correlation and an r-squared value of 1 is a perfect correlation. The PA units containing pairs of sensors displaying the greatest degree of correlation to the mean concentrations were reserved for quality control purposes during the study including the mobile audit unit and the two collocated DEC building units.

Collocations of PA Units against the Floyd Dryden BAM

After arrival in Juneau, all PA units were collocated outdoors against the Federal Equivalent Method (FEM) $PM_{2.5}$ Beta Attenuation Monitor (BAM) at the Juneau Floyd Dryden site to obtain an initial study correlation over five days in April. The data was collated into one-hour periods to allow for comparison to the one-hour sample period of the BAM. While the PA units continued to show good correlation amongst themselves, they demonstrated poor correlation with the BAM. A linear correlation between the BAM and the mean of the PA sensors showed a multiplicative bias of 0.60, and additive bias of 4.1 µg /m3, and an r-squared statistic of 0.392. While the PA units often recorded similar concentration trends, they failed to demonstrate a response to several periods of elevated concentrations recorded by the BAM, which caused the low multiplicative bias. The maximum concentration recorded by the BAM during the collocation was 12.0 µg/m3. This limited range of concentrations was not representative of the range of concentrations recorded throughout the study period.

The Audit PA device was collocated against the Floyd Dryden BAM to assess PA performance in comparison to the BAM at elevated concentrations during seven days impacted by wildfire smoke beginning on July 9th. The maximum 1-hour concentration recorded by the BAM was 28.0 µg/m3. The multiplicative bias between the PA unit and BAM concentrations was 2.26, the additive bias was -1.32 µg/m3, and the r-squared value was 0.918. The PA unit and BAM

concentrations trends were well correlated but over-reported by the PA unit. The PA unit reported values more than double those reported by the BAM at elevated concentrations.

The PA units were collocated against the Floyd Dryden BAM again at the end of the sampling season for 13 days in October. During this collocation, the mean of the PA sensor one-hour concentrations had a multiplicative bias of 1.35, an additive bias of -0.78 µg/m3, and an r-squared value of 0.525. Unlike the initial collocation, the PA units routinely showed a response to concentration variations recorded by the BAM, but frequently over-reported concentrations in comparison to the BAM, especially during periods of elevated concentrations.

Due to the difference between correlation statistics during the three periods of collocation at the BAM, DEC did not apply a correction factor to the entire PA dataset to normalize it to the BAM during data analysis. However, a correction factor was applied during the peak in wildfire smoke in an analysis to determine if PA sensors and the BAM were observing similar concentrations. **Figure 4** shows the linear correlations from the three PA Audit vs BAM collocation periods. The initial, wildfire-impacted, and final collocations each have significantly different correlation statistics.

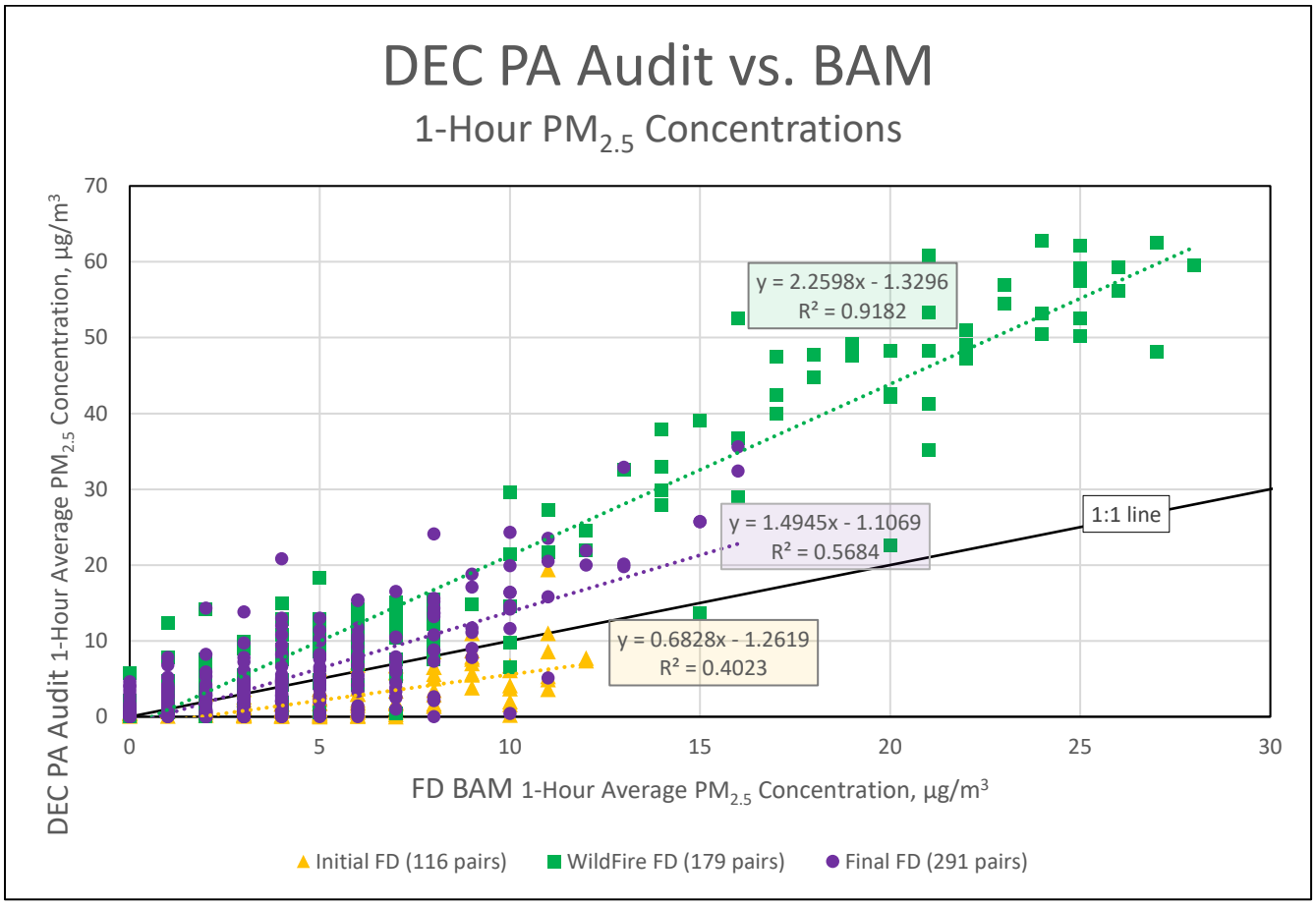

Figure 5. Linear correlations for three Audit – BAM collocations. Yellow is the initial collocation before the study period, green is during the peak wildfire event, and purple is the final collocation after the study period.

Collocated PA Units at the DEC Building

DEC collocated two PA units at the DEC Building, DEC Building 1 and DEC Building 2. They were used to determine the performance and comparability of PA units throughout the study period. The two PA units maintained excellent correlation throughout the study period, indicating that concentrations recorded by PA units are directly comparable to each other **(Figure 5)**. This confirmation of comparability indicated the PA units did not experience drift throughout the study period and that data could be compared between PA units. This is particularly important for a saturation study where the focus is on the inter-comparison of the samplers within the network rather than absolute measurements.

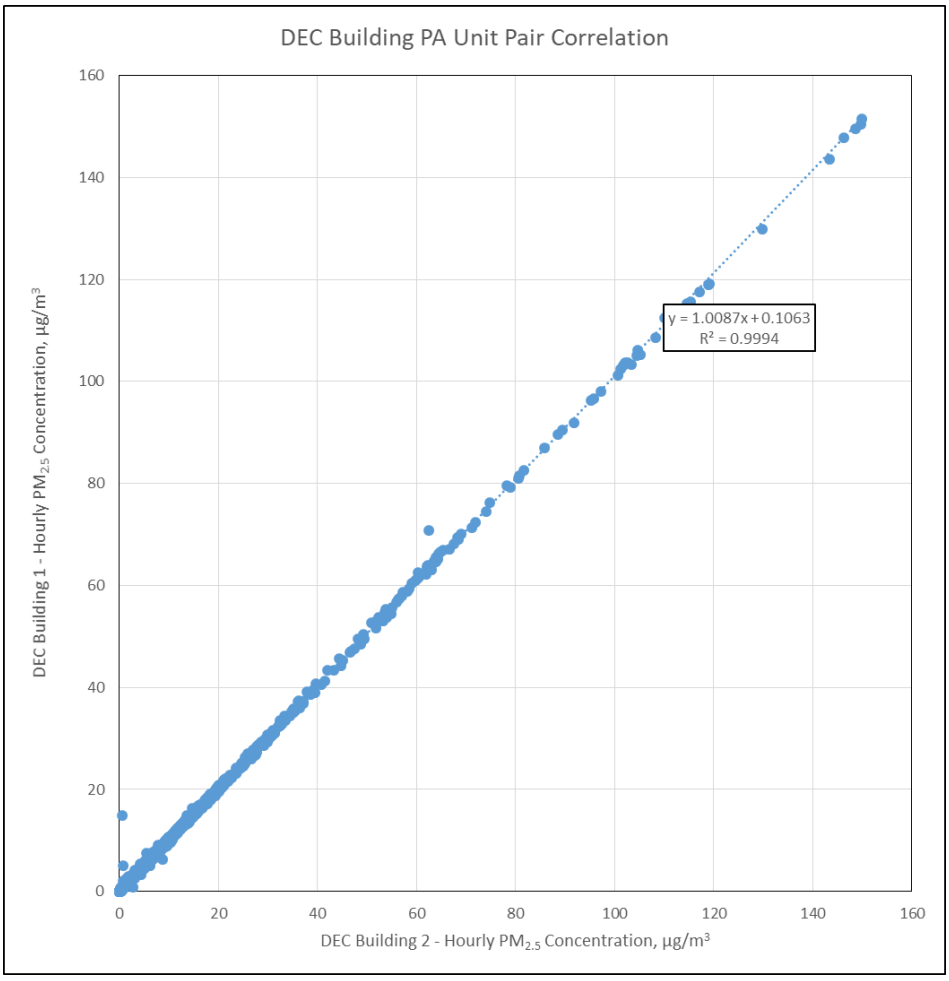

Figure 6. Linear correlation between PA units collocated at the DEC Building site throughout the study period.

Transient 'Audit' PA Monitor

DEC employed one PA monitor as an 'audit' device to assess sensor performance throughout the study and determine the validity of aberrant site readings. The audit monitor was transiently deployed to 11 sites and collocated with the Floyd Dryden BAM midseason during a portion of the wildfire-impacted period. As seen in Table 1, comparisons of hourly concentrations recorded by the audit and corresponding site PA monitor during collocation events showed excellent correlation over a wide range of concentrations.

Table 1. Results of PA site audits using the transient PA audit unit.

Site	Slope	Intercept	r^2	Total Hours	Maximum Concentration	Minimum Concentration	Standard Deviation
6th & Park St	0.995	-0.04	0.991	44	11.8	0.0	1.8
City Hall	1.015	0.09	0.994	66	34.2	0.0	5.9
N. Douglas Hwy	0.946	-0.19	0.993	67	7.5	0.0	1.3
W 8th & Calhoun Ave	1.018	0.03	0.999	76	19.7	2.8	3.7
12th & C	1.076	-0.32	0.997	68	18.1	4.7	2.7
Downtown Library	0.997	-0.04	0.995	172	42.3	0.0	6.4
Glacier Ave & Willoughby Ave	0.962	0.06	0.995	95	7.7	0.2	1.7
Customs	1.013	-0.06	0.999	127	27.0	0.7	4.5
City Museum	0.981	-0.80	1.000	188	140.0	9.7	32.1
DEC Building 1	1.005	-0.04	0.997	191	36.9	0.0	3.1
DEC Building 2	1.002	-0.13	0.997	189	37.1	0.0	3.1
NOAA Subport	0.951	0.99	0.980	938	29.6	0.4	4.1

Recommendations for future PA studies

DEC would recommend collocating a PA unit with any reference standard throughout a study period. While the PA unit Plantower sensors showed good correlation amongst themselves throughout all concentration ranges, DEC was unable to determine an appropriate correlation with the Federal Equivalence Method monitor that could be applied to the PA dataset. This prevented a direct comparison of concentrations between the Downtown sites and the Mendenhall Valley Floyd Dryden site. A PA unit at Floyd Dryden would have allowed a direct comparison between the Downtown study area and the Floyd Dryden site, which DEC could have treated as a background site. This could have provided more insight into possible air quality impacts of cruise industry activities that occur mainly in the Downtown study area which are unlikely to impact the Floyd Dryden site.

Results

Based on the particulate matter measurements from the PA, the air quality in Juneau during the study period can be considered as "Good" using the EPA Air Quality Index (AQI) classifications, with only a few days during wildfire smoke events considered as "Moderate" to "Unhealthy for Sensitive Groups".[8] While there is strong evidence cruise ships had short-term impacts on air quality in downtown Juneau, there is no evidence to suggest the cruise ship industry air quality impacts in Juneau during the 2019 cruise ship season would have led to 24-hour $PM_{2.5}$ violations of NAAQS.

Emissions in downtown Juneau did not originate from a consistent source during the study period. In addition to cruise ship emissions, slash burning, outdoor food vendors, and residential activities had noticeable short-term impacts on downtown Juneau's air quality. $PM_{2.5}$ data collected from downtown Juneau PA sites can be difficult to interpret, and distinguishing between emissions sources requires supplemental information. With different cruise ships in port every day, ships entering and leaving the port at different times, and inconsistent meteorological conditions, each study day was assessed independently for local air quality impacts. Webcam footage and data collected from downtown Juneau meteorological stations were used to locate likely sources during periods of elevated $PM_{2.5}$ concentrations observed at the PA sites. In addition to local sources, Juneau also experienced an abnormal influx of wildfire smoke from Western Canadian wildfires during the 2019 summer season. Each day during the study period was closely scrutinized to determine sources of air quality impacts and what sites or group of sites seemed to be the most affected.

Groups of sites in downtown Juneau seemed to be affected by emission plumes depending on their relative geographic location. PA sites located on the hill portion of downtown Juneau at an elevation of 70 feet and greater were grouped as "elevated sites," PA sites residing in the lower elevation portions in the area of Juneau known as the "flats" were grouped as "flats sites," and PA sites located along the waterline and docks were grouped as "waterline sites." The N. Douglas and City Hall sites were not grouped; the N. Douglas site due to the site's unique location and the City Hall site due to identified localized sources as discussed later in the report.

The following sections communicate the analysis process for separating and determining the sources for air quality impacts on downtown Juneau during the 2019 summer cruise ship season.

Wildfire Smoke

Wildfire smoke from South Central Alaskan and Western Canadian wildfires was the largest measured impactor of air quality in Juneau during the study period. Juneau and much of Southeast Alaska experienced unusual intermittent wildfire smoke from late May until early

[8] AQI classifications are based on the more accurate regulatory grade sampling equipment, but are often used in the context of sensor measurements to describe air quality in general terms.

September, although air quality alerts were only issued from July 5th through July 8th for Southeast Alaska. The peak in wildfire smoke occurred June 26th – July 15th. The Juneau Floyd Dryden BAM monitor also recorded a corresponding increase in $PM_{2.5}$ values over the same period. Typically, Juneau PA sensors and the Floyd Dryden FEM BAM are not expected to observe similar PM concentrations due to the distance between the locations, varied terrain, meteorological conditions, and emission sources observed at each location. However, during wildfire smoke events, the air is generally well mixed, and a similar background PM concentration is expected across all sites. If a consistent wildfire pollution background could be determined, it should be possible to separate increases in $PM_{2.5}$ concentrations as a result of cruise ship emissions from above that of the overlying wildfire smoke.

PA sensors demonstrated a high concentration bias from wildfire smoke. During the last week of the peak wildfire smoke event, the audit PA was collocated next to the Floyd Dryden FEM BAM during the wildfire smoke event to assess whether a correction factor to the PA dataset could be applied.

The linear correction factor determined from the Audit-BAM collocation during heavy wildfire smoke was applied to PA data from 6/28/19 to 7/15/19, the peak of wildfire smoke in Juneau. Comparing corrected $PM_{2.5}$ concentrations from downtown PA sites to the Floyd Dryden BAM monitor shows a similar trend in concentrations **(Figure 6)**. During this wildfire smoke period, large increases in $PM_{2.5}$ concentrations observed at the downtown Juneau PA sites can be attributed to the expected background PM concentrations from the wildfire smoke. Emissions from cruise ships did not stand out beyond the expected PM concentrations from wildfire smoke. Only two hourly periods, 6/28 3:00 PM and 7/3 5:00 PM, identified by arrows in **Figure 6**, had corrected PM concentrations for a group of PA sites 10 $\mu g/m^3$ greater than that of the FEM monitor. Both hourly PM spikes were identified to be the result of activities impacting a single PA site and therefore unlikely to be the result of cruise ship emissions.

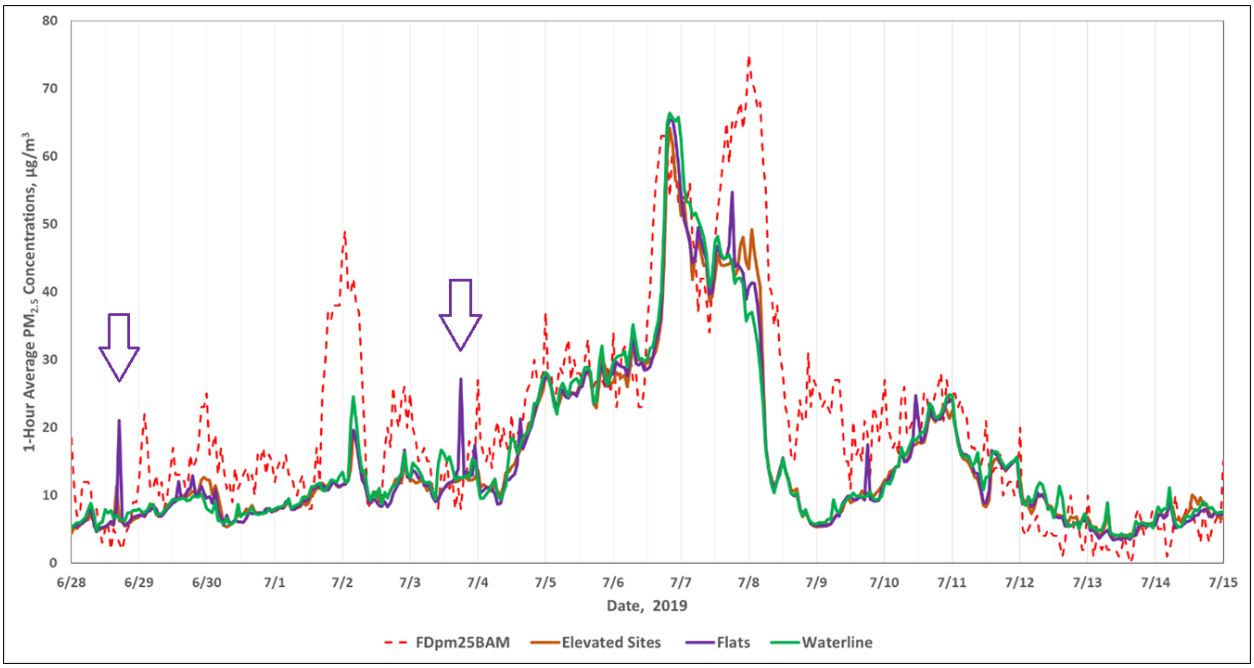

Figure 7. Hourly PM2.5 concentrations (µg/m3) for Juneau Floyd Dryden FEM BAM and PM2.5 concentrations for downtown Juneau PA sites during the June 28th through July 15th wildfire smoke event. Purple arrows point to periods when a group of PA sites had a $PM_{2.5}$ concentration > 10 µg/m^3 than the FEM BAM.

City Hall Site

The City Hall PA site consistently recorded values above the rest of the downtown Juneau PA sites, with the greatest differences mostly occurring between 6:00 AM and 7:00 PM. Additionally, 84% of elevated values recorded by the City Hall PA site occurred when a nearby weather station located at the Downtown Library reported winds coming from the southern direction. Frequently particulate matter is created at this location by outdoor grills serving food to passengers and crews coming off of the cruise ships. These vendors operate in Juneau's Marine Park, approximately 160 feet south of the City Hall PA site. Staff working inside the Juneau City Hall reported smelling the grills and were concerned the site would be biased by the grill impact. Particulate matter concentration spikes at the City Hall are observed on days when at least one cruise ship is in port, except for May 4th which was the Juneau Maritime Festival and featured many outdoor food vendors near Marine Park. Early morning spikes at the City Hall site many hours before the arrival of any cruise ships suggest there may be other localized emissions sources contributing to the elevated particulate matter.

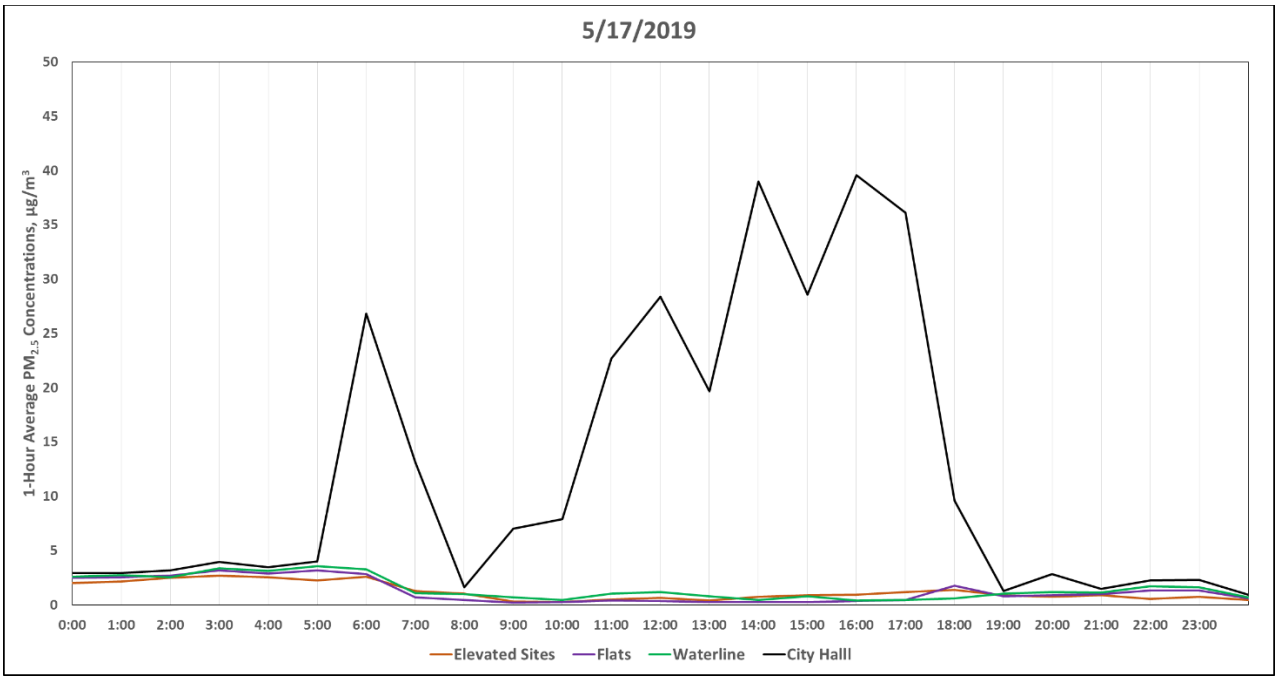

Figure 8. Study day May 17th demonstrating the difference between the City Hall site and all other PA sites.

Other PA sites near City Hall did not observe similar particulate increases (see **Figure 7**) during elevated City Hall concentrations. Furthermore, elevated particulate matter concentration at City Hall often would precede the arrival of any cruise ships by several hours further decoupling the site from direct cruise ship emissions. While $PM_{2.5}$ concentrations at City Hall are localized and likely not the result of direct cruise ship emissions, because the vendors only grilled when cruise ships were in port, these emissions are an incidental result of cruise ship activity.

Due to identified local biases during an analysis of daily PA data sets, $PM_{2.5}$ concentrations at the City Hall site are not grouped with the flats, waterline, or elevated sites. However, when no ships are present, the City Hall site could be associated with the Waterline sites.

Recreational Emissions

During the study period, brief spikes in $PM_{2.5}$ concentrations at one site occasionally occurred as a result of local recreational activity, such as grilling/smoking and slash burns/bonfires, typically occurring later in the evening. These events took place without warning and were often not observable using webcam data. During recreational events, $PM_{2.5}$ concentrations may spike to as high as 250 $\mu g/m^3$, though usually only data from one site was impacted. An example of a large localized spike in $PM_{2.5}$ concentration comes from the North Douglas site 6/5 – 6/8 **(Figure 8)**. Three consecutive nights the site observed brief spikes at the same time. Webcam footage does

not show any large emission plume coming from the site, therefore supporting the interpretation as emissions from localized recreational activity.

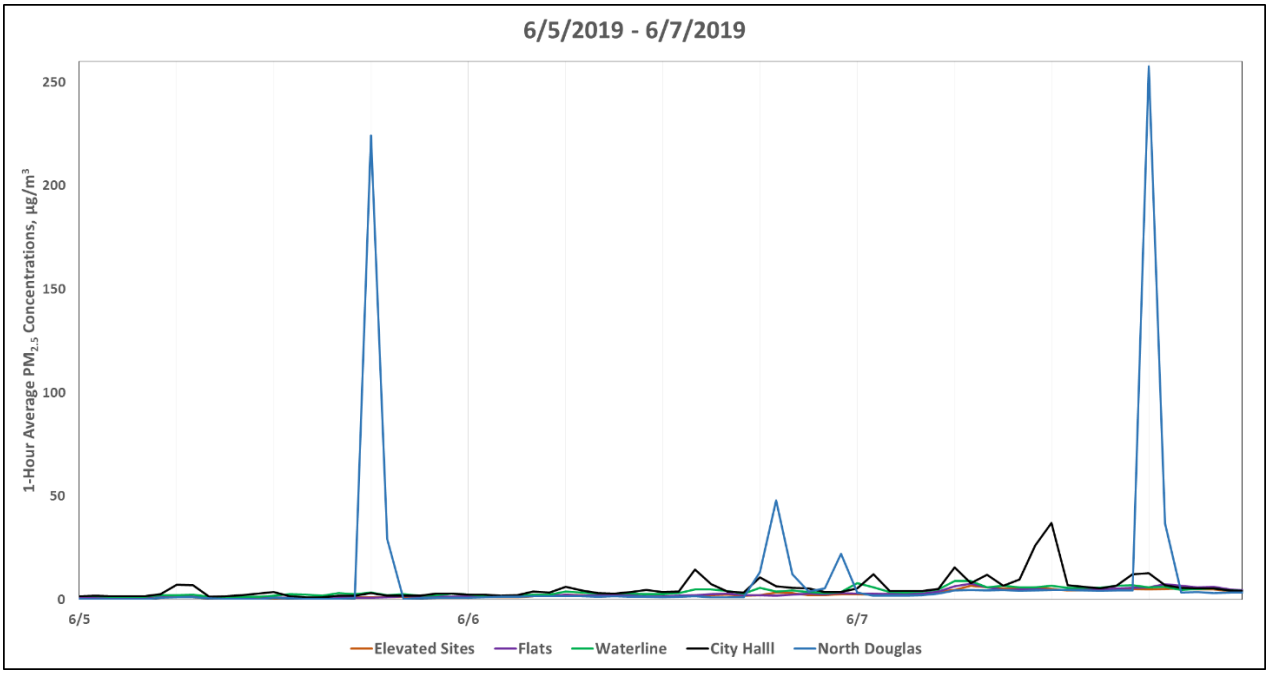

Figure 9. Study period from 6/5/19 to 6/8/19 displaying large evening spikes at the North Douglas site as a result of localized recreational activity.

The only time staff at DEC were explicitly informed of localized recreational activity occurred on August 2nd at the 5th & N. Franklin PA site. Residents of the host site informed air monitoring staff of a fish smoker operating within several meters of the PA sensor from 11:15 AM to about 10:00 PM. The PA data shows a noticeable increase in particulate concentrations starting at 12:00 PM and remaining elevated until about 9:00 PM. Hourly $PM_{2.5}$ concentrations peaked at 7:00 PM at 39 µg/m3, nearly 28 µg/m3 greater than any other site, as shown in **Figure 9**. None of the other nearby sites observed noticeable increases due to the localized event.

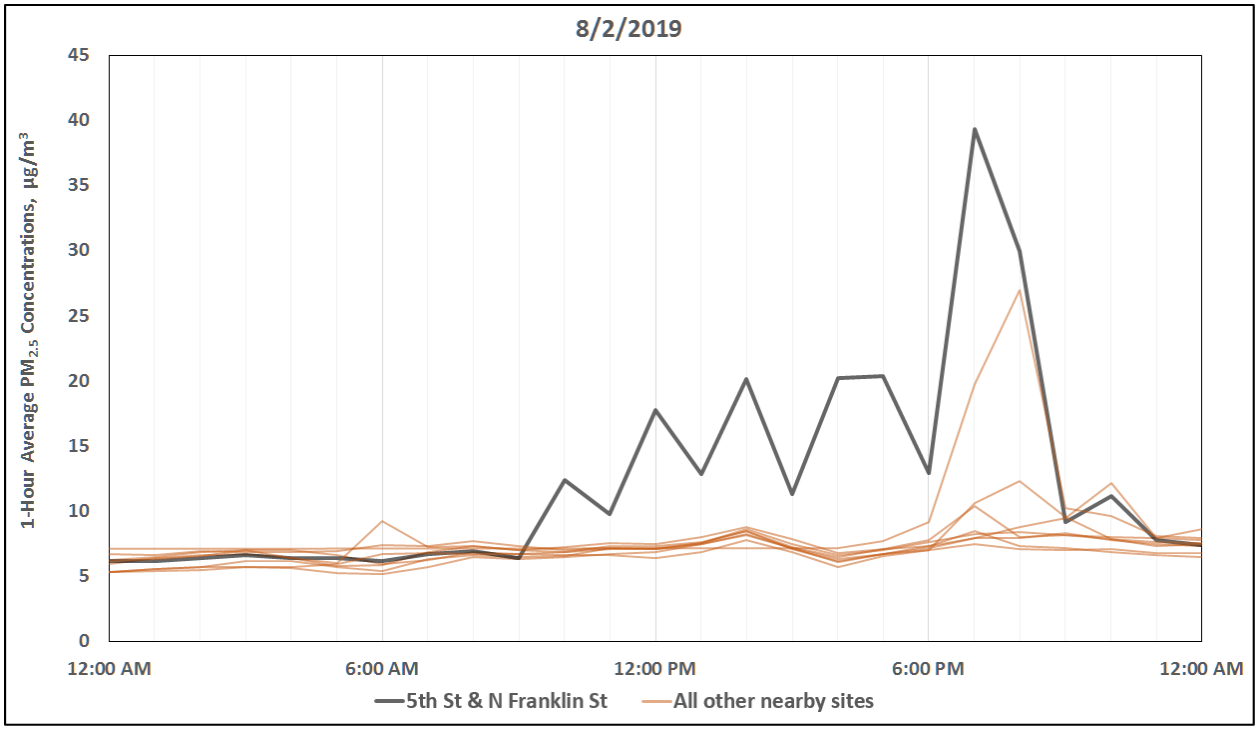

Figure 10. $PM_{2.5}$ concentrations for "elevated sites" August 2nd, 2019. 5th & N. Franklin St site reported elevated PM concentrations due to fish smoking, while all other nearby sites showed no comparable increase in PM concentrations.

Identifying recreational emissions is an important aspect of understanding the local air quality impacts and important for separating these impacts from cruise ship emissions.

Cruise Ship Air Quality Impacts and Case Study

Short-term impacts in air quality observed from both cruise ship emissions and other local emission sources often showed similar characteristics as measured by the PA sites. The magnitude of cruise ship air impacts was lower than expected based on public complaints during the 2017 and 2018 cruise ship seasons in Juneau and requires increased scrutiny. Nevertheless, cruise ship emission impacts could be identified using archived webcam footage, meteorological data from downtown Juneau stations, and $PM_{2.5}$ data collected by the PA sites.

Rather than discuss every day during the study period in this report, DEC chose to focus the data analysis process on a case study of the data collected on August 30th and 31st. This two-day period is a good representation of data analysis for the cumulative study period and demonstrates how to distinguish between various emission sources. **Figure 10** shows 1-hour averaged $PM_{2.5}$ data from all downtown PA sites for August 30th and 31st.

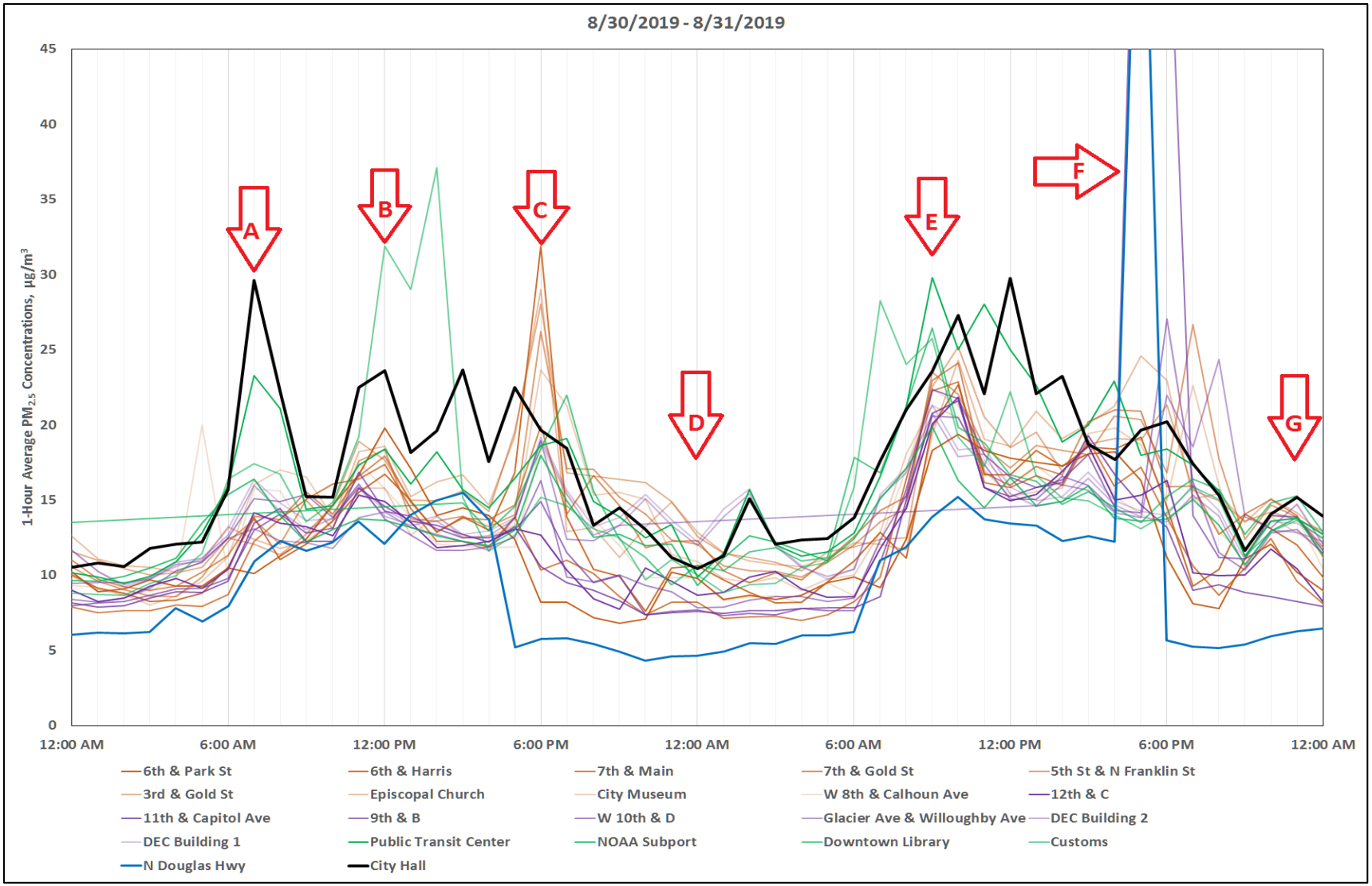

Figure 11. PM2.5 concentrations during the study days 8/30/19 and 8/31/19 were observed at all PA sites. Arrows A-G point to periods of air quality impacts. Green lines are waterline sites, brown lines are elevated sites, and purple lines are flats sites. The thick black and blue line are the City Hall and N Douglas Hwy sites respectively.

Friday, August 30th, 7:00 AM. From Figure 10, arrow A.

Starting early morning on August 30th, $PM_{2.5}$ concentrations at the downtown sites are all at slightly elevated levels, with an average near 10 $\mu g/m^3$, likely as a result of residual smoke from Canadian wildfires.

The first cruise ship arrived on Friday, August 30th at 5:00 AM. As the ship arrives winds are slowly blowing the emissions away from downtown Juneau.

The second ship arrived at 7:30 AM as shown in **Figure 11** (webcam footage) and as the ship docked, winds began to stagnate and switched directions. From webcam footage, visible emissions plumes appeared to move toward downtown Juneau as the wind shifted. Emissions from construction work near the Transit Center site were also observed from webcam footage. All sites began to see increases in $PM_{2.5}$ with the public Transit Center and City Hall Sites seeing the largest increases. The City Hall site, for reasons previously discussed, typically reported $PM_{2.5}$ concentrations inconsistent with other sites. The emissions from the construction work seemed to only impact the Public Transit Center and possibly the City Museum PA sites; brief emissions can be seen coming from the construction site throughout the day possibly further impacting the Public Transit Center site.

Friday, August 30th, 12:00 PM. From Figure 10, arrow B.

Two more cruise ships arrived between 11:00 AM and 12:00 PM as well as a large tanker ship that docked south of the Customs PA site between the two southernmost cruise ships. Additionally, as seen in **Figure 12,** the first ship to arrive in port started additional engines while preparing for its 1:00 PM departure. All sites reported increases in $PM_{2.5}$ concentrations during this period, peaking during 12:00 PM, with Customs and 'Elevated' PA sites experiencing the largest increases. A large spike in $PM_{2.5}$ concentrations observed at the Customs site is likely the result of the tanker ship which arrived shortly before 12:00 PM and continued to produce visible emissions until 2:30 PM. Increases in $PM_{2.5}$ at the elevated sites, and most other sites, were likely the result of cruise ship emissions moving over Juneau which can be seen from various webcam angles.

Friday, August 30th, 6:00 PM. From Figure 10, arrow C.

At 2:00 PM a large fire started on a beach across the channel from downtown Juneau on Douglas Island. The winds blew the smoke from the fire up the channel likely resulting in a small $PM_{2.5}$ increase at the N. Douglas PA site. At 5:30 PM the winds began to stagnate and the smoke from the large fire, and an additional smaller beach fire, began to accumulate in the middle of the channel. At 6:20 PM the winds shifted and the smoke moved towards town causing a sharp increase in $PM_{2.5}$ at nearly all sites, especially the 'elevated' sites. Webcam footage seen in **Figure 13** shows the densest part of the plume to be elevated, explaining why elevated sites seemed to be more affected.

Saturday, August 31th 12:00 AM. From Figure 10, arrow D

The three remaining cruise ships left between 9:30 PM and 10:30 PM. As the cruise ships were leaving, the wind appeared to be lightly blowing the emissions away from the downtown sites. From the time the ships leave August 30th at 10:30 PM until August 31st at 7:00 AM there did not appear to be any noticeable emissions sources. With little to no wind, $PM_{2.5}$ concentrations from all emissions sources slowly dispersed and concentrations decreased.

Saturday, August 31st, 8:30 AM. From Figure 10, arrow E

On Saturday, August 31st the first ship arrived at 6:30 AM. With low wind speeds, the ship's emissions lingered in the channel south of Juneau as the ship came to port. Three other cruise ships came to the port before 8:30 AM, with each ship's emissions lingering in the channel south of Juneau. At 8:30 AM the winds shift direction and all of the emissions accumulating in the channel blow towards downtown Juneau, seen in Figure 14. All sites saw sharp increases over the next couple of hours as winds slowly blew emissions towards the sites. Winds continue to blow cruise ship emissions towards downtown Juneau and all sites remain at elevated $PM_{2.5}$ concentrations. The smallest of the cruise ships boards at the Franklin Dock, a dock connected to Juneau's power grid. Typically ships at this dock connect to shore power instead of running additional generators, however, on August 31st the cruise ship at the Franklin Dock appeared to continue running onboard generators.

Saturday, August 31st, 5:00 PM. Figure 10, arrow F.

At 5:00 PM and 6:00 PM two sites, N. Douglas and 9th & B, reported large spikes in $PM_{2.5}$ concentrations. These spikes were not observed by other PA sites and were likely the result of localized residential activity.

Saturday, August 31st, 10:00 PM. Figure 10, arrow G.

One final small spike occurred between 9:00 PM and 11:00 PM as the three remaining ships departed after which $PM_{2.5}$ concentrations decreased across all sites.

The above case study represents a period in which cruise ship emission air quality impacts lasted for many hours each day. During the five-month study emissions events from cruise ships were typically brief and only lasted one or two hours. Although hourly peak $PM_{2.5}$ concentrations from cruise ship emissions do not appear to cause sharp peaks like those observed in localized events, the PA grid was able to detect air quality impacts from ship emissions.

Figure 12. Webcam footage from Mendenhall Apartments on 8/30/19. A plume above the closest cruise ship and a plume from construction work on the right side of the image are indicated with red arrows.

Figure 13. Webcam footage from Mendenhall Apartments 8/30/19. Emissions blowing towards Juneau can be seen coming from all four cruise ships with a large plume over the ship furthest away in the image, marked with a red arrow.

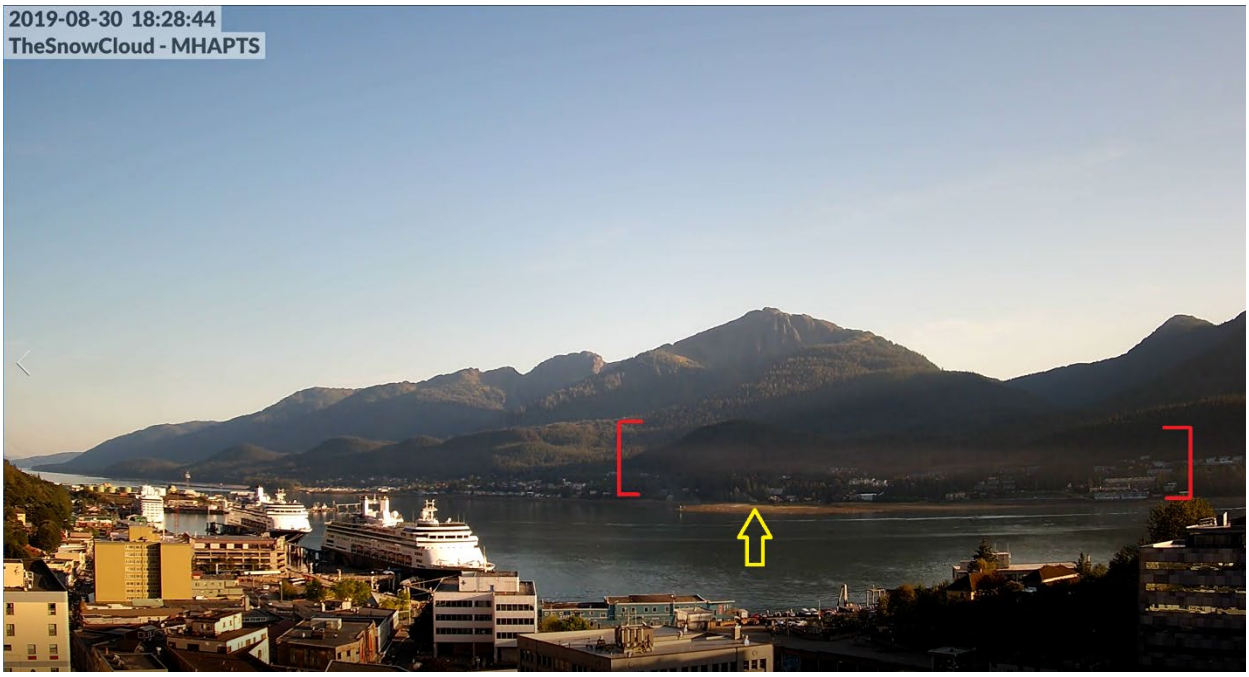

Figure 14. Webcam footage from Mendenhall Apartments 8/30/19. A large fire on Douglas Island (yellow arrow) creates a plume (red brackets) which is slowly transported towards Juneau as winds switch direction.

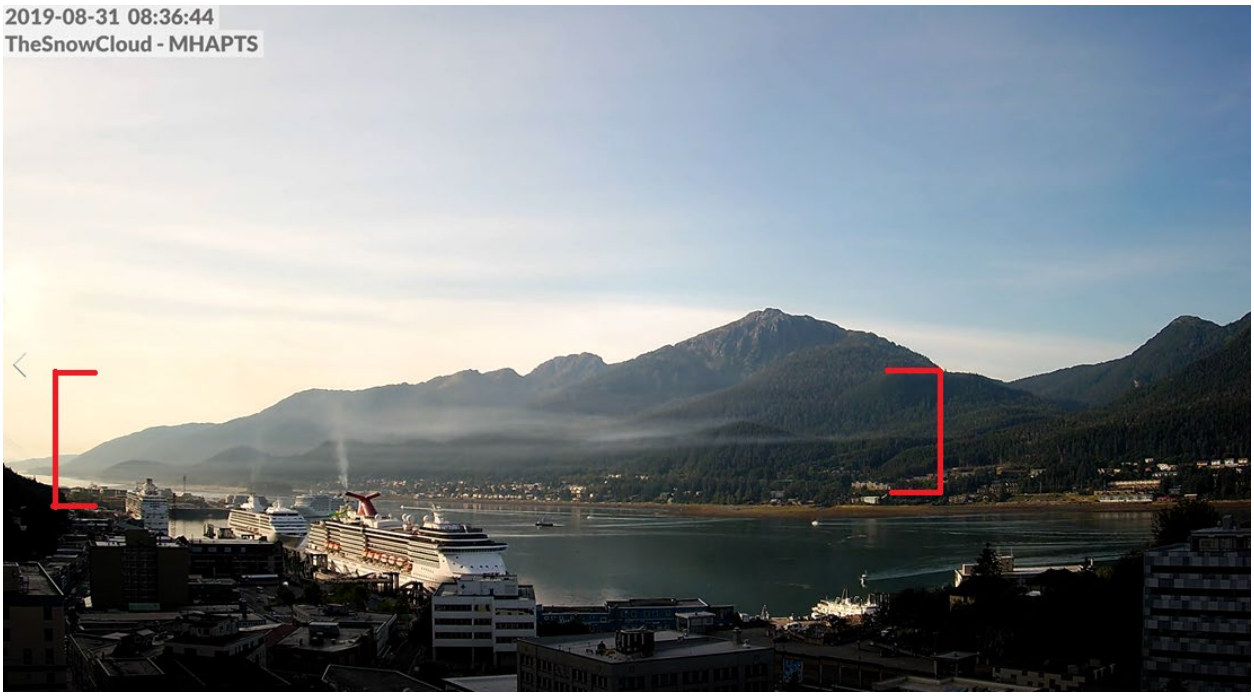

Figure 15. Webcam footage from Mendenhall Apartments 8/31/19. Cruise ship emission plumes can be seen accumulating and moving towards downtown Juneau. Plume identified in red brackets.

SO_2 Sampling The purpose of the passive SO_2 sampling network was to help identify areas affected by diesel emissions from cruise ships. The lower than expected SO_2 concentrations necessitated a longer than anticipated exposure period of the Ogawa passive samplers and therefore did not allow a resolution fine enough to identify short periods of SO_2 impacts. Ogawa samplers collocated with continuous Federal Reference Method SO_2 monitoring equipment at the Alaska National Core Multipollutant Site in Fairbanks, Alaska did not correlate well at low SO_2 concentrations and further demonstrated the inability of the Ogawa samplers to help in detecting SO_2 in emissions plumes during the study.

$PM_{1.0}$ Fraction

$PM_{1.0}$ particulate fraction contains the smallest and most harmful to human health portion of particulates. Emissions from diesel combustion have a greater $PM_{1.0}$ fraction than other emission sources so $PM_{1,0}$ fractionation can be used to indicate possible diesel sources. We looked at the $PM_{1.0}$ fraction of the PurpleAir data during suspected cruise ship emission events to determine if it can be used as an indicator of cruise ship emissions. While there was some evidence to suggest a possible connection between $PM_{1.0}$ and cruise ship emissions under very specific circumstances, generally the $PM_{1.0}$ fraction could not be used to identify emission sources.

Conclusion

It is important to emphasize the Purple Air sensors used in downtown Juneau for this study are not regulatory monitoring equipment. While the sensors were precise and capable of detecting small variations in particulate levels, the PA sensors cannot be calibrated to local conditions and data should only be used to determine general observations and concentration trends.

Assessing short-term air quality impacts from cruise ships in Juneau can be difficult due to varying emissions sources and meteorological conditions. Additionally, the Ogawa passive SO_2 samplers were not sensitive enough to detect short-term increases in SO_2, which may have further helped to identify diesel emissions from ships. During the study period, however, short-term emissions plumes from cruise ships were detected by the PA sensors in the form of widespread elevated $PM_{2.5}$ concentrations affecting multiple sites simultaneously.

Early in the 2019 cruise season, the cruise line companies were worked together to reduce their impact on local air quality.[9] Two of the strategies used for reducing emissions were reducing idle times and switching to a low sulfur marine fuel while in port. While it is difficult to compare Juneau's 2019 cruise ship-related air quality impacts to the previous year's impacts, the 2019

[9] https://www.juneauempire.com/news/cruise-ship-complaint-numbers-for-this-year-may-surprise-you/

season had fewer public complaints than the previous two seasons.[10] Although the strategies were likely effective in reducing air quality impacts, it remains unclear whether those changes are permanent and if they apply to ports other than Juneau.

Data collected did not identify a single maximum impact location in downtown Juneau or the flats that should be used in any follow-up study. But the data indicated that weather-dependent, various parts of the downtown area and the flats were impacted by short-term plumes. Emission plumes from cruise ships did not seem to impact one particular site in downtown Juneau but rather, depending on meteorological conditions and locations of the emitting ship, would impact elevated sites, flats sites, or often all sites.

The PurpleAir saturation study provided information about areas of Juneau affected, and demonstrated the need to better assess short-term impacts with at least 1-hour resolution. Furthermore, meteorological data from nearby meteorological stations and webcam footage proved to be valuable in identifying air impact sources. The Ogawa passive SO_2 samplers were not sensitive enough to detect low concentrations of SO_2 over short periods needed to assess emissions plumes.

Next Steps

DEC has ordered several survey-grade sensor pods capable of measuring PM, Carbon Monoxide (CO), Nitrogen Oxides (NO_x), and SO_2 to deploy at multiple locations in downtown Juneau, with at least one site to be located in the elevated area and one site in the flats area. The new sensor pods will be similarly assessed for accuracy and precision to the PurpleAir sensors before being installed in the community. While the new equipment is also not regulatory grade, the addition of gaseous monitoring combined with onsite meteorological data will provide better and more detailed information for source identification. The new CO, NO_x, and SO_2 sensor technology allows for short-term resolution of down to one hour averaging and will not only be capable of measuring short-term air quality impacts but will also help to evaluate emissions plumes characteristics to determine possible sources.

With the new monitoring equipment and continued use of available webcam footage, DEC expects to better assess all emissions sources affecting the downtown area and provide more accurate information regarding year-to-year air quality impacts from cruise ship emissions.

The saturation study only addressed air quality impacts at the port of Juneau. Air quality impacts from cruise ships at other port communities may need to be addressed. While emissions mitigation plans put in place by cruise line groups specifically for Juneau seemed to be effective, the impact from cruise ship emissions at other Southeast Alaska port communities remains unclear.

[10] https://dec.alaska.gov/media/19814/2019-cpvec-air-annual-report-final.pdf

For additional information and access to all of the raw data please visit https://dec.alaska.gov/air/air-monitoring/juneau-cruise-ship-monitoring-project/.

Appendix A

PurpleAir PA-II sensors

PurpleAir sensors were used for all $PM_{2.5}$ measurements. Each PurpleAir contains two Plantower PMS5003 laser particle counters, a Bosch BME280 temperature/humidity/pressure sensor, as well as an onboard SD card reader for data storage. Each individual Plantower sensor takes measurements at 80-second intervals and counts suspended particles in sizes of 0.3, 0.5, 1.0, 2.5, 5.0, and 10 µm with a counting efficiency of 50% at 0.3 µm and 98% at ≥0.5 µm. Particle bins are then processed into $PM_{1.0}$, $PM_{2.5}$, and PM_{10} mass concentrations in $\mu g/m^3$ with an effective range between 0 to 500 $\mu g/m^3$ and a maximum consistency error of ±10% at 100 to 500 $\mu g/m^3$ and ±10µg/m3 at 0 to 100 $\mu g/m^3$.

Table A-1. PurpleAir PA-II specifications

Range of measurement	0.3~1.0; 1.0~2.5; 2.5~10 Micrometer (µm)
Counting Efficiency:	50%@0.3µm 98%@>=0.5µm
Effective Range:	0~500 µg/m³
Maximum Range:	≥1000 µg/m³
Resolution:	1 µg/m³
Maximum Consistency Error:	±10%@100~500µg/m³ ±10µg/m³@0~100µg/m³
Standard Volume:	0.1 Liter (L)
Single Response Time:	≤1 Second
Total Response Time:	≤10 Seconds

Data Storage

PurpleAir sensors collected particle counts, mass concentrations, as well as temperature and relative humidity information, and reported averaged values on 80-second intervals. Data collected from the PurpleAir sensors was wirelessly transmitted to and stored through the ThingSpeak network and cloud service. Additionally, all data was stored locally on an SD card.

Wireless Connectivity.

Nineteen of the 21 sites used a Novatel Wireless Mifi 6630 Mobile Hotspot unit to wirelessly connect the PurpleAir units to the ThingSpeak network. The other two sites used a connection to a local Wi-fi network.

Power

All PurpleAir units were powered by 110V AC power. Each site PurpleAir unit and Mi-fi hotspot were connected to a single USB hub powered through an extension cord. To avoid exposure to moisture, the extension cord terminal connecting the USB hubs was enclosed in the junction box to which the PurpleAir units were mounted.